



DIALOG®

**PROJECT TECHNICAL
SPECIFICATIONS**

**Introductory Information,
Contracting Requirements
Specifications: Divisions 01, 03,
05-10, 12, 20-23, 25-28 and 31**

**MILLWOODS TRANSIT CENTRE
RENEWAL
Edmonton, Alberta**

**Tender and Project No.: 934195
Date: 2019-05-06 Bid Documents**

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Note that the existing base building drawings are for reference only to show the general area of the Work.

END OF SECTION

1. GENERAL**1.01 WORK OF THIS CONTRACT**

- .1 Work of this Contract comprises the following:
 - .1 Transit Centre Building and Covered Walkway as indicated in Special Provisions, Part 2, Item 2.1.
 - .2 Construction of new Edmonton Transit Service (ETS) Clock Tower, as indicated in these specifications: Submit as a Separate Price in accordance with Special Provision, Part 2, Schedule E.
- .2 Municipal Address:
 - .1 Millwoods LRT Transit Centre
 - .2 28 Avenue NW/Hewes Way
 - .3 Edmonton, Alberta, Canada
- .3 Legal Description: SE 2-52-24-W4M
- .4 Physical Limits: Work of Contract is not necessarily restricted to Work within property lines of site, but includes Work required by Contract Documents, both within and outside property lines.
- .5 Contractual Arrangement: Work is being performed under a single contract using a Stipulated Price Arrangement using the CCDC 2-2008 standard contract form and supplementary conditions (if any).

1.02 DEFINITIONS

- .1 Capitalized terms that are not otherwise defined in these Project Technical Specifications have the respective meanings given to them in the General Conditions.

1.03 SUBSTITUTIONS AND PRODUCT OPTIONS

- .1 Substitutions: Materials that in the opinion of the Contractor meet the requirements of the named Acceptable Materials or Basis-of-Design Materials listing in the Technical Specifications of the Project Manual, and are submitted to the Consultant as required by this Section for consideration for use in the Project.
- .2 Unsolicited Substitutions: Substitutions found in the Work that have not been formally accepted by the Consultant in accordance with the requirements of this Section; unsolicited substitutions found in the work may result in a request to remove the affected work and replaced with the specified materials, or accepted with a suitable credit to the contract where substitution is found suitable for the affected work as described later in this Section.
- .3 In making a Proposal for Substitution the Contractor represents:
 - .1 That it has personally investigated the proposal and (unless the proposal explicitly states otherwise) determined that it performs in a similar way or is superior to the Product or method specified.
 - .2 That the same guaranty will be furnished as for the originally specified Product or construction method.
 - .3 That it will coordinate installation of the accepted substitute into the Work, making such changes in the Work as may be required to accommodate the change.
 - .4 That it will bear costs and waives claims for additional compensation for costs that subsequently become apparent arising out of the substitution.
 - .5 That the quotation is complete and includes related costs and adjustments to adjacent construction or layouts.

- .4 Consultant may consider acceptance of Proposed Substitutions where:
 - .1 Products selected by Contractor from the specified Acceptable Materials or Basis-of-Design Materials are not available.
 - .2 Delivery date of Products selected from those specified would unduly delay completion of Contract.
 - .3 Different Products or construction methods to those specified that are considered by the Contractor as performing in a manner similar to, or superior to those specified.
 - .4 Verification that the substitute Products can be obtained, meet the performance and aesthetic standards required for the project, and meet requirements of the Building Code.
 - .5 Different Products or construction methods that will result in credit to Contract Price and maintain the specified performance.
 - .6 Products or construction methods that add cost to the Contract Price may be considered where additional value or life cycle cost benefits can be demonstrated for the City.
- .5 Should Proposed Substitution be found acceptable by the Consultant, in part or in whole, the Contractor shall:
 - .1 Not make any substitution until full implication of the change to Consultant's design and redesign has been fully considered
 - .2 Assume full responsibility and costs when substitution affects any other Work
 - .3 Pay for any design or drawing changes required by the Consultant as a result of substitution
 - .4 Ensure that drawings incorporating and coordinating aspects of affected Work bear the seal and signature of an architect or engineer registered in Province of the Work
- .6 Product Options: Performance or Prescriptive Standards: Select any Product, assembly or material that meets or exceeds the specified standards for Products specified only by referenced standards and performance criteria.
 - .1 Acceptable Materials: Select any named Product, assembly or material contained in the listing of Acceptable Materials.
 - .2 Basis-of-Design Materials: Use the named Product contained in the Basis-of-Design Material listing, unless an addendum is issued indicating acceptance of additional Acceptable Materials.
 - .3 Incorporation of Specified Options: Contractor agree to coordinate the installation of the selected option into the Work:
 - .1 Make any changes in the Work as may be required to accommodate the selected option
 - .2 Notify Consultant where the selected option is inconsistent with the layouts and configurations indicated on Drawings and Schedules
 - .3 Pay costs and waive claims for additional compensation for costs that are implicit in the use of listed options including costs of re-design, and preparation of drawings and details required by the Consultant

1.04 PROJECT MEETINGS

- .1 Project meetings requirements as indicated in Special Provisions, Part 2.Item 2.9.
- .2 Administrative: Contractor schedule and the Consultant will administer project progress meetings throughout the progress of the work as follows:
 - .1 Consultant will distribute written notice of each meeting four days in advance of meeting date.
 - .2 Contractor will provide physical space and make arrangements for meetings.

- .2 Minutes: Contractor will record minutes, will chair the meeting and distribute minutes to parties of record prior to the next scheduled meeting.

1.05 PROGRESS SCHEDULE

- .3 Progress Schedule as indicated in Special Provisions, Part 2, Item 2.10.

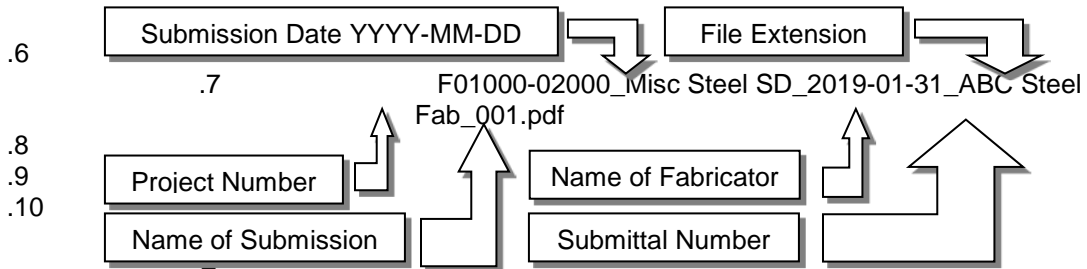
1.05 SITE SURVEYING AND LAYING OUT

- .4 Site Surveying and Layout as indicated in Special Provisions, Part 2, item 2.15.
- .5 Records: Maintain a complete, accurate log of control and survey work as it progresses and as follows:
 - .1 On completion of foundations and major site improvements, prepare a certified Legal Survey and Real Property Report showing dimensions, locations, angles and elevations of Work.

1.07 SUBMITTALS

- .1 This section specifies general requirements and procedures for submissions of shop drawings, Product data, and samples to Consultant for review; additional specific requirements for submissions are specified in individual sections of Project Manual and as follows:
 - .1 Action Submittals: Submittals confirming constructability and conformity with design intent, and that require review and acceptance by Consultant before starting any work.
 - .2 Informational Submittals: Submittals necessary for coordination of the Work, for delegated design not performed by the Consultant or for proof of performance, and that do not require review and acceptance by the Consultant.
 - .3 Sustainable Design Submittals: Submittals required for proof of environmental performance and applicable contributions to specified project requirements.
- .2 Electronic Submittals: Submit shop drawings, product data, design criteria, delegated design documentation, and other documents required by the specifications electronically using open source Portable Document Format (PDF) software that is compatible with ISO 32000-1:2008 Document Management:
 - .1 Software Writers: Any software that can save to or write a PDF including that allows for encryption and signature.
 - .2 Scanned Copies: Legible scanned PDF files of paper originals are acceptable; scanned submittals that are not legible will be rejected.
 - .3 File Size: Maximum file sizes for delivery of PDF submittals are as follows:
 - .1 E-Mail Delivery: 5 Megabytes (MB)
 - .2 FTP Site Delivery: 100 MB
 - .3 Split Delivery: Break larger PDF files into small packages where necessary to meet delivery restrictions; identify split packages as "1 of 2" and "2 of 2" in the Subject Line of submission after other required information listed below.
 - .4 Sheet Orientation: Assemble PDF sheets in a single file; unless resulting file is larger than 10 MB, rotated to a "Ready-to-Read" orientation with majority of text horizontal to the sheet with no additional adjustments or formatting required by the viewer.
 - .4 File Security: Do not set any permissions on the file; protected documents will not be accepted.

.5 File Identification: File name must contain Project Number, Name of Submission, Date of Submission, Name of Fabricator and Submittal Number with underscore between each item; do not use periods except immediately prior to document type; example file name follows:



.11 Transmission Requirements: Send non-zipped files as an attachment to e-mail or upload to FTP site; zipped files will be rejected:

.1 E-Mail Transmission: Include same name as the attachment file name without the file type extension in the Subject Line; e-mail that does not contain appropriate subject will be rejected.

.2 FTP Transmission: Notify Consultant using e-mail that documents have been uploaded; use same subject line protocol as noted above.

.3 Transmittal Layout: Include only one attachment or one topic per e-mail transmission, with the following text appearing in the body of the transmission; <> indicates text edited by sender:

- Attention: Michael Rivest
- Project Number 01255E0801
- Project Name: <Insert Name>
- Name of Contractor: <Insert Name>
- Name of Subcontractor: <Insert Name>
- Name of Fabricator: <Insert Name>
- Name of Product or Assembly: <Insert Name>
- Submission Method: <e-mail> <FTP site>

- Attached is one set of <Shop Drawings> <Product Data> <Insert Name of Other Document> relating to the above mentioned project, product or assembly.

●

- Attachments are for your review, comments and acceptance prior to starting fabrication of the items listed.

Please return reviewed documents to:

- Name of Contractor: <Insert Name>
- Name and e-mail address of Primary Recipient: <Insert Name> and <e-mail address>

.3 Hard Copy Submittals: Submit shop drawings, Product data, design criteria, delegated design documentation, and other documents required by the specifications as follows:

.1 Size: Submit paper documents ranging in size as follows:

- .1 Minimum Sheet Size: 215 mm x 280 mm

- .2 Maximum Sheet Size: 750 mm x 1000 mm
- .2 Quantity: Prepare drawings containing full size templates or patterns on sheets of sufficient size to convey required information and as follows:
 - .1 Drawings up to 280 mm x 430 mm: Submit one (1) photo reproducible copy.
 - .2 Drawings larger than 280 mm x 430 mm: Submit one (1) photo reproducible copy
- .3 Contractor will retain original for inclusion in first copy of Operations and Maintenance Manual, and reproduce as many sets of shop drawings as required for inclusion in remaining Operations and Maintenance Manuals, as required for their own use and one additional copy for use of Subcontractor retain three (3) copies for their own use and inclusion in Operations and Maintenance Manuals, and return last copy to Subcontractor.
- .4 Subcontractor may make as many copies as required for their own use.
- .5 Consultant will destroy any additional copies sent by Contractor in excess of the number requested.
- .4 Shop Drawings: Original of drawings drawn accurately to scale, modified standard drawings provided by manufacturers, or modified standard drawings provided by Contractor to illustrate details of portions of Work, that are specific to project requirements:
 - .1 Do not base Shop Drawings on reproductions of Contract Documents except as allowed by use of electronic drawing files noted above.
 - .2 Include the following information on Shop Drawings, as applicable:
 - .1 Information cross referenced to applicable portions of Contract Documents
 - .2 Include dimensions consistent with units shown on drawings; converted values are acceptable when items or information are not produced in indicated units
 - .3 Identification of Products
 - .4 Fabrication and installation drawings
 - .5 Roughing-in and setting diagrams
 - .6 Wiring diagrams showing site installed wiring, including power, signal, and control wiring
 - .7 Shop work manufacturing instructions
 - .8 Templates and patterns
 - .9 Schedules
 - .10 Design calculations
 - .11 Compliance with specified standards
 - .12 Notation of coordination requirements by specific related Subcontractors; the term "By Others" will not be acceptable
 - .13 Notation of critical dimensions established by site measurement, or that have to be maintained to fit components
 - .5 Product Data: Submit Product data sheets such as manufacturers' catalogue sheets, brochures, performance charts and diagrams, and similar literature used to illustrate standard manufactured Products, modified as follows:
 - .1 Delete information not applicable to project
 - .2 Supplement standard information to provide details applicable to project
 - .3 Cross reference Product data information to applicable portions of Contract Documents

- .6 Samples: Submit samples for materials, assemblies or equipment as examples of quality, finishes or workmanship in quantities indicated and when requested by the Technical Specification Sections; additional samples will be considered where performance or appearance of the work is considered a critical requirement by the Contractor where samples are not specifically required and as follows:
 - .1 Submit full range or multiple samples when variations in colour, pattern or texture is a natural occurrence of the materials being considered for use for the Work; reviewed and accepted samples will become standard of workmanship and material against which installed work will be verified.
 - .2 Identify samples with name and number of project, date, name of Contractor, name of Subcontractor, and name of supplier/manufacturer and intended use of material represented by Sample.
 - .3 Do not proceed with fabrication or delivery of materials until Samples are reviewed; review of Samples does not imply acceptance of finished Work.
 - .4 Work judged by Consultant as being below the standard set by sample may be rejected; in which event, Contractor will replace with acceptable Work, at no additional cost to the City.

1.08 REGULATORY REQUIREMENTS

- .1 Governing Building Code: Work of this Project is based minimum requirements of the 2014 Alberta Building Code, which is considered as the Governing Building Code requirements for the Project:
 - .1 Specific design and performance requirements listed in the specifications or indicated on the Drawings may exceed the minimum requirements established by the referenced Building Code; these requirements will govern over the minimum requirements listed in the Building Code.
- .2 Contract Documents: Contractor is not responsible for verifying that Contract Documents comply with regulatory requirements, except for where Delegated Design criteria listed in Section 01 33 50 – Delegated Design Submittals require a professional engineer to design specific elements of construction, and as follows:
 - .1 The City may make changes required to Contract Documents, and any resulting change in Contract Price or Contract Time will be made in accordance with General Conditions of Contract.
 - .2 If Contract Documents are at variance, or changes that require modification to Contract Documents are made to regulatory requirements by Authority Having Jurisdiction, subsequent to date of Bid closing, Contractor shall notify Consultant in writing requesting direction immediately when variance or change becomes known to them.
 - .3 If Contractor fails to notify Consultant in writing and obtain the City's direction as required and performs Work knowing it to be contrary to regulatory requirements, Contractor shall be responsible for and shall correct violations thereof and shall bear costs, expenses, and damages attributable to his failure to comply with provisions of such regulatory requirements.
- .3 Easements and Notices: The City will obtain permanent easements and rights of servitude that may be required for performance of Work; Contractor is required to give notices required by regulatory requirements.
- .4 Development Permit: The City has applied for, obtained, and paid for development permit.
- .5 Building Permit: Contractor will apply for, obtain and pay for building permit on behalf of the City, and other permits required for Work and its various parts, and as follows:
 - .1 Contractor will require that specific Subcontractors obtain and pay for permits required by authorities having jurisdiction, where their Work is affected by Work requiring permits.

- .2 Contractor will display building permit and other permits in a conspicuous location at Place of Work.
 - .6 Occupancy Permits: Contractor will apply for, obtain, and pay for occupancy permits, including partial occupancy permits where required by authority having jurisdiction and as follows:
 - .1 Consultant will issue appropriate instructions to Contractor for correction to Work where Contract Document deficiencies are required to be corrected in order to obtain occupancy permits, including partial occupancy permits.
 - .2 Contractor shall correct deficiencies in accordance with Consultant's instructions. Where deficiency is not corrected, The City reserves the right to make correction and charge Contractor for costs incurred.
 - .3 Contractor will turn occupancy permits over to the City after Subcontractors have completed their portions of Work.
 - .7 Other Permits, Licenses, Certificates and Approvals: Except as otherwise specified, Contractor shall apply for, obtain, and pay all fees associated with, permits, licenses, certificates, and approvals required by regulatory requirements and Contract Documents, based on General Conditions of Contract and the following:
 - .1 Regulatory requirements and fees in force on date of Bid submission, and,
 - .2 Any change in regulatory requirements or fees scheduled to become effective after date of tender submission and of which public notice has been given before date of tender submission.
- 1.09 QUALITY CONTROL
- .1 Quality Control as indicated in Special Provisions, Part 2, item 2.29.
- 1.10 CONSTRUCTION SITE SAFETY REQUIREMENTS
- .1 Construction Site Safety Requirements as indicated in Special Provisions, Part 2, item 2.16.
- 1.11 CONSTRUCTION FACILITIES AND TEMPORARY CONTROLS
- .1 Temporary Facilities for Project Coordination and Consultants as indicated in Special Provisions, Part 2, Item 2.13., including the following:
 - .1 Overloading of Structures: Take precautions to prevent any part the structure from being loaded with a load greater than its calculated bearing capacity until completion of construction:
 - .1 Make every temporary support as strong as permanent support.
 - .2 Do not place load on concrete floors until they have obtained their permanent set and Consultant's authorization has been received.
 - .2 Temporary Facility Requirements: Provide hoists, cranes and moving equipment, and shoring and bracing required for hoisting, lifting and moving equipment and materials required for the project into final position within the structure and as follows:
 - .1 Notify affected Subcontractors and coordinate placement of hoisting, lifting and moving equipment, and shoring and bracings.
 - .2 Provide qualified personnel to operate and erect hoists, cranes and moving equipment, and shoring and bracing.
 - .3 Provide qualified engineer where site engineering is required to inspect and supervise erection procedures.
 - .3 Notification Requirements: Prepare risk control plan and engineered lift study for any equipment or material movements that have the potential to overload the structure, adjacent buildings and structures, or affect occupant safety and as follows:

- .1 Notify the Consultant of engineered erection procedures for hoisting, lifting and moving equipment, and shoring and bracings.
- .2 Prepare risk control plan and engineered lift study before equipment and materials requiring detailed erection procedures sufficiently in advance of when they are scheduled to arrive on site to allow for Consultant's review.
- .3 Submit risk control plan and engineered lift study to the Consultant as an Informational Submittal as described above for Submittals.
- .4 Site Storage and Overloading: Confine apparatus, storage of Products, and operations of employees to limits indicated by laws, ordinances, permits or the Contract Documents and that do not unreasonably encumber the premises with Products.

1.12 COMMON PRODUCT REQUIREMENTS

- .1 Product and Material Quality: Provide and pay for labour, Products, tools, construction machinery and equipment, water, heat, light, power, transportation and other facilities and services necessary for the performance of the Work in accordance with the Contract and as follows:
 - .1 Provide only new Products unless otherwise specified in the Contract Documents; Products that are not specified shall be of a quality best suited to the purpose required and their use subject to the approval of the Consultant.
 - .2 Maintain good order and discipline among their employees engaged on the Work and will not employ anyone who is not skilled in the task assigned to them.
- .2 Storage, Handling and Protection: Handle and store Products in a manner to prevent damage, adulteration, deterioration and soiling and in accordance with manufacturer's instructions when applicable and as follows:
 - .1 Store packaged or bundled Products in original and undamaged condition with manufacturer's seals and labels intact.
 - .2 Protect and store Products subject to damage from weather in weatherproof enclosures
- .3 Manufacturer's Instructions: Install or erect Products in accordance with manufacturer's instructions and as modified by Technical Specifications Sections; do not rely solely on labels or enclosures provided with Products; obtain written instructions directly from manufacturers and as follows:
 - .1 Notify the Consultant in writing of conflicts between the specifications and manufacturer's instructions so the Consultant can establish the course of action.
 - .2 Improper installation or erection of Products due to failure to comply with these requirements authorizes the Consultant to require removal and reinstallation at no increase in Contract Price.
- .4 Workmanship: Provide workmanship of Workmanship best quality executed by workers experienced and skilled in their respective duties for which they are employed and as follows:
 - .1 Immediately notify the Consultant if required Work is such as to make it impractical to produce required results.
 - .2 Do not employ any unfit person or anyone unskilled in their required duties.
 - .3 Decisions as to the quality or fitness of workmanship in cases of dispute rest solely with the Consultant, whose decision is final.
- .5 Concealment: Conceal pipes, ducts and wiring in finished areas within floors, walls and ceilings, except indicated as being exposed as an architectural element; inform Consultant if there is a contradictory situation before installation and install as directed by Consultant.

1.13 EXECUTION REQUIREMENTS

- .1 Hours of Work as indicated in Special Provisions, Part 2, Item 2.19.
- .2 Occupancy by the City: The City reserves the right to occupy the building and site for installation of equipment and storage of supplies at any time prior to date of Interim Acceptance:
 - .1 Such possession or use shall not be construed as final acceptance of the project or any portion thereof.
 - .2 Contractor will provide and maintain full services such as heat, light, water and similar services between times of occupancy by the City, to date of Substantial Performance of the Work, at no cost to the City.
- .3 Smoking Policy: Facility is a smoke free environment; no one will be allowed to smoke anywhere on site; both inside and outside of buildings except in area as directed by the Contractor; keep designated smoking areas clean and sanitary, do not permit butts to accumulate or enter the watershed.
- .4 Consumables Policy: Food or drink consumption by construction forces will only be permitted within areas designated by Contractor; keep designate eating areas clean and sanitary; use closed waste receptacles and remove trash on a daily basis.
- .5 Installation: Locate the Products and other components of the Work accurately, in correct alignment and elevation as indicated and as follows:
 - .1 Make vertical work plumb and make horizontal work level.
 - .2 Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
 - .3 Conceal pipes, ducts, and wiring in finished areas, unless indicated specifically as being exposed as architectural features:
 - .1 In rooms or areas having no finished ceiling; pipes, conduits and ducts will generally be left exposed, except where indicated on the Mechanical drawings as built into walls or behind furring. Electrical conduit and fittings shall be built into walls.
 - .2 In the event of conflicts occurring between equipment shown in concealed areas, observe the following order of priority:
 - Structural elements
 - Plumbing drains
 - Sprinkler piping
 - Ductwork
 - Heating piping
 - Plumbing piping
 - Electrical conduit
 - .4 Maintain minimum headroom clearance of 2440 mm in spaces without a suspended ceiling.
- .6 Inform the Consultant of impending installation of fixtures, switches and attachments and confirm actual locations prior to final installation:
 - .1 Location of fixtures, apparatus or outlets shown or specified shall be considered as approximate only. The actual location shall be as directed and required to suit conditions at the time of installation as defined by Consultant.
 - .2 Locations noted on drawings are diagrammatic only.
 - .3 Note furring requirements and limitations shown on the drawings.

.4 Make allowance for the possibility that indications and locations shown on mechanical and electrical drawings are diagrammatic.

.5 Inform the Consultant before any masonry, concrete forming, or installation work is carried out where the Contractor determines that furring allowances described above cannot be obtained.

.7 Inform the Consultant before proceeding with the work where the location of holes in the structure could affect the nature or strength of the structure.

1.14 CUTTING AND PATCHING

.1 Approvals: Submit written requests in advance of cutting or alteration which affects the following:

.1 Structural integrity of any element of the Project

.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 the City or other contractor

1.15 ANCHORS AND FASTENERS

.1 Fastenings: Provide metal fastenings and accessories in same texture, colour and finish as adjacent materials, and as follows:

.1 Prevent electrolytic action between dissimilar metals and materials.

.2 Use non-corrosive hot dip galvanized steel fasteners and anchors for securing exterior work, unless stainless steel or other material is specifically requested in affected specification Section.

.3 Space anchors within individual load limit or shear capacity and ensure they provide positive permanent anchorage. Wood, or any other organic material plugs are not acceptable; coordinate design of fastenings and anchors with requirements listed below.

.4 Keep exposed fastenings to a minimum, space evenly and install neatly.

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

.2 Equipment Fastenings: Use fastenings of standard commercial sizes and patterns with material and finish suitable for service, and as follows:

.1 Use heavy hexagon heads, semi-finished unless otherwise specified.

.2 Use No. 304 stainless steel for exterior areas.

.3 Bolts may not project more than one diameter beyond nuts.

.4 Use plain type washers on equipment, sheet metal and soft gasket lock type washers where vibrations occur.

.5 Use resilient washers with stainless steel.

.3 Provide anchors and fasteners as required to anchor each component securely in place, accurately located and aligned with other portions of the Work:

.1 Mount components at heights directed by Consultant where mounting heights are not indicated.

.2 Allow for building movement, including thermal expansion and contraction.

.4 Anchors for systems, pipes, conduits and equipment, hangers and support systems, and connections to building structure shall be the responsibility of the installing Subcontractor; installing Subcontractor shall retain a professional engineer registered in Province of the Work to review/design anchor installation to ensure that all anchors and attachments to the structure are suitable for the purposes intended, properly installed, including those where installation deviates from design data and standards published by anchor and hanger support manufacturers:

.1 Submit proof of load carrying capacity for standard anchors and hanger supports used in construction when requested by the Consultant or Contractor.

.5 Do not use Powder Actuated Tools on site without prior approval of the Consultant; comply with requirements of the local Occupational Health and Safety Act, General Safety Regulations when powder actuated tools are used.

1.16 HOUSEKEEPING

.1 Individual Subcontractors will be responsible for daily housekeeping under the Contractor's cleaning program. Subcontractors will provide employees for general clean-up as directed by the Contractor.

.2 Clean Project site and work areas daily, including common areas. Coordinate progress cleaning for joint use areas where more than one installer has worked. Enforce requirements strictly. Dispose of materials lawfully:

.1 Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.

.2 Do not hold materials more than seven (7) days during normal weather or three (3) days if the temperature is expected to rise above 25°C.

.3 Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.

.3 Maintain Project site free of waste materials and debris.

.4 Clean areas where work is in progress to the level of cleanliness necessary for proper execution of the Work and safety of personnel in the area:

.1 Remove liquid spills promptly.

.2 Broom clean or vacuum the entire work area, as appropriate, where dust impairs proper execution of the Work.

.5 Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property, and that will not damage exposed surfaces.

.6 Remove debris from concealed spaces before enclosing the space.

.7 Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Performance.

.8 Clean areas and spaces where cutting and patching are performed; completely remove paint, mortar, oils, putty, and similar materials:

.1 Thoroughly clean piping, conduit, and similar features before applying paint or other finishing materials. Restore damaged pipe covering to its original condition.

.9 Burying or burning waste materials on site will not be permitted. Washing waste materials down sewers or into waterways will not be permitted.

.10 Clean and protect construction in progress and adjoining materials already in place during handling and installation. Apply protective covering where required to ensure protection from damage or deterioration until Substantial Performance.

.11 Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.

- .12 Contractor will supervise construction operations to assure that no part of the construction; completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

1.17 FINAL CLEANING

- .1 Verify that cleaning agents and methods do not remove finishes and permanent protective coatings on surfaces being cleaned.
- .2 Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average institutional building cleaning and maintenance program.
- .3 Comply with manufacturer's written cleaning instructions.
- .4 Use only cleaning materials recommended by manufacturer of material to be cleaned.
- .5 Use cleaning materials only on surfaces recommended by cleaning material manufacturer.
- .6 Conduct cleaning and waste removal operations to comply with local laws and ordinances, Federal and local environmental and antipollution regulations
- .7 Complete the following cleaning operations before requesting final review for acceptance of Declaration of Substantial Performance in accordance with Closeout Procedures:
 - .2 Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.
 - .3 Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
 - .4 Rake grounds that are not planted or paved to a smooth, even textured surface.
 - .5 Remove tools, construction equipment, machinery, and surplus material from Project site.
 - .6 Remove snow and ice to provide safe access to building. Broom clean or remove snow and ice from all exterior paved areas designed for pedestrian or vehicular traffic, including parking areas.
 - .7 Clean exposed exterior and interior hard surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces.
 - .8 Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
 - .9 Sweep concrete floors broom clean in unoccupied spaces.
 - .10 Vacuum carpet and similar soft surfaces, removing debris and excess nap; shampoo if visible soil or stains remain.
 - .11 Clean transparent materials, including mirrors and glass in doors and windows:
 - .1 Remove glazing compounds and other noticeable, vision obscuring materials.
 - .2 Replace chipped or broken glass and other damaged transparent materials.
 - .3 Polish mirrors and glass, taking care not to scratch surfaces.
 - .4 Restore reflective surfaces to their original condition.
 - .12 Remove labels that are not permanent.
 - .13 Remove protective films from equipment and accessories.
 - .14 Touch up and otherwise repair and restore marred, exposed finishes and surfaces. Replace finishes and surfaces that cannot be satisfactorily repaired or restored or that already show evidence of repair or restoration.
 - .15 Remove paint from ULC, CSA, WHI and similar labels, including mechanical and electrical nameplates.
 - .16 Wipe surfaces of mechanical and electrical equipment, elevator equipment, and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.

- .17 Replace parts subject to unusual operating conditions. Restore equipment, machinery or systems used as temporary facilities to "as-new" condition so that warranties take effect at Substantial Performance.
 - .18 Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
 - .19 Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
 - .20 Clean ducts, blowers, and coils.
 - .21 Clean light fixtures, lamps, globes, and reflectors to function with full efficiency. Replace burned out bulbs, and those noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapour fixtures to comply with requirements for new fixtures.
 - .22 Leave Project clean and ready for occupancy.
- .8 Comply with safety standards for cleaning:
- .2 Do not burn waste materials.
 - .3 Do not bury debris or excess materials on the City's property.
 - .4 Do not discharge volatile, harmful, or dangerous materials into drainage systems.
- .9 Remove waste materials from Project site and dispose of lawfully
- 1.38 PROJECT CLOSEOUT
- .1 Starting, Testing, Adjusting and Balancing (STAB): Coordinate requirements for STAB requirements for installed equipment with requirements of Mechanical and Electrical Divisions; implement a STAB program generally consisting of the following:
- .2 Start equipment and operating components to confirm proper operation
 - .3 Remove malfunctioning units, replace with new units, and retest
 - .4 Adjust operating components for proper operation without binding
 - .5 Adjust equipment for proper operation
 - .6 Test each piece of equipment to verify proper operation
 - .7 Test and adjust controls and safeties
 - .8 Replace damaged and malfunctioning controls and equipment
 - .9 Comply with qualification requirements for Quality Control listed earlier in this Section where a factory authorized service representative is required to inspect site assembled components and equipment installation.
- .2 Systems Demonstration: Demonstrate operation of each system to the City before requesting final inspection and applying for Substantial Performance:
- .2 Instruct personnel in operation, adjustment and maintenance of equipment and systems, using provided operation and maintenance data as the basis for instruction.
 - .3 Also refer to Mechanical and Electrical requirements for specific requirements for the following:
 - .1 Equipment start-up
 - .2 Fire alarm verification
 - .3 Additional items identified in Technical Specification Sections
- .3 Closeout Procedures: Collect reviewed submittals and assemble documents executed by Subcontractor's, suppliers and manufacturers as required below before final Application for Payment and as follows:
- .2 Execute transition of Performance and Labour and Materials Payment Bond to Warranty Period requirements.

- .3 Submit a final statement of accounting giving total adjusted Contract Price, previous payments, and monies remaining due.
 - .4 Consultant will issue a final change order reflecting approved adjustments to Contract Price not previously made.
- .4 Takeover Procedures: Carefully inspect the Work and ensure it is complete before application for certificate of Substantial Performance; confirm that major and minor construction deficiencies are complete; that defects are corrected and that building is clean and in condition suitable for occupancy and as follows:
- .2 Notify the Consultant in writing, of satisfactory completion of the Work and request final review and confirmation that Work is ready for takeover by the City
 - .3 Consultant will prepare a list of deficiencies and defects if any exist that will require corrective action.
 - .4 Make application for certificate of Substantial Performance when Consultant considers deficiencies and defects have been corrected and it appears requirements of the Contract have been performed.

1.39 CLOSEOUT SUBMISSIONS

- .1 Operation and Maintenance Data: Provide an organized compilation of operating and maintenance data including detailed technical information, documents and records describing operation and maintenance of individual Products or systems as specified in the technical sections and as follows:
 - .2 Binders: "D" ring type, heavy duty vinyl binders having clear plastic pockets on the spine and front cover for project information inserts; limited to a maximum of 75 mm spine width and no more than 2/3 full.
 - .3 Binder Colours:
 - .1 Architectural: Black
 - .2 Mechanical: Green
 - .3 Electrical: Royal Blue
 - .4 Shop Drawings: Red
 - .4 Quantity:
 - .1 Final Electronic Version: Provide one (1) copy of manufacturer's maintenance manuals and operational schematics scanned or native format PDF on USB memory stick.
 - .2 Final Paper Version: Provide one (1) copy of manufacturer's maintenance manuals and operational schematics, bound as specified in this Section.
 - .5 Content: Coordinate requirements with specific requirements contained in the Technical Specifications required for each Bid Package; include cover sheets identifying:
 - .1 Date submitted
 - .2 Project title, location and project number
 - .3 Names and addresses of Contractor and all Subcontractors
 - .4 Table of Contents of all binder volumes and disciplines
 - .5 List of warranties and guaranties for the project
 - .6 List of approvals and certificates for the project
 - .6 Material, Product or System Data: Include the following listing of information for each individual tab within the Operation and Maintenance Manuals:
 - .1 Tab Contents: Include vendor name, and equipment make, model and serial number

- .2 Spare parts lists: Source of spare parts for materials that are not kept at site; list of spare parts that are required to be kept at site
- .3 Warranty or Guaranty information and claim procedure specific to material, Product or system
- .7 Operation Data: Description of each system and its controls and as follows:
- .1 Control schematics for each system including environmental controls
- .2 Description of operation of each system at various loads together with reset schedules and seasonal variances
- .3 Operation instruction for each system and each component
- .4 Description of actions to be taken in event of equipment failure
- .8 Maintenance Data: Servicing, maintenance, operation and troubleshooting instructions for each item of equipment and as follows:
- .1 Maintenance schedules with tasks and frequencies including listing of tools required to complete maintenance and estimated task time
- .9 Performance Data: Equipment manufacturer's performance data sheets with point of operation as left after facility systematic testing and balancing was completed including the following:
- .1 Equipment performance verification test results
- .2 Special performance data as specified in individual Technical Specification Sections
- .10 Maintenance Materials: Provide additional materials prior to completion of Work in following quantities:
- .1 Sheet Resilient Flooring and Carpet Materials: Each type, colour and pattern for following installed quantities:
- | | |
|---|-----------------------|
| Under 10 m ² | Leave larger remnants |
| 10 m ² – 25 m ² | 5% of installed area |
| >25 m ² – 100 m ² | 4% of installed area |
| >100 m ² – 500 m ² | 3% of installed area |
| >500 m ² – 1000 m ² | 2% of installed area |
| Over 1,000 m ² | 1% of installed area |
- .2 Ceiling Board: Each type for installed quantities, minimum 1 box or 1% of quantity installed, whichever is greater.
- .3 Non-Resilient Flooring: Each type, colour and pattern, minimum 1 box or 2% of quantity installed, whichever is greater.
- .4 Paint: Each colour and type, minimum 1-4 litre can for trim colours and 2-4 litre cans for field colours.
- .5 Vinyl Composite Tile: Each type, colour and pattern, minimum 1 box or 2% of quantity installed, whichever is greater.
- .6 Spare Parts: Provide spare parts prior to completion of the work as indicated below and in various specification sections:
- Door Hardware spare parts and maintenance materials: as specified in Section 08 71 00.
 - Mechanical spare parts and maintenance materials: as indicated in Mechanical Divisions.
 - Electrical spare parts and maintenance materials: as indicated in Electrical Divisions.

- .11 Record Documents: Record documents will consist of a hard copy of the Project Manual (Specification) and Drawings and will be used to accurately and neatly record deviations from contract documents caused by site conditions and change orders as follows:
- .1 Record locations of concealed components of mechanical and electrical services
 - .2 Identify drawings as "Project Record Copy".
 - .3 Maintain in new condition and make available for review on site by Consultant.
 - .4 Submit record documents to Consultant on completion of Work and prior to final inspection.
 - .5 The Consultant will review the record drawings in print form and when accepted, the Consultant will make arrangements with the City to incorporate architectural, structural, mechanical and electrical deviations noted on record documents.

2. PRODUCTS

2.37 NOT USED

3. EXECUTION

3.37 SPECIFICATION FORMATS AND CONVENTIONS

- .1 Specification Format: The specifications are based on MasterFormat jointly published by Construction Specifications Canada (CSC) and Construction Specifications Institute (CSI) using the 2014 updated master list of numbers and titles that classify work results or construction practices:
- .2 Section Identification: The Specifications use section numbers and titles to help cross-referencing in the Contract Documents.
 - .3 Sections in the Project Manual are in numeric sequence; however, the sequence is incomplete and not intended to be read as a continuous and sequential page-by-page requirement.
 - .4 Consult the table of contents at the beginning of the Project Manual to determine numbers and names of sections in the Contract Documents.
 - .5 The section numbers do not and cannot indicate the scope of work for individual Subcontractors (trade scope of work), they are used to establish the total work required for the Project.
- .2 MasterFormat is primarily used to organize project manuals, organize detailed cost information and relate drawing notations to the specifications.
- .3 The 6 Number, 50 Division format replaces the previous 5 Number, 16 Division format used before 2004.
- .4 Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:
- .2 Related Requirements: Related requirements listed in the specifications indicating specification sections that are related to work of the section do not create a trade scope of work:
 - .1 Related requirements are provided to indicate closely coordinated requirements during preparation of the documents and that may aid the Subcontractor in fully incorporating components relating to their trade scope of work.
 - .2 Subcontractors are expected to coordinate with sections affecting their work and ensure that trade scope of work is fully accounted for, including requirements of Division 00 and 01 and other sections that may not be listed in the listings associated with related requirements.

- .3 Laws, Statutes, Codes and Reference Standards: Dated reference standards listed in the Specifications generally reflect the version used to establish the performance requirements for the work described:
- .1 Reference to any provincial or national statutes and codes includes the full content of the code or statute including an amendment, revision or consolidation published by the Authority Having Jurisdiction.
 - .2 Dated reference standards listed in provincial or national codes or statutes apply to the Work of the Contract.
 - .3 Dated reference standards listed in provincial codes or statutes govern where an older or newer version of a reference standard is listed in the Specifications.
- .4 Abbreviated Language: Language used in the Specifications and other Contract Documents is abbreviated to aid interpretation of the documents:
- .1 Words and meanings shall be interpreted as appropriate and are intended to be read as a whole, not extracted and read individually.
 - .2 Words implied but not stated, shall be inferred as the sense requires.
- .5 Imperative Mood and Streamlined Language: Generally used in the Specifications to avoid assigning specific responsibilities to the Contractor or the Subcontractor that affect trade scopes of work:
- .1 Requirements expressed in the imperative mood are to be performed by Subcontractors.
 - .2 Occasionally, the indicative or subjunctive mood may be used in the Section text for clarity to describe responsibilities that must be fulfilled indirectly by Subcontractors or by others when so noted.
- .6 Use of Shall and Will: Use of the words shall and will is minimized throughout the specification, but are used to indicate preferred directives to the Contractor and Subcontractor where greater clarity to the documentation is achieved using those words:
- .1 For the purposes of this Specifications, the word "shall" is a directive requiring that the Contractor undertake a specific task or assignment.
 - .2 For the purposes of this Specifications, the word "will" is a directive indicating an action or task required by the City, and Consultant.
- .7 Use of Singular and Plural Words: The language of the Specifications is essentially plural, and usage of singular and plural words is governed as follows:
- .1 Every attempt has been made to apply singular and plural word usage based on numbers of components required by the project; however, it is expected that use of singular and plural words will be interpreted in context to what the Contract Documents indicate.
 - .2 The use of plural words when ascribed to a singular requirement shall be reasonably interpreted as relating to a singular requirement when a count of components described by the plural word indicates a single occurrence.
 - .3 The use of a singular word version when ascribed to multiple requirements shall be reasonably interpreted as relating to multiple requirements when a count of components described by the singular word indicates multiple occurrences.
- .8 Use of Gender Specific Words: The language of the Specifications is generally written as nouns arising from the Contract and that relate to the partnerships, firms or corporations involved and generally avoid the use of gender specific pronouns where ever possible:

- .1 Words describing gender and that relate to the partnerships, firms and corporations can be interpreted as relating to the Contractor and Subcontractor as defined by the Contract within the context of what the Contract Documents require for those parties.

END OF SECTION

1. GENERAL**1.01 SUMMARY**

- .1 This Section includes administrative and procedural requirements governing Allowances.
 - .1 Certain materials and equipment are specified in Contract Documents by Allowances.
 - .2 In some cases, these Allowances include installation.
 - .3 Allowances have been established instead of additional requirements and to defer selection of actual materials and equipment to a later date when additional information is available for evaluation.
 - .4 If necessary, additional requirements will be issued by Change Order.
- .2 Types of Allowances include the following:
 - .1 Cash Allowances.

1.02 RELATED REQUIREMENTS

- .1 [Section 01 00 06 – General Requirements: Quality Control](#): List of tests covered by testing and inspection allowances.
- .2 [Section 01 00 06 – General Requirements: Demonstration and Training for Non-Commissioned Buildings](#)
- .3 [Division 26 – Electrical Services](#): Power and Communications.

1.03 DEFINITIONS

- .1 The following definitions apply to the Allowances specification:
 - .1 Cash Allowance: The words “PC Sum”, “Prime Cost Sum”, or “Expenditure Allowance” will be synonymous with the Term “Cash Allowance”.

1.04 SUBMITTALS

- .1 Submit proposals for purchase of products or systems included in Allowances, in the form specified for Change Orders.
- .2 Submit invoices or delivery slips to show actual quantities of materials delivered to site for use in fulfillment of each Allowance.

1.05 CASH ALLOWANCE

- .1 Cash Allowances are lump sum amounts for materials, or materials and installation where quantity, quality, or design information is not known prior to Contract signing, and to cover costs for quality control, inspection and testing specified in [Section 01 00 06 – General Requirements: Quality Control](#).
- .2 Use Cash Allowance only as directed by Consultant for the City's purposes, and only by Change Orders that indicate amounts to be charged to Allowance.
- .3 Materials Only: Change Orders authorizing use of funds from Cash Allowance for purchase of materials only shall include and provide payment for:
 - .1 Net cost of material.
 - .2 Applicable duties and taxes.
 - .3 Delivery to site.

- .4 The following items do not form a part of Cash Allowance for purchase of materials, and shall be accounted for as a part of Contract Sum:
 - .1 Handling at site, including unloading, un-crating, storage and hoisting.
 - .2 Protection from damage by elements or otherwise.
 - .3 Labour for installation and finishing.
 - .4 Other expenses required to complete installation.
 - .5 Overhead and profit.

 - .4 Materials and Installation: Change Orders authorizing use of funds from Cash Allowance for purchase of materials and installation shall include and provide payment for:
 - .1 Net cost of material.
 - .2 Applicable duties and taxes.
 - .3 Delivery to site.
 - .4 Handling at site, including unloading, un-crating, storage and hoisting.
 - .5 Protection from damage by elements or otherwise.
 - .6 Labour for installation and finishing.
 - .7 Other expenses required to complete installation.
 - .8 The following items do not form a part of Cash Allowance for purchase of materials and installation, and shall be accounted for as a part of Contract Sum:
 - .1 Overhead and profit.

 - .5 Testing and Inspection: Change Orders authorizing use of funds from Cash Allowance for testing and inspections shall include and provide payment for:
 - .1 Cost of engaging testing agencies.
 - .2 Actual tests and inspections.
 - .3 Reporting of results.
 - .4 The following items do not form a part of Cash Allowance for testing and inspections
 - .1 Incidental labour by Contractor required to assist testing agency.
 - .2 Costs for retesting if previous tests and inspections result in failure.
 - .3 Contractor will account for their incidental labour costs as a part of Contract Price.

 - .6 Costs of services not required by Contract Documents are not included in Cash Allowance.
 - .7 Credit unused amounts remaining in Cash Allowance to the City by Change Order at Project closeout.
- 1.06 ADMINISTRATION
- .1 Each Allowance will be adjusted to actual cost as defined below and Change Order will amend Contract Price.
 - .2 Progress payments for Work and material authorized under Allowances will be made in accordance with contract terms of payment.
- 2. PRODUCTS**
- 2.01 PRODUCTS AND SYSTEMS
- .1 At earliest practical date after award of Contract, advise Consultant of date when final selection and purchase of each product or system described by an Allowance must be completed to avoid delaying Work.

.2 At Consultant's request, obtain proposals for each Allowance for use in making final selections. Include recommendations that are relevant to performing Work.

.3 Purchase products and systems selected by Consultant from designated supplier.

3. EXECUTION

3.01 EXAMINATION

.1 Examine products covered by an Allowance promptly on delivery for damage or defects. Return damaged or defective products to manufacturer for replacement.

3.02 PREPARATION

.1 Coordinate materials and their installation for each Allowance with related materials and installations to ensure that each Allowance item is completely integrated and interfaced with related Work.

3.03 SCHEDULE OF ALLOWANCES

.1 Contract Price includes Cash Allowance indicated below and is comprised of the following items:

Schedule of Allowances		
Materials Only		
Division 26	Lighting Fixture L1	\$32,000.00
Materials and Installation		
Division 26 Electrical Services	Power and Communications	\$70, 000.00
.2	Collected amount of Cash Allowances is equal to:	\$32,070.00

3.04 SCHEDULING WORK COVERED BY ALLOWANCE

- .1 Comply with the following:
 - .1 Perform Work within Contract Time.
 - .2 Include Work in construction schedule.
 - .3 Consultant will supply Contractor with required documentation or information within time specified, or where such time is not specified, in sufficient time to permit construction schedule to be maintained.

3.05 PERFORMANCE OF WORK COVERED BY ALLOWANCES

.1 Consultant will determine by whom and for what amounts Work covered by Allowances will be performed.

- .2 If not specified, Consultant will determine manner in which prices for Work covered by Allowances will be obtained.
- .3 When requested or specified, Contractor will assist the Consultant by identifying potential suppliers and Subcontractors and by obtaining prices for Work covered by Allowances.

3.06 CONTRACTOR'S RESPONSIBILITIES

- .1 Contractor's responsibilities for Work covered by Allowances shall be same as for other Work of this Contract.
- .2 On notification in writing of selection of supplier or Subcontractor by Consultant, Contractor will execute purchase agreement with designated supplier or enter into subcontract or amend existing subcontract with designated Subcontractor.

3.07 DETERMINATION OF ACTUAL COSTS

- .1 Actual cost of items included in an Allowance amount shall be determined by:
 - .1 Actual amount duly payable by Contractor to Subcontractor or suppliers, and
 - .2 Contractor actual cost of material and labour for Work performed by his own forces.
- .2 Trade discounts and refunds shall be credited to the City.
- .3 Notwithstanding the foregoing, cash discounts, if any, on accounts paid by Contractor before net due. Contractor may retain date.

END OF SECTION

Material Allowance Expenditure		Initiated by	
[NAME OF INSTITUTION]		Trade	
		Date	
System/Material			
Electrical			
Mechanical			
Other			
Description of Systems/Area			
Material			
Material Quantity x Unit Rate			Total
	Acknowledgement (Signature)		Date
Contractor			
Mechanical Subcontractor			
Electrical Subcontractor			
The City's Representative			
Consultant			
Cost Control			
Original Amount			
Cost of Work to Date			
Cost of this Work			
Balance			

1. GENERAL**1.01 INTENT**

- .1 The intent of Delegated Design Submittals required by this Section is to account for professional engineering responsibility for design, review and acceptance of components of Work forming a part of permanent Work in accordance with Building Code, and that has been assigned to a design entity other than Consultant including, but not limited to, the following:
 - .1 Design requiring structural analysis of load bearing components and connections.
 - .2 Design requiring compliance with fire safety regulations.
 - .3 Design requiring compliance with life or health safety regulations.
- .2 This Section provides standard forms for submittal of Letters of Commitment and Compliance required complying with requirements of Building Code and design delegated to a professional engineer within technical Specifications Sections.
- .3 Delegated Design Submittals are not required for components of Work requiring engineering for temporary Work (for example: crane hoisting, engineered lifts, false Work, shoring, concrete formwork) that would normally form a part of Contractor or responsible Subcontractor's, suppliers or manufacturer's scope-of-Work.
- .4 The requirements of this Section are in general conformance with recommended Responsibilities for Engineering Services for Building Projects published by Association of Professionals in Engineering and Geoscience in Alberta (APEGA), with regards to duties of specialty professionals appointed during construction period.

1.02 RELATED REQUIREMENTS

- .1 **Section 01 00 06 – General Requirements:** Submittals: Submission of required supporting documentation by Delegated Design Professional Engineers.
- .3 **Section 01 00 06 – General Requirements:** Quality Control: Quality control and assurance responsibilities for engineered design of shop and site fabricated components.
- .4 **Section 07 05 53 – Fire and Smoke Assembly Design Requirements and Identification:** Quality control and assurance responsibilities for preparation of Engineering Judgements of fire resistive materials required for the project.
- .5 Technical Specifications Sections make specific reference to delegated design requirements described in this Section.
 - .1 **Section 03 45 00 – Architectural Precast Concrete:** Concrete panel anchorages and connections.
 - .2 **Section 05 12 00 – Structural Steel Framing:** Steel connection requirements.
 - .3 **Section 05 31 00 – Steel Decking:** Span and thickness requirements.
 - .5 **Section 05 50 00 – Metal Fabrications:** Design of steel stairs, landings, guards and handrails, and other load supporting elements.
 - .6 **Section 07 84 00 – Firestopping:** Engineering Judgements for firestop and smoke seal assemblies.
 - .7 **Section 09 21 16 – Gypsum Board Assemblies:** Seismic restraints for bracing and anchorages of walls and ceilings.
 - .8 **Section 31 63 29 – Drilled Concrete Piles**
 - .9 Coordinate additional items with disciplines for items requiring delegated design submittals.

1.03 DEFINITIONS

- .1 The following definitions apply to the Delegated Design Submittals specification:
- .2 Delegated Design Professional Engineer: The professional engineer hired or contracted to the fabricator or manufacturer to design specialty elements, produce delegated design submittals and Shop Drawings to meet the requirements of the Project; who is registered in the province of the Work; and who is not the Consultant.
- .3 Letters of Commitment and Compliance: Documents prepared by the delegated design professional engineer as recommended by APEGA's Responsibilities for Engineering Services for Building Projects.
- .4 Engineering Judgement for Fire Rated Assembly Components: A written proposal submitted by manufacturer to the Authority Having Jurisdiction arising from a variation that modifies the manufacturer's standard listed assemblies and details to account for actual site conditions and as follows:
 - .1 Engineering Judgements are prepared by a certified specialist that has completed a sanctioned examination and has professional accreditation in the assemblies affected by site conditions different than those forming standard listed assemblies and details.
 - .2 Person issuing Engineering Judgement must be directly employed by the manufacturer and have direct experience in the preparation of Engineering Judgements required for the Project.
 - .3 Person signing the Engineering Judgement must be a Certified Fire Protection Specialist; Engineering Judgements do not require signature and seal of a professional engineer unless required by the Authority Having Jurisdiction.

1.02 SUBMITTALS

- .1 Provide required information in accordance with [Section 01 00 06 – General Requirements](#): Submittals.
- .2 Informational Submittals: Provide the following submittals during the course of the Work:
 - .1 Letter of Commitment: Submit a signed and sealed Letter of Commitment on company letterhead addressed to Consultant in accordance with format in Appendix A attached to the end of this Section prior to starting Work requiring design and seal of a professional engineer.

1.03 PROJECT CLOSEOUT SUBMISSIONS

- .1 Record Documentation: Submit the following required information in accordance with [Section 01 00 06 – General Requirements](#): Closeout Submissions before application for Substantial Performance of the Work:
 - .1 Letter of Compliance on company letterhead addressed to Consultant in accordance with format in Appendix B attached to the end of this Section on completion of Work requiring design and seal of a professional engineer.
 - .2 Engineering Judgements: Submit Product literature and compliance certificates as required by [Section 07 84 00](#) and include any required Engineering Judgements that became necessary to account for installation conditions that are different than tested assemblies.

2. PRODUCTS**2.01 DELEGATED DESIGN**

- .1 Performance and Design Criteria: Provide Products and systems complying with specific performance and design criteria indicated where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents.
- .2 Submit a written request for additional information to Consultant and Contractor if criteria indicated within documents are not sufficient for the Subcontractor to perform services or certification required.
- .3 Delegated design will be required for elements designed by a specialty professional engineer, which may include:
 - .1 Elements normally fabricated off-site
 - .2 Elements that require specialized fabrication equipment or a proprietary fabrication process not usually available at job site (for example: open web steel joists, wood trusses, combination wood and metal or plywood joists, prefabricated wood or metal buildings, noise and vibration isolation devices, elevators).
 - .3 Elements requiring engineering associated with fire protection or life safety, that are specifically assigned by architectural; structural; mechanical; or geotechnical disciplines of Consultant (for example: sprinkler system pipe sizing, permanently attached façade access equipment design).
 - .4 Elements requiring civil engineering, not normally a part of scope of services performed by architectural; structural; mechanical; electrical; or geotechnical disciplines of Consultant (for example: structural steel connection design, steel deck design).

3. EXECUTION**3.01 IMPLEMENTATION**

- .1 Include Summary of Work described in technical specification section as a part of the required Letter of Commitment.
- .2 Prepare required submittals and present to Consultant within sufficient time to allow for Consultant's detailed review and acceptance.

APPENDIX A

LETTER OF COMMITMENT – ALBERTA

Submit a signed and sealed [Letter of Assurance] [Letter of Commitment] on company letterhead in the form as follows:

[Date]

DIALOG®

[Consultant's Address]

Attention: [Consultant's Registered Professional's Name]

Re: Letter of Commitment for Delegated Design of [System of Component Work]

[NAME OF PROJECT]

[PROJECT NUMBER]

[CITY, PROVINCE]

As the retained registered professional engineer for design and field review of the above named component of Work and project, I hereby give assurance I am qualified to perform the following Work as required by Contract Documents:

1. [Prepare appropriate design documents for System or Component of Work];
2. Preparation of shop and erection documents;
3. Review fabrication [structural] [fire rated] [life and health safety] components;
4. Review erection [structural] [fire rated] [life and health safety] components.
5. [Modify list to suit System or Component of Work.]

I hereby give assurance I will be responsible for above noted Work described in Section [?????] – [Name of Section] of Project Manual including requirements of [Contract Documents] change orders and change directives.

I also undertake to be responsible for field review, fabrication and erection of [structural] [fire rated] [life and health safety] components as required to ascertain substantial compliance with the Building Code and Contract Documents.

I will notify you in writing if my responsibility is terminated at any time during the course of Work covered by this Letter of Commitment.

Retained Professional Engineer

Signature

Date

(APPLY SEAL)

APPENDIX B

LETTER OF COMPLIANCE – ALBERTA

[Date]

DIALOG®

[Consultant's Address]

Attention: [Consultant's Registered Professional Engineer]

Re: Letter of Compliance for Delegation of Design of [System of Components or Work]

[NAME OF PROJECT]

[PROJECT NUMBER]

[CITY, PROVINCE]

I hereby give assurance that I have fulfilled my obligations for field review as [outlined by previously submitted Letter of Commitment]

I hereby give assurance that aspects of [structural] [life and health safety] Work as defined by previously submitted Letter of Commitment substantially complies with Contract Documents and Building Code.

Retained Professional Engineer

Signature

Date

(Apply seal)

END OF SECTION

1. GENERAL**1.01 SUMMARY**

- .1 This section is included for the information of the Contractor and concrete Subcontractors so that they can coordinate their activities with the City's inspection and testing agency; costs for inspection and testing will be paid for by the City directly; Contractor and Subcontractors shall include coordination costs only, do not include any costs for actual inspection and testing.
- .2 Terms of reference for inspection and testing services for concrete work include:
 - .1 Inspection and testing agency is responsible for the review of concrete work and reporting compliance with the specified requirements.

1.02 RELATED REQUIREMENTS

- .1 Section 03 20 00 – Concrete Reinforcement: Reinforcement placed in structural concrete
- .2 Section 03 31 00 – Structural Concrete: Concrete inspection and testing related to structural concrete.
- .3 Section 03 33 00 – Architecturally Exposed Concrete
- .4 Section 03 45 00 – Precast Architectural Concrete
- .5 Section 31 08 10 – Geotechnical Inspection and Testing: Concrete forming a part of below grade structures.

1.03 REFERENCE STANDARDS

- .1 American Concrete Institute (ACI):
 - .1 ACI 311.4R-05, Guide for Concrete Inspection
 - .2 ACI CP-1-12, Technical Workbook for ACI Certification of Concrete Field Testing Technician – Grade I
 - .3 ACI CP19-12, Technician Workbook for ACI Certification of Concrete Strength Testing Technician
- .2 American Society for Testing and Materials (ASTM):
 - .1 ASTM C873/C873M-15, Standard Test Method for Compressive Strength of Concrete Cylinders Cast in Place in Cylindrical Molds
- .3 Canadian Standards Association (CSA):
 - .1 CAN/CSA A23.1-14, Concrete Materials and Methods of Concrete Construction
 - .2 CAN/CSA A23.2-14, Methods of Test for Concrete
 - .3 CSA A165 Series-14, CSA Standards on Concrete Masonry Units
 - .4 CSA A179-14, Mortar and Grout for Unit Masonry
 - .5 CSA A283-06 (R2016), Qualification Code for Concrete Testing Laboratories
 - .6 CSA A371-14, Masonry Construction for Buildings
- .4 Miscellaneous Applicable References:
 - .1 Alberta Building Code 2014
 - .2 Reviewed Concrete Mix Designs for Project

1.04 QUALITY ASSURANCE

- .1 Regulatory Requirements: Determine compressive strength of concrete as prescribed in CSA A23.1 and A23.2 based on 28 day test as required by 2014 Alberta Building Code.
- .2 Qualifications: Provide proof of qualifications when requested by City.
 - .1 Inspection and Testing Personnel: Confirmation that concrete inspection and testing agency and personnel are certified in accordance with CSA A283.
 - .2 Inspection and Testing Agency: Confirmation that inspection and testing agency is experienced in aspects of the required work described in this Section and as required by certification agency.
 - .3 Conflict of Interest: Statement indicating that inspection and testing agency is independent from the Contractor and concrete work Subcontractor.

2. PRODUCTS**2.01 REPORTS: GENERAL**

- .1 Provide inspection reports in accordance with Section 01 00 06 – General Requirements: Submittals, and Quality Control.
- .2 Review and provide comments and recommendations regarding the Contractor's mix designs when requested by the City.
- .3 Notify the City of noncompliant, or potentially noncompliant, workmanship or materials as soon as possible, but in any case, within one day of discovery.
- .4 Submit material test reports at regular intervals mutually agreed upon between the testing agency and the City, but no later than five (5) working days after completion of the test.
- .5 Upon completion of the Work requiring concrete inspection and testing, submit a final report summarizing previous reports, signed by the agency's inspector responsible for the testing and inspection program.
- .6 Submit copies of reports to the following:
 - .1 City
 - .2 Consultant
 - .3 Contractor
 - .4 Concrete Supplier
- .7 Prepare detailed monthly invoices addressed to the City and submitted for review.

2.02 REPORTS: CYLINDER TESTING

- .1 Cylinders of each individual batch of cylinders shall be identified by the letters A, B, C, and continuing in succession for the project, labelled with the suffix "L" for laboratory cured and "F" for site cured cylinders respectively.
- .2 Report test results of one (1) batch per form.
- .3 Include the following information for each report:
 - .1 Project Name, Contractor and Subcontractor
 - .2 Concrete Supplier
 - .3 Date and Time of Sampling
 - .4 Air Temperature at Time of Sampling
 - .5 Concrete Mix Design Identification

- .6 Exact location on the structure at which concrete is being placed
 - .7 Specimen Number
 - .8 Concrete Temperature
 - .9 Specified concrete strength
 - .10 Slump specified in mix design
 - .11 Slump, measured at point of discharge from the delivery vehicle, prior to addition of plasticizing agents
 - .12 Specified air content
 - .13 Measured air content
 - .14 Method of curing
 - .15 Test number
 - .16 Test date and age of cylinder
 - .17 Cylinder strength and test result
 - .18 Running average of three consecutive strength tests as defined by A23.1 for the class of concrete being tested
 - .19 Remarks regarding compliance
- .4 Store a carton of 12 cylinder moulds together with slump apparatus on site for use should a test be required when testing company inspector is not present; instruct Contractor or Subcontractor on use of moulds.

3. EXECUTION

3.01 INSPECTION: BATCH PLANT AND TRUCK MIXERS

- .1 Make occasional reviews of the concrete batching facility for inspection and reporting of the following:
- .1 Storage of materials
 - .2 Batching equipment and operation
 - .3 Condition and operation of truck mixers

3.02 INSPECTION: FRESH CONCRETE AT SITE

- .1 Inspection and testing agency will review delivery slips for appropriate mix for application and time expired between batching and beginning of placing the load.
- .2 Addition of water to truck mixers after leaving the plant is governed by the limitations of CSA A23.1 Clause 5.2.4.3.2; inspection and testing agency will notify the Contractor and City and Consultant about concrete that has had water added.
- .3 Fresh concrete will be considered deficient for the following reasons:
- .1 Allowable time from mixing has exceeded
 - .2 Water has been added beyond the limits of A23.1
 - .3 Measured slump not within limits specified in mix design
 - .4 Measured air content not within limits
 - .5 Incorrect mix design for scheduled placement
- .4 Notification of Deficient Concrete:
- .1 Inspection and testing agency will notify the Contractor and Subcontractor verbally and follow up with a written report submitted to Contractor, City and Subcontractor about concrete that is considered deficient and should not be placed.
 - .2 Inspection and testing agency will notify the City verbally and follow up with a written report about placed concrete considered deficient.

- .3 Inspection and testing agency will attend occasional site meetings as directed by the City to review inspection reports regarding quality control of concrete as it relates to the following:
 - .1 Mixing and delivery
 - .2 Conveying and depositing
 - .3 Consolidation and curing
 - .4 Installation and removal of formwork
 - .5 Re-shoring and protection of placed concrete

3.03 TESTING: GENERAL

- .1 Inspection and testing agency shall coordinate with the Subcontractor for notification requirements regarding the timing of testing and inspections.
- .2 Inspection and testing agency shall coordinate their activities with the Subcontractor and Contractor; be aware of the current work schedule and bring to the attention of the City any testing or inspection requirement apparently being overlooked.
- .3 Additional tests may be directed by the City, or requested by the Contractor or the Subcontractor with reference to accelerated strength prediction, cold weather concreting and removal of forms:
 - .1 Costs of tests requested by the City will be paid by the City.
 - .2 Costs of tests requested by the Contractor will be paid by the Contractor.
 - .3 Costs of tests requested by the Subcontractor will be paid for by the Subcontractor.
- .4 Inspection and testing agency will immediately inform the City where sufficient number of site visits is not clearly identified and make a recommendation for additional site visits as required to form an opinion as to the compliance of the work.
- .5 Inspection and testing agency will immediately inform the City where site conditions are such that a reduced program of testing and inspections is deemed appropriate to form an opinion as to the compliance of the work.
- .6 Re-Testing/Re-Inspecting:
 - .1 Provide quality control services, including re-testing and re-inspecting, for construction that revised or replaced Work that failed to comply with requirements established by the Contract Documents.
 - .2 Payment for costs arising from re-testing and re-inspections are the responsibility of the Contractor.

3.04 TESTING: MATERIALS

- .1 Test and report on cement, fine and coarse aggregates, mixing water and admixtures, as directed by the City.
- .2 Conduct tensile and bend tests on reinforcing steel as directed by the City.

3.05 TESTING: CONCRETE

- .1 Perform a complete test set for each 50 m³ of concrete, or fraction thereof, and in any event, not less than one test set for each type of concrete each day it is used.
- .2 Sampling of Concrete
 - .1 Sample concrete in accordance with CSA A23.2-1C.
 - .2 Sample concrete as close to the point of final deposit in the forms as is practicable.

-
- .3 Each test set shall consist of a slump test, air content test, temperature measurement, and not less than five (5) 100 mm x 200 mm cylinders for compression testing, all in accordance with A23.2-3C and as follows:
- .1 Test one (1) cylinder at seven (7) days, moist cured.
 - .2 Test two (2) cylinders at twenty-eight (28) days.
 - .3 Test two (2) additional cylinders if and when directed by the City.
 - .4 Contractor may elect to have testing agency make and test additional cylindrical specimens at other ages to assist in determining timing of formwork removal; costs of this additional testing shall be borne by Contractor.
- .4 Contractor may elect to have testing agency make and test additional cylindrical specimens at other ages to assist in determining timing of formwork removal; costs of this additional testing shall be borne by Contractor.
- .5 Conduct additional tests for air content as required by A23.2-4C or A23.2-7C.
- .6 Core tests, if required, shall be tested saturated, surface dry in accordance with CSA A23.1/A23.2; if core is taken from concrete that will remain dry during the life of the structure, the cores shall be tested air dry.
- .7 Provide Contractor with criteria for maintaining facilities for temporary storage of concrete test cylinders, review site curing of test cylinders and provide guidance to the Contractor regarding curing and storage procedures.

END OF SECTION

1. GENERAL

1.01 SUMMARY

- .1 This section includes requirements for design, supply and installation of concrete forming materials and accessories required for structural concrete

1.02 RELATED REQUIREMENTS

- .1 Section 03 20 00 – Concrete Reinforcing
- .2 Section 03 31 00 – Structural Concrete
- .3 Section 03 33 00 – Architecturally Exposed Concrete: Formwork for architectural finishes.
- .4 Section 03 35 00 – Concrete Finishing: Coordinate finish requirements for floor flatness, floor levelness and other formed and non-formed surfaces.
- .5 Section 03 45 00 – Precast Architectural Concrete
- .6 Section 07 84 00 – Firestopping: Placement of preformed firestopping and smoke seal materials in concrete formwork.
- .7 Section 07 92 00 – Joint Sealants
- .8 Section 08 44 26 – Point Supported Structural Curtain Wall Assemblies: Placement of anchor plates and embedded plates required for curtain wall framing support.
- .9 Section 31 63 29 – Drilled Concrete Piles

1.03 REFERENCE STANDARDS

- .1 Canadian Standards Association (CSA):
 - .1 CAN/CSA A23.1/A23.2-09, Concrete Materials and Methods of Concrete Construction
 - .2 CAN/CSA O86-09, Engineering Design in Wood
 - .3 CSA O121-08, Douglas Fir Plywood
 - .4 CSA O141-05 (R2009), Softwood Lumber
 - .5 CSA O151-09, Canadian Softwood Plywood
 - .6 CSA S269.1-1975 (R2003), Falsework for Construction Purposes
 - .7 CAN/CSA S269.3-M92 (R2013), Concrete Formwork

1.04 ADMINISTRATIVE REQUIREMENTS

- .1 Coordination: Consultant will require a meeting attended by Contractor, Subcontractor for work of this Section, and other work affected by this Section to coordinate the following requirements:
 - .1 Coordinate requirements of this Section with Section 03 33 00; architecturally exposed concrete that is placed as standard exposed concrete will be removed at no additional expense to the City.

1.05 QUALITY ASSURANCE

- .1 Regulatory Requirements: Design formwork materials, construction and removal in accordance with CSA A23.1/A23.2 and CSA S269.1 using anticipated construction gravity loads and lateral loads related to the rate of concrete placing in accordance with CSA O86.

2. PRODUCTS

2.01 MANUFACTURERS

- .1 Acceptable Materials Manufacturers: Subject to compliance with requirements specified in this Section; where multiple listings of manufacturers occur, use any of the following listed manufacturers' products in accordance with Section 01 00 06 – General Requirements: Substitutions and Product Options.
- .2 Substitutions: Consultant may consider additional manufacturers having similar products to Acceptable Materials Manufacturers listed above during the construction period, provided they meet the performance requirements established by the named products and provided they submit requests for substitution in accordance with Section 01 00 06 – General Requirements: Substitutions and Product Options before starting any work of this Section:
 - .1 Do not use substitute materials to establish Bid Price.
 - .2 Substitutions that appear as a part of the project without review and acceptance by the Consultant will be rejected, and replaced with one of the specified materials

2.02 FORMWORK MATERIALS

- .1 Plywood Form Liner: Use materials harvested under sustainable forestry practices and as follows:
 - .1 Exposed Concrete: Douglas Fir to CSA O121, COFI Form Plus, MDO Grade, T and G edge; minimum 19 mm thick.
 - .2 Unexposed Concrete: Canadian Softwood Plywood to CSA O151, SHG Grade, T and G edge; minimum 16 mm thick.
 - .3 Architecturally Exposed Concrete: Refer to Section 03 33 00 for architectural form liner requirements.
- .2 Formwork Lumber: Sanded plywood and solid lumber, free from defects, damage, residual concrete, and other deleterious materials, and using only new materials for exposed to view concrete, and as follows:
 - .1 Concrete without Special Architectural Features: Use wood and wood product formwork materials to CSA O121.
 - .2 Concrete with Special Architectural Features: Use formwork materials specified in Section 03 33 00.
- .3 Void Forms: Provide materials capable of providing temporary support for reinforcing placement and wet concrete loads, environmental effects and as follows:
 - .1 Type A; Below Walls, Grade Beams and Pile Caps: Expanded polystyrene compressible fill material having a compressive strength of not greater than 27 kPa at 5% deformation, and having a proven ability to displace loadings arising from frost or moisture movement of subgrade without damaging concrete materials:
 - .1 Acceptable Materials:
 - Beaver Plastics Frost Cushion Void Form System
 - Plasti-Fab GeoSpan Compressible Fill Material

- .2 Type B; Under Concrete Structural Slabs on Grade: Expanded polystyrene compressible fill materials having a compressive strength not greater than 27 kPa at 5% deformation, profiled to allow movement of soil into void form material and having a proven ability to displace loadings arising from frost or moisture movement of subgrade without damaging concrete materials:

.1 Acceptable Materials:

- Beaver Plastics Frost Cushion Void Form System
- Plasti-Fab GeoVoid Compressible Fill Material

- .4 Hardboard: To CAN/CGSB 11.3, Type 2, minimum density 500 kg/m³, tempered hardboard (Masonite), 6 mm nominal thickness, one face smooth finish, free from defects or damage deleterious to use and function.

2.03 ACCESSORY MATERIALS

- .1 Form Release Agent: Proprietary, non-volatile material that will not stain the concrete or impair the subsequent application of finishes or coatings to the surface of concrete, derived from agricultural sources, non-petroleum containing, low or no VOC material.
- .2 Sealant: Crack repair and construction joint sealant, as specified in Section 07 92 00.
- .3 Anchors and Fastening: Refer to Section 05 05 23 for post-installed anchor requirements.

2.04 FORM FABRICATION

- .1 Design forms in accordance with CSA O86.1 for the anticipated construction gravity loads and lateral loads related to the rate of concrete placing.
- .2 Construct forms of wood, metal, or any other approved materials, to produce concrete conforming to the shape, lines and dimensions shown on drawings and to prevent excessive mortar leakage.
- .3 Maintain formwork for re-use in such condition that the original standard of finish produced does not deteriorate.
- .4 Coordinate architectural formwork requirements with Section 03 33 00.
- .5 Provide temporary ports or openings, as required, to allow for cleaning and inspection.

3. EXECUTION

3.01 INSTALLATION

- .1 Formwork: Conform to tolerances described in CSA A23.1/A23.2; design forms to CSA O86.1 for the anticipated construction gravity loads and lateral loads related to the rate of concrete placing; modify tolerances for architecturally exposed concrete as listed in Section 03 33 00 and as follows:
- .1 Setting Embedded Assemblies: Set embedded assemblies accurately in locations and to elevations indicated on Drawings; survey measure critical areas and components that align with other construction.
- .2 Form Release Coatings: Coat forms with form release coating; apply before reinforcement and cast-in items are placed.
- .3 Exposed Corners: Form exposed corners of columns, beams and walls with square edged architectural corners, unless chamfers of other sizes are specifically indicated on drawings.
- .4 Review of Earthen Forms: Obtain Consultant's acceptance for use of earth forms; hand trim sides and bottoms and remove loose earth before placing concrete.

-
- .5 Reinforcing Templates: Construct templates and supports to rigidly fix reinforcing dowels and anchor rods in the forms prior to placing concrete.
 - .6 Cast-in Anchors: Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete; use setting drawings, templates, diagrams, instructions, and directions provided with items being embedded.
 - .2 Treatment of Tie Holes: Make exposed tie holes spaced on regular even grid at a spacing as shown on the Drawings.
 - .3 Formwork Removal and Re-shoring: Leave formwork in place for following minimum periods of time after placing concrete:
 - .1 2 days for walls and sides of beams.
 - .2 2 days for footings and abutments.
 - .3 Re-use formwork and falsework in accordance with requirements of CAN/CSA A23.1.
 - .4 Void Forms: Install polystyrene type void forms under perimeter grade beams on unfrozen soils; on levelled ground surface; and installed in accordance with manufacturer's written instructions.

END OF SECTION

1. GENERAL**1.01 SUMMARY**

- .1 Work of this Section forms a part of the sequence of construction associated with construction of the concrete slab and requires coordination for subgrade compaction, installation of depressurization layers and impermeable membranes, and procedures relating to installation of concrete slab.
- .2 This Section describes requirements for supply and installation of high puncture resistant plastic underslab soil gas impermeable vapour suppression membranes specifically manufactured for contact with ground under concrete slabs on grade, including installation of gas permeable depressurization layer and accessories required for a complete installation and describes the following:
 - .1 Contractor's responsibilities for quality management necessary to achieve design solutions based on performance values described in this Section.
 - .2 Contractor's responsibilities for development and implementation of quality management program to control installation procedures and repair membranes during construction.
 - .3 The City's responsibilities for third-party quality audit of installed system using a qualified C-NRPP Certified Mitigation Professional.

1.02 RELATED REQUIREMENTS

- .1 Section 03 20 00 – Concrete Reinforcing: Coordination of reinforcing steel supports having wide bearing base to reduce potential for puncturing under slab membrane materials.
- .2 Section 03 31 00 – Structural Concrete: Coordination for prevention of damage to under slab membrane materials during concrete placement, and coordination of concrete mix design compatible with placement over plastic membranes.
- .3 Section 07 92 00 – Joint Sealants: Edge of slab and penetration sealants, sealants forming a part of Vacuum Monitoring Point assemblies.
- .4 Section 20 05 10 – Mechanical Systems Pipe and Pipe Fittings: Schedule 40 PVC piping and pipe fittings for rough-in of underslab depressurization equipment.

1.03 REFERENCE STANDARDS

- .1 American Association of State and Highway Transportation Officials (AASHTO):
 - .1 AASHTO M288-15, Standard Specification for Geotextile Specification for Highway Applications
- .2 American Concrete Institute International (ACI):
 - .1 ACI 302.2R-06, Guide for Concrete Slabs that Receive Moisture-Sensitive Flooring Materials
- .3 American Society for Testing and Materials (ASTM International):
 - .1 ASTM A123/A123M-17, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
 - .2 ASTM A653/A653M-17, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
 - .3 ASTM C33/C33M-18, Standard Specification for Concrete Aggregates

- .4 ASTM C117-13, Standard Test method for Materials Finer than 75 µm (No. 200) Sieve in Mineral Aggregates by Washing
 - .5 ASTM C136/C136M-14 Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
 - .6 ASTM E154/E154-08a (2013)e1, Standard Test Methods for Water Vapor Retarders in Contact with Earth Under Concrete Slabs, Walls, or as Ground Cover
 - .7 ASTM D698-12e2, Standard Test Methods for Laboratory Compaction Characteristics of Soil using Standard Effort (600kn-m/m³)
 - .8 ASTM D882-18, Standard Test Method for Tensile Properties of Thin Plastic Sheeting
 - .9 ASTM D1709-16ae1, Standard Test Methods for Impact Resistance of Plastic Film by the Free-Falling Dart Method
 - .10 ASTM D1434-82 (2015)e1, Standard Test Method for Determining Gas Permeability Characteristics of Plastic Film and Sheeting
 - .11 ASTM D1785-15, Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80 and 120
 - .12 ASTM D2466-15, Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40
 - .13 ASTM D4355/D4355M-14, Standard Test Method for Deterioration of Geotextiles by Exposure to Light, Moisture and Heat in a Xenon Arc Type Apparatus
 - .14 ASTM D4491-99a, Standard Test Methods for Water Permeability of Geotextiles by Permittivity
 - .15 ASTM D4751-12, Standard Test Method for Determining Apparent Opening Size of a Geotextile
 - .16 ASTM D5821-13, Standard Test Method for Determining the Percentage of Fractured Particles in Coarse Aggregate
 - .17 ASTM E96/E96M-16, Standard Test Methods for Water Vapor Transmission of Materials
 - .18 ASTM E154/E154M-08a (2013) e1, Standard Test Methods for Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Walls, or as Ground Cover
 - .19 ASTM E1643-11, Standard Practice for Selection, Design, Installation and Inspection of Water Vapour Retarders used in Contact with Earth or Granular Fill under Concrete Slabs
 - .20 ASTM E1745-11, Standard Specification for Water Vapour Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs
 - .21 ASTM E1993/E1993M-98 (2013)e1, Standard Specification for Bituminous Water Vapor Retarders used in Contact with Soil or Granular Fill Under Concrete Slabs
 - .22 ASTM F1249-13, Standard Test Method for Water Vapor Transmission Rate through Plastic Film and Sheeting using a Modulated Infrared Sensor
 - .23 ASTM F1267-18, Standard Specification for Metal, Expanded, Steel
- .4 Canadian Association of Radon Scientists and Technologies (CARST):
- .1 Canadian National Radon Proficiency Program (C-NRPP)
- .5 Canadian Standards Association (CSA Group):
- .1 CAN/CSA A23.1/A23.2-09, Concrete Materials and Methods of Concrete Construction
 - .2 CSA G40.20-13/G4021-13 (R2018), General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel, including updates
- .6 Health Canada/Radiation Protection Bureau (HC):
- .1 Radon Infiltration Building Envelope Test System (RIBETS)
- .7 International Standards Organization (ISO):
- .1 ISO/TS 11665-13:2017, Measurement of Radioactivity in the Environment. Air:Radon 222. Determination of Diffusion Coefficient in Waterproof Materials: Membrane Two-Side Activity Concentration Test Method

1.04 ADMINISTRATIVE REQUIREMENTS

- .1 Contractor's Quality Management Program: Establish standardized approach to managing quality of materials and workmanship during execution of the work associated with installation of soil gas suppression membranes and radon mitigation system the building enclosure including the following:
 - .1 Quality Assurance: Activities, actions, corrective remedies and procedures performed before and during execution of the Work by the Contractor to protect against defects and deficiencies, and confirming that construction is consistent with specified regulatory and performance requirements, qualification statements and certification requirements listed within the Specification.
 - .2 Limitations: Quality management activities performed by the Contractor do not include contract administration and reporting performed by the Consultant or quality auditing activities performed by the City.
- .2 Quality Audit Program: Consultant will engage a third-party quality auditor in accordance with Section 01 00 06 - General Requirements: Quality Control to perform an observation and testing program to verify that specified performance requirements associated with the underslab soil gas suppression membrane and radon mitigation system are achieved as follows:
 - .1 Qualifications: Quality auditor will be a C-NRPP Certified Mitigation Professional having extensive experience with rough-in installation of radon mitigation systems of similar size and complexity required for the Project.
 - .2 Quality Auditor: Quality auditor will conduct observations of installed Products, and perform post-construction testing and related actions during and after execution of the Work to corroborate that activities described in the Contractor's quality management program complies with Specifications.
 - .3 Limitations: Quality audit activities are additional to the quality management activities performed by the Contractor and are not intended to repeat testing performed by the Contractor; quality auditor does not include contract administration and reporting performed by the Consultant.
- .3 Coordination: Coordinate delivery of specified materials to coincide with placement of underslab granular materials, prior to installation of reinforcing steel and concrete slab, and as follows:
 - .1 Concrete Slabs in Contact with Grade: Coordinate reinforced concrete slab with requirements described in Section 03 31 00 – Structural Concrete for the following requirements:
 - .1 Concrete Mix Design: Coordinate mix design to reduce quantity of cracks in slab, and reduce water content to account for impermeable membrane in direct contact with] concrete slab.
 - .2 Reinforcing Steel: Coordinate type of reinforcing steel carriers or chairs to distribute point loads and minimize the number of accidental penetrations and repairs to the impermeable membrane.
 - .3 Concrete Placement: Coordinate placement of concrete using methods that reduce potential for displacement or puncturing of the impermeable membrane.
 - .4 Sealants: Confirm sealant types and compatible with joint types and installation conditions for slab perimeter, around penetrations and openings to prevent soil gases from entering the building.
 - .2 Underslab Services: Coordinate placement of underslab utilities and other penetrations through impermeable membrane so that they are complete before installation of impermeable membrane and application of sealants and pre-manufactured transition boots.

- .3 Concealed Vacuum Monitoring Points (VPM): Coordinate with Section 08 31 00 – Access Doors and Panels for location of access panels within permanent framed wall construction; coordinate location of VPMs to confirm that they are installed at furthest point from extraction pits within each depressurization field.
- .4 Concealed Roughed-In Risers: Coordinate with Section 08 31 00 – Access Doors and Panels for location of access panels when risers are installed within permanent construction; coordinate location of a panels so they are located at riser connection point.
- .5 Protection of Installed Products: Performance of membranes and depressurization components is heavily dependent on quality of installation, resistance to damage after installation and integrity of sealants applied to penetrations through and perimeters of concrete slabs; enforce quality management program procedures to prevent puncturing, tearing, weakening or damaging of membranes during construction; and repair any damage occurring as work progresses:
- .4 Pre-Construction Meetings: Arrange for a pre-installation meeting to confirm installation methods and materials in accordance with Section 01 00 06 - General Requirements: Project Meetings, attended by Construction Manager, installing Subcontractor, Consultant and the City confirming the following:
 - .1 Critical Knowledge Session: Installation of soil gas suppression membrane and radon is critical to health and safety of future occupants of the building:
 - .1 Discuss the importance of installation of membrane components and the need to prevent punctures and gaps during installation.
 - .2 Discuss the need for diligence in repairing membranes during installation to maintain specified performance.
 - .2 Depressurization Layer: Confirm transmissivity and load bearing characteristics of Products proposed for use.
 - .3 Suction Pits: Confirm configuration, placement and quantity of suction pits based on Products proposed for use, and that are adjusted based on transmissivity of materials used for Project as directed by the Consultant.

1.05 SUBMITTALS

- .1 Provide required information in accordance with [Specifier Selection Required].
- .2 Action Submittals: Provide the following submittals before starting any work of this Section:
 - .1 Product Data: Submit copies of manufacturer's product literature indicating conformance with specified performance and life cycle requirements, technical information relating to specified materials, including listing of accessory materials required for complete installation and manufacturer's written installation instructions.
- .3 Informational Submittals: Submit the following:
 - .1 Contractor's Quality Management Plan: Submit quality management plan describing Contractor's responsible for work of this Section's approach to maintaining quality of installation and handling of specified products to maintain integrity of gas suppression membranes and radon mitigation systems; Contractor before starting work of this Section.
 - .2 Site Quality Control Reports: Submit as-built information describing actual products used, and listing any modifications that may have been required to account for site conditions encountered during installation and execution after completion.

1.06 DELIVERY, STORAGE, AND HANDLING

- .1 Delivery and Acceptance Requirements: Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly identifying product name and manufacturer.
- .2 Storage and Handling Requirements: Store materials in a clean, dry area in accordance with manufacturer's instructions; protect materials during handling and application to prevent damage or contamination.

1.07 WARRANTY

- .1 Perimeter Sealants: Provide sealant manufacturer's warranty covering repair and replacement of concrete slab perimeter sealants and penetration sealants arising from defects in installation and materials:
 - .1 Warranty Term: Two (2) years from date of Substantial Performance.
 - .2 Material Coverage: Replacement of defective materials, including labour to replace defective materials.
 - .3 Installation Coverage: Repairs for defective installation including cost of replacement materials and labour to replace defective materials.
 - .4 Scheduling of Warranty Repairs: Schedule warranty work to occur as soon as possible after defective conditions are identified, within a mutually agreed time between The City and the installing Subcontractor.

2. PRODUCTS**2.03 MANUFACTURERS**

- .1 Nominal Aggregate Descriptions: Aggregates described in this section are nominal, and indicate a gradation that establishes the expected performance of each layer of construction:
 - .1 Consultant recognizes that local availability, and pit sourcing of aggregates may require adjustment of void content, sieve sizing and percent passing by weight from gradations listed in the Specification when aggregates are used for depressurization layer.
 - .2 Quantity of suction pits will be adjusted when void content is lower than Consultant's design reference, and will be confirmed during pre-construction meeting described above.
- .2 Acceptable Product Manufacturers: Subject to compliance with requirements specified in this Section; where multiple listings of manufacturers occur, use any of the following listed manufacturers' products in accordance with Section 01 00 06 - General Requirements: Product Options including the following:
 - .1 Membrane Manufacturers:
 - .1 Stego Industries LLC
 - .2 W.R. Meadows
 - .2 Geo-Composite Manufacturers:
 - .2 GSE Environmental
 - .3 SKAPS Industries
 - .4 Tensar International Corp.
 - .3 Structural Foam Manufacturers:
 - .2 Plasti-Fab EPS Product Solutions

- .3 Substitutions: Consultant may consider additional manufacturers having similar products to Acceptable Products Manufacturers listed above during the construction period, provided they meet the performance requirements established by the named products and provided they submit requests for substitution in accordance with Section 01 00 06 - General Requirements: Substitutions before starting any work of this Section:

- .1 Do not use substitute materials to establish Bid Price.
- .2 Substitutions that appear as a part of the project without review and acceptance by the Consultant will be rejected, and replaced with one of the specified materials.

2.02 SYSTEM DESCRIPTION

- .2 System Performance Requirements: Products specified in this Section are required to control the ingress of soil gases such as water vapour, radon, carbon-dioxide, methane and other noxious gases that are deleterious to the health of building occupants:
- .1 System Compatibility: Use only Products that have proven compatibility with each other, following manufacturers written instructions and recommended products.
 - .2 System Rough-in: Contractor is only responsible for specified system rough-in components specified in this Section:
 - .2 Post Occupancy Testing: Post occupancy testing will be conducted by The City.
 - .3 System Activation: Conversion of system rough-in to active depressurization system will be conducted by The City when measurements of soil gases and radon show concentrations above prescribed safety limits.
 - .4 Responsibility for Activation: Installation of active depressurization components does not form a part of the Work of the Contract, and is the City's responsibility.

2.03 MATERIALS

- .2 Underslab Soil Gas Suppression Membrane and Radon Mitigation System: Products specified in this Section require subgrade preparation and installation of components comprised of the following layers to meet prescribed Building Code functional requirements for rough-in of the primary impermeable membrane and radon mitigation system:
- .1 Concrete Slabs in Contact with Grade: Refer to Section 03 31 00 – Structural Concrete.
 - .2 Impermeable Membrane: Soil gas suppression membrane installed in contact with underside of concrete slab.
 - .3 Depressurization Layer: Products comprised of:
 - .2 Clean, Coarse Aggregate.
 - .3 Premanufactured Geo-composite.
 - .4 Pre-Formed Structural Foam Ventilation Form.
 - .4 Grade Separation Geotextile: Geotextile fabric laid over compacted subgrade to prevent soil fines from entering granular depressurization layer.

2.04 IMPERMEABLE MEMBRANE

- .1 Premanufactured Impermeable Membranes: High density, puncture resistant co-extruded plastic sheet membrane purposely manufactured for contact with soil or granular fill under concrete slabs meeting specified performance requirements as follows:
- .1 Tensile Strength and Puncture Resistance: Minimum 7.9 N/m tensile strength and 2200 g puncture resistance in accordance with ASTM E1745 Class A.
 - .2 Water Vapour Permeance: Nominal 0.40 ng/Pa•s•m² (0.007 Perm) maximum in accordance with ASTM E1745 after conditioning.

- .3 Radon Permittivity: Maximum 9.9×10^{-12} m²/s in accordance with ISO/TS 11665, Method C (K124/02/95).
- .4 Methane Permeability: Maximum Gas Transmission Rate (GTR) nominal 150 mL/m²•day in accordance with ASTM D1434.
- .5 Thickness: Minimum 510 µm (20 mil) in accordance with CSA A23.1.
- .6 Acceptable Products:

- .1 Stego Wrap 20 Mil Vapor Barrier
- .2 WRM Perminator EVOH Gas Vapor Barrier

- .2 Membrane Continuity: Sealing tapes, membrane anchors and termination bars, sealants and accessories for use at membrane overlaps, termination to foundations, sealing around penetrations, and installation accessories required by manufacturer for installation forming a vapour and soil gas tight system in accordance with CAN/CSA A23.1 and ASTM E1643.

1.02 DEPRESSURIZATION LAYER

- Although the VMP can be installed when activation becomes necessary, it is easier and less expensive to install this component when placing the concrete slab.
- A minimum of one VMP is required for each depressurization field area, and must be placed at the furthest point away from the extraction pit (with extraction pit as close to centre of the floor plan as possible).
- Additional VMPs may be required where depressurization areas are transected by grade beams, with one VMP placed prior to the transection, and the next one placed at the furthest point within the area being transected.

- .1 Vacuum Monitoring Points (VMP): PVC plastic, Schedule 40 pipe, minimum 50 mm interior Ø x 300 mm long; joining adhesives and pipe fittings meeting requirements of ASTM D1785 and ASTM D2466, and as follows:
 - .1 Slotted VMP Pipe: Slotted piping section having a series of 2.5 mm slots spaced at approximately 8 mm o/c along the length of pipe.
 - .2 Pipe Caps: Solvent welded caps installed to each end of slotted suction pit pipe, nominal inside diameter matching outside diameter of suction pit pipe.
 - .3 Pressure Monitoring Tube: 9.5 mm outside Ø flexible polyethylene tubing sealed to top PVC cap x Length required to loop from under slab location and terminate above slab surface allowing for 600 mm of coiled tubing within access panel.
 - .4 Access Panel: Refer to Section 08 31 00 – Access Doors and Panels for access panels.
 - .5 Sealants: Compatible with materials and forming a permanent seal between differing materials, refer to Section 07 92 00 – Joint Sealants.
 - .6 Labelling: Permanent labels compatible with finishes applied to access panels containing the words RADON VACUUM MONITORING POINT.
- .2 Premanufactured Geo-Composite: Drainage composite comprised of three-planar drainage core covered with needle punched polypropylene geotextile fabric heat laminated to both faces of core and as follows:
 - .1 Thickness: Nominal 8 mm
 - .2 Load Rating: Nominal 100 MPa
 - .3 Transmissivity: Nominal 3.0 to 3.5×10^{-3} m²/s providing equivalent to 60% void content when compared to clean, coarse aggregate described above.
 - .4 Water Flow Rate: Nominal 3,600 to 3,800 L/m² (90 to 95 GPM/ft²)
 - .5 Crushed Gravel Layer: Crushed gravel having the following properties, when geo-composite materials are used instead of clean, coarse aggregate described above:
 - .1 Nominal Gradation: 25 mm to 0.08 mm with a minimum of 50% by weight being retained on 5 mm screen and at least one face resulting from fracture.

- .2 Crushed Faces: Minimum of 60% crushed on 2 faces 3 faces measured by particle mass in accordance with ASTM D5821.
- .3 Layer Thickness 150 mm to replace clean, coarse aggregate layer thickness described above.
- .6 Acceptable Products:
 - .1 GSE TenDrain 300 mil Geo-composite
 - .2 SKAPS TRANSNET HPDE Geo-composite with TN 270 GeoNet
 - .3 Tensar RoaDrain RD-7
- .3 Premanufactured Polystyrene Foam Depressurization System: Panelized underslab soil gas depressurization system having permanent continuously interconnected channels formed into moulded expanded polystyrene boards manufactured in accordance with CAN/ULC S701, Type 2, and as follows:
 - .1 Compressive Strength: 275 kPa Minimum at 10% Deformation
 - .2 Load Bearing Capacity: 25 kPa Maximum
 - .3 Soil Bearing Capacity (Compacted Subgrade): 100 kPa Minimum
 - .4 Void Content: Nominal 75% providing 0.6 m²/s transmissivity.
 - .5 Thickness: 100 mm
 - .6 Nominal Effective R_{SI}-Value: 1.8
 - .7 Basis-of-Design Products: Plasti-Fab Radon Guard PlastiSpan HD
- .4 Depressurization Layer Accessories: Provide accessory materials required for complete rough-in including the following:
 - .1 Suction Pit used with Geo-Composite Depressurization Layer: Aggregate filled depressurization pit, minimum 0.5 m³ granular volume, and as follows:
 - .2 Clean, Coarse Aggregate: Free draining, clean crushed aggregates containing minimal fines and organic content based on Alberta averages, based on similar properties to ASTM C33 or ASTM D448 Sieve #6 (19 mm to 9.5 mm) modified as follows:
 - .1 Crushed Faces: Minimum of 75% crushed on 3 faces measured by particle mass in accordance with ASTM D5821, with aggregates suitable for interlocking and structural stability as a working platform for subsequent construction.
 - .2 Void Content: Nominal 40% ±2%
 - .3 Layer Thickness: 150 mm providing nominal 1.5 x 10⁻⁴ m²/s transmissivity.
 - .4 Dry Rodded Density: Nominal 1550 to 1570 kg/m³
 - .5 Bulk Relative Density: Nominal 2.50 to 2.65
 - .6 Limitation for Aggregate Substitutions: High silt granular materials such as road-crush, pit-run gravel or stone-dust are not acceptable.
 - .3 Geotextile Pit Cover: As specified for grade separation geotextile specified below.
 - .4 Pre-fabricated Suction Pit: Welded steel angle framed, pre-fabricated suction pit, set-in-place on concrete pad having nominal minimum 0.3 m³ enclosed volume, and as follows:
 - .1 Steel Angles: In accordance with CSA G40.20/G40.21, Grade 300W, nominal 51 X 51 X 6 mm steel angle, galvanized after fabrication having Grade 100 (705 g/m²) zinc coating in accordance with ASTM A123.
 - .2 Depressurization Piping Access: Circular insert welded to mesh before galvanizing, sized to fit outside diameter of depressurization piping.
 - .3 Mesh Grade: Heavy duty, hot-dip post-galvanized, nominal 2 mm thickness with 25 mm x 9 mm nominal opening providing a minimum 60% open area in accordance with ASTM F1267, Type II, Class 2, Grade A.

- .4 Galvanized Steel Decking: Structural steel deck formed from nominal 35 mm profile, 1.3 mm (18 ga.) thickness, cold rolled sheet steel in accordance with CSA S136 and ASTM A653/A653M, Structural Steel (SS), Grade 230 having Z275 zinc coating.
- .5 Underslab Plastic Depressurization Piping: PVC plastic, Schedule 80 pipe, minimum 150 mm interior Ø; joining adhesives and pipe fittings meeting requirements of ASTM D1785 and ASTM D2466, installed as specified in Section 20 05 10 – Mechanical Systems Pipe and Pipe Fittings.
- .6 Above Slab Plastic Riser Piping: PVC plastic, Schedule 40 pipe, minimum 150 mm interior Ø; joining adhesives and pipe fittings meeting requirements of ASTM D1785 and ASTM D2466, installed as specified in Section 20 05 10 – Mechanical Systems Pipe and Pipe Fittings, and as follows:
 - .1 Pipe Cap: Solvent welded cap installed to top end of riser pipe, nominal inside diameter matching outside diameter of riser pipe.
 - .2 Pipe Identification Labels: Permanent labels compatible with pipe and pipe fittings containing the words SOIL GAS AND RADON EXTRACTION PIPE, spaced at 1800 mm o/c along the length of extraction Piping.
- .7 Grade Separation Geotextile: Woven geotextile fabric, manufactured specifically for grade separation applications from polyolefin or polyester and having elongation less than 50% in accordance with AASHTO M288 with a Class 2 survivability and as follows:
 - .1 Apparent Opening Size: Maximum 0.250 mm sieve, in accordance with ASTM D4751.
 - .2 Permittivity: Minimum 0.02 per second, in accordance with ASTM D4491.
 - .3 UV Stability: Minimum 50% after 500 hours exposure in accordance with ASTM D4355.
- .8 Concrete Slab Perimeter and Penetration Sealants: Sealants, applied after completion of concrete slab, refer to Section 07 92 00 – Joint Sealants.

2. EXECUTION

2.01 EXAMINATION

- .1 Verification of Conditions: Verify that base materials are placed level and compacted, and are acceptable to Consultant before starting installation of Products specified in this Section:
 - .1 Installation of Products specified in this Section will denote acceptance of site conditions.

2.02 PREPARATION

- .1 Subgrade Preparation: Prepare subgrade in accordance with Division 31 ready for installation of soil gas mitigation materials specified in this Section.
- .2 Foundation Preparation: Remove adhered mud and other substances deleterious to adhesion of membrane accessories to concrete foundation surfaces and utility penetrations.
- .3 Grade Separation Geotextile: Install grade separation geotextile in accordance with manufacturer's written instructions.

2.03 INSTALLATION

- .1 Clean, Coarse Aggregate Layer: Install aggregate layer on grade separation geotextile in a single lift to achieve thickness indicated on Drawings and compact into a stable working platform having a minimum 98% of maximum dry unit weight in accordance with ASTM D698.

- .2 Premanufactured Geo-Composite: Install premanufactured geo-composite on compacted subgrade in accordance with manufacturer's written installation instructions and cover with crushed gravel in a single lift to achieve thickness indicated on Drawings and compact into a stable working platform having a minimum 98% of maximum dry unit weight in accordance with ASTM D698.
- .3 Premanufactured Polystyrene Foam Depressurization System: Install premanufactured foam panels on compacted subgrade in accordance with manufacturer's written instructions.
- .4 Vacuum Monitoring Points: Install vacuum monitoring points at furthest distance from radon gas extraction pit to locations indicated on Drawings and as follows:
 - .1 Set slotted pipe into pit filled with clean, coarse aggregates specified in this Section, with top of pit in contact with depressurization layer.
 - .2 Protect polyethylene monitoring tube by wrapping with heavy weight polyethylene sheet to prevent damage during placement of adjacent materials and concrete slabs.
 - .3 Maintain protection of monitoring tube until enclosing construction is completed and access panel is installed.
 - .4 Consultant will confirm actual number of VMPs based on review of Sieve Analysis report before installation of gas impermeable membranes, and will instruct Contractor if additional monitoring points are required and will administer this using change process identified in the Contract.
- .5 Radon Gas Extraction Pit: Install radon gas extraction pit and roughed-in PVC depressurization piping to locations indicated on Drawings; where % Void Content of clean, coarse aggregates are within gradations described in this Section or as follows when gradations are less than required:
 - .1 Increased Pits: Numbers of radon gas extraction pits increases exponentially for each 5% reduction in granular Void Content.
 - .2 Decreased Pits: Numbers of radon gas extraction pits decreases exponentially for each 5% improvement in granular Void Content.
 - .3 Consultant will confirm actual number of radon gas extraction pits based on review of Sieve Analysis report before installation of gas impermeable membranes, and will instruct Contractor if addition or deletion of suction pits is required and will administer this using change process identified in the Contract.
- .6 Rough-In Soil Gas and Radon Extraction Piping: Install rough-in piping to locations indicated on Drawings as follows:
 - .1 Join piping using manufacturers recommended adhesives to provide gas tight joints.
 - .2 Cap open ends of rough-in piping and risers to prevent ingress of soil gases into occupied spaces.
 - .3 Apply permanent labels to risers indicating connection points; install labels on exterior face of access panels where riser pipes and vacuum monitoring points are contained within permanent construction.
- .7 Impermeable Membrane: Install membranes in accordance with manufacturer's written instructions and ASTM E1643, accounting for the following:
 - .1 Unroll membrane with the longest dimension parallel to direction of concrete placement.
 - .2 Install impermeable membrane on top of depressurization layer in direct contact with concrete slab and as follows:
 - .1 Membrane Continuity: Overlap edges, apply seam tape and seal penetrations to form a continuous membrane, and prevent bleed water and paste from concrete placement reducing effectiveness of the depressurization layer.

- .2 Membrane Termination: Adhere edges of membrane to face of grade beam to form continuous connection to impervious building elements.
- .3 Seal penetrations including pipe and conduit risers in accordance with manufacturer's written instructions.
- .4 Make no additional penetrations except as required for placing of reinforcing steel and permanent utilities.
- .8 Impermeable Membrane Repairs during Installation: Repair damaged areas by cutting patches of membrane; sized to overlap damaged area a minimum of 150 mm to each side of puncture; and tape all sides using manufacturer's required tape or patching materials.
- .9 Concrete Slabs: Install concrete slabs in accordance with Section 03 31 00 – Structural Concrete after Consultant has reviewed and accepted installed gas suppression membranes and depressurization components.
- .10 Sealants: Install sealants in accordance with Section 07 92 00 – Joint Sealants to full perimeter of floor between slab edge and foundation, full circumference of penetrations through the slab, and joints between separately installed floor slabs to maintain effective seal against ingress of soil gases and radon.

2.04 SITE QUALITY CONTROL

- .1 Contractor's Quality Management Activities: Conduct activities described in Quality Management Program and prepare a final report verifying materials used, extensive repairs or modifications to installation arising from site conditions confirming that installed soil gas suppression membranes and radon mitigation systems were installed in accordance with performance requirements described in this Section.
- .2 Consultant's Quality Auditor Activities: Quality auditor will perform three (3) site reviews to observe installation of system components and rough-ins as follows:
 - .1 Reporting: Quality auditor will document their activities and include photographs of observed conditions; reports will be submitted to The City, Consultant and Contractor after each site review.
 - .2 First Review: Quality auditor will review and provide written confirmation that materials delivered to site meet performance requirements for work described in this Section.
 - .3 Second Review: Quality auditor will review and provide written confirmation that installation of suction pits, depressurization layers, impermeable membranes and accessory are consistent with achieving the performance requirements for work described in this Section.
 - .4 Third Review: Quality auditor will conduct leakage test after installation of membrane and repairs, prior to placement of concrete slab to confirm that impermeable membrane is continuous and free from punctures having potential to allow soil gases and radon into the building. Quality auditor will review and document installation of sealants at perimeter of slab and slab penetrations, and capping and labelling of roughed-in riser pipes after installation of concrete slab.
- .3 Consultant's Activities: Consultant will review information and provide instructions to Contractor if installation is deficient or deleterious site conditions are observed and reported on by the quality auditor.

END OF SECTION

1. GENERAL**1.01 RELATED REQUIREMENTS**

- .1 Section 03 08 30 – Concrete Inspection and Testing
- .2 Section 03 11 00 – Concrete Forming and Accessories
- .3 Section 03 31 00 – Structural Concrete
- .4 Section 31 63 29 – Drilled Concrete Piles

1.02 REFERENCE STANDARDS

- .1 American Society for Testing and Materials (ASTM):
 - .1 ASTM A955/A955M-17a, Standard Specification for Deformed and Plain Stainless-Steel Bars for Concrete Reinforcement
 - .2 ASTM A1064/A1064M-13, Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.
- .2 Canadian Standards Association (CSA):
 - .1 CSA A23.1-14/A23.2-14, Concrete Materials and Methods of Concrete Construction / Test Methods and Standard Practices for Concrete
 - .2 CSA A23.3-14, Design of Concrete Structures
 - .3 CSA G30.18-09 (R2014), Carbon Steel Bars for Concrete Reinforcement
 - .4 CSA W47.1-09 (R2014), Certification of Companies for Fusion Welding of Steel
 - .5 CSA W59-13, Welded Steel Construction (Metal Arc Welding)
 - .6 CSA W186-M1990 (R2016), Welding of Reinforcing Bars in Reinforced Concrete Construction
- .3 International Organization for Standardization (ISO):
 - .1 ISO/IEC 17025:2005, General Requirements for the Competence of Testing and Calibration Laboratories
- .4 Reinforcing Steel Institute of Canada (RSIC):
 - .1 RSIC Manual of Standard Practice

1.03 SUBMITTALS

- .1 Provide required information in accordance with Section 01 00 06 – General Requirements: Submittals.
- .2 Action Submittals: Provide the following submittals before starting any work of this Section:
 - .1 Shop Drawings: Submit shop drawings conforming to CSA A23.1/A23.2 and RSIC Manual of Standard Practice, consisting of bending, cutting and placing drawings for reinforcing steel, and as follows:
 - .1 Prepare shop drawings such that all reinforcement can be carried out without reference to the Structural Drawings.
 - .2 Indicate concrete cover to reinforcing.
 - .3 Indicate bar bending details, lists, and placing drawings including but not limited to sizes, spacing, lengths, location and quantities of reinforcement, splices and laps, and mechanical connections, with identifying code marks to permit correct placement, spacing and location of spacers and hangers.

- .4 Indicate each type of reinforcement support and spacing accessory. Reinforcement estimates provided on the drawings do not include the weights of these support bars.
- .5 Indicate stirrup spacing, bent bar diagrams, bar arrangement tie spacing, hoop spacing, and supports for concrete reinforcement.
- .6 Indicate splicing details, and include manufacturer's product data where mechanical splicing systems are proposed for use on project stating type and performance of each type of system proposed for use.
- .7 Indicate construction joint locations, coordinated with the Contractor's concrete pour plan. Detail reinforcement to suit proposed joint locations, including additional bars at joints when specified on Drawings.
- .2 Submit a written report confirming that the reinforcing steel has been placed properly for each concrete pour, prior to the Consultant's general review. The Consultant's review is non-exhaustive and does not relieve the Contractor or Subcontractor of their responsibilities.
- .3 Certificates: Submit copies of welding certificates applicable to welding procedures and personnel.

1.04 QUALITY ASSURANCE

- .1 Regulatory Requirements: Design and detail lap lengths and bar development lengths in accordance with CSA A23.1/A23.2.
- .2 Fabrication: Fabricate reinforcement, placement and support in accordance with CSA A23.1/A23.2.
- .3 Welding: Qualify procedures and personnel according to the following:
 - .1 Welders shall be qualified by Canadian Welding Bureau for classification of work being performed.
 - .2 The fabricator and welder companies shall be certified to CSA W47.1, Division 1 or 2.
 - .3 Fusion welding procedures in accordance with CSA W59.

1.05 DELIVERY, STORAGE AND HANDLING

- .1 Delivery and Acceptance Requirements: Deliver, store, and handle steel reinforcement to prevent bending and damage; avoid damaging coatings on steel reinforcement.
- .2 Deliver bundles reinforcement, clearly identified in accordance with bar bending details and lists.
- .3 Provide adequate blocking between stacked bundles of straight to prevent contact between the layers of bundles.
- .4 Unprotected on-site storage of reinforcement shall not exceed 30 Days and total on-site storage time shall not exceed 120 Days.
- .5 When protection is required, cover reinforcement with opaque polyethylene sheeting or other equivalent protective material. For stacked bundles, the protective covering shall be draped over the sides of the bundles around the perimeter of the stack. Secure the covering with provisions for adequate air circulation around the bars to prevent condensation under the protective covering.
- .6 Store reinforcement in a manner to prevent rusting that can affect the bonding capacity of the reinforcement as described in CSA A23.1 6.1.6.2. Remove rust, mud, grease, oil or other bond breaking coatings from reinforcement prior to pouring concrete.

2. PRODUCTS

2.01 MATERIALS

- .1 Reinforcing Bars: Deformed steel bars meeting requirements of CSA G30.18, Grade 400 W.
- .2 Supports: To CSA A23.1/A23.2, wire chairs, bolsters, reinforcing bars, precast concrete blocks and plastic spacers.
 - .1 Basis-of-Design Materials: Dayton-Superior.
 - .2 Supports shall have sufficient strength, stability and stiffness to carry the loads from the reinforcement, construction crew, and concreting pressures without failure, displacement, or significant deformation.
 - .3 Precast concrete bar supports to CSA A23.1 / A23.2 with a quality and strength equal to or greater than that specified for the member in which they are used.
 - .4 Reinforcing bars to CSA G30.18, with a size not less than 15M.
- .3 Tie Wire: 1.5mm diameter annealed wire, coated when using coated reinforcement.

2.02 REINFORCEMENT ACCESSORIES

- .1 Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place. Supports shall have sufficient strength and stiffness to carry the loads from the reinforcement, construction crew, and concreting pressures without failure, displacement, or significant deformation.
 - .1 Manufacture bar supports from steel wire, plastic, or precast concrete according to RSIC's Manual of Standard Practice, of greater compressive strength than concrete and as follows:
 - .2 Space bar supports so that any sagging between supports will not reduce the specified concrete cover significantly. Refer to CSA A23.1 6.6.8.
 - .3 Use plastic protected steel wire or stainless steel bar supports for concrete surfaces exposed to view where legs of wire bar supports contact forms. Use bar supports that minimize contact with the forms. Steel wire supports are not permitted for slabs with exterior exposure.

2.03 FABRICATION

- .1 Fabricate reinforcing as directed in CSA A23.1/A23.2.
- .2 Weld in accordance with CSA W186.
- .3 Obtain Consultant's approval for locations of reinforcement splices other than shown on steel placing drawings.
- .4 Prepare bundles of bar reinforcement for shipping with marks, clearly identified in accordance with bar bending details and lists.

3. EXECUTION

3.01 PREPARATION

- .1 Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials detrimental to bond with concrete.
- .2 Detailing: Conform to CSA A23.1/A23.2 and CSA A23.3 for all hooks, bends, laps and similar details not specifically shown on Drawings and as follows:
 - .1 Support bars generally are not shown in the drawings; any reinforcement estimates provided on the drawings do not include the weight of support bars.

- .2 Locate chairs for reinforcing at a maximum of 1200 mm centres; secure chairs in place to prevent displacement during placing of concrete.

3.02 INSTALLATION

- .1 Place reinforcing steel as indicated on reviewed placing drawings and in accordance with CSA A23.1/A23.2; place bars accurately, with no bends or kinks other than those called for.
- .2 Accurately position, support, and secure reinforcement against displacement; locate and support reinforcement with bar supports to maintain minimum concrete cover; do not tack weld crossing reinforcing bars
- .3 Weld reinforcing bars according to CSA W186 requirements.
- .4 Provide side spacers for all vertical and steeply sloping forms, such as for columns and walls, to secure the reinforcement against displacement and maintain the specified cover.
- .5 Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.
- .6 Site Bending: Do not site bend reinforcement except where indicated or accepted by Consultant:
 - .1 When site bending is accepted or indicated on Drawings, bend without heat, applying a slow and steady pressure.
 - .2 Use designation 'W' reinforcing bars when bending is required.
 - .3 Replace bars that develop cracks or splits.
- .7 Where parallel reinforcement is placed in two or more layers, place bars in the upper layer directly above those in the bottom layer, unless otherwise permitted by the Consultant.
- .8 Do not bundle bars, unless specifically shown on the Drawings.
- .9 Position of reinforcing steel takes precedence over position of conduit or piping. Do not cut reinforcing to accommodate conduit or piping without permission from Consultant.
- .10 Do not cut or puncture vapour retarder; repair damage and reseal vapour retarder before placing concrete:
- .11 Before placing concrete, remove all dirt, oil or other coatings from reinforcing that could reduce the bond
- .12 Lifting of reinforcement bars or welded wire reinforcement into position during a pour is not permitted. Provide bar supports in all instances.
- .13 Place reinforcement conforming with tolerance listed in CSA A23.1 6.6.8.

3.03 SITE QUALITY CONTROL

- .1 Reinforcement Review: The Consultant's general review, and any testing and inspection by independent testing agencies retained by the City, are undertaken to inform the City of the Contractor's performance, and in no way shall replace the Contractor's quality control procedures or relieve him of his contractual responsibility:
 - .1 Review the placement, positioning, quantity and sizing of reinforcement for conformance with the Structural Drawings and the Subcontractor's shop drawings.
 - .2 Submit a written report confirming that the reinforcing steel has been placed properly for each concrete pour, prior to the Consultant's general review. The Consultant's review is non-exhaustive and does not relieve the Contractor or Subcontractor of their responsibilities.
 - .3 Advise the Consultant a minimum of 24 hours prior to the placement of concrete. Failure to give adequate notice may cause the Consultant to classify the work as defective.

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- .4 Field reviews of reinforcement is part of the Consultant's responsibilities to the Authority Having Jurisdiction. Do not place concrete until reinforcement and its placement has been inspected by the Contractor's quality control representative and by the Consultant.
 - .5 Correct defects and irregularities to the satisfaction of the Consultant, at no cost to the City. Budget sufficient time for the Consultant to review corrections in reinforcement prior to the placement of concrete.
 - .6 If required by the Consultant, provide samples of reinforcing steel, at no charge to the City, from the project site for destructive testing by an independent agency.

END OF SECTION

1. GENERAL

1.01 RELATED REQUIREMENTS

- .1 Section 03 08 30 – Concrete Inspection and Testing
- .2 Section 03 11 00 – Concrete Forming and Accessories
- .3 Section 03 20 00 – Concrete Reinforcing: Requirements for reinforcing steel
- .4 Section 03 33 00 – Architecturally Exposed Concrete: Concrete for architectural finishes.
- .5 Section 03 35 00 – Concrete Finishing: Coordinate finish requirements for floor flatness, floor levelness and other formed and non-formed surfaces; applied levellers, densifiers, sealers.
- .6 Section 07 92 00 – Joint Sealants: Requirements for installation of sealants and joint fillers in movement and control joints.
- .7 Section 08 44 26 – Point Supported Structural Aluminum Curtain Walls: Placement of anchor plates and embed plates required for curtain wall support.
- .8 Section 09 30 00 – Tiling: Coordination and requirements for tile sinkages and sloped flooring.
- .9 Section 31 63 29 – Drilled Concrete Piles

1.02 DEFINITIONS

- .1 The following definitions apply to the Structural Concrete specification:
- .2 Delegated Design Professional Engineer: Professional engineer hired or contracted to Contractor or Subcontractor to produce delegated design submittals to meet requirements of the Project, and registered in the province of the Work, and who is not the Consultant; also refer to Section 01 33 50.
- .3 Workability: The term Workability broadly describes the total properties and expectations for concrete delivered to site as follows:
 - .1 Individual tested properties of concrete that account for confined or free flow slump, penetration, compaction, or relative plasticity of various concrete mix designs used for the project
 - .2 Overall properties involved with mixing, handling, transportation, and placement using vibratory compaction methods without loss of homogeneity of in-place concrete.

1.03 REFERENCE STANDARDS

- .1 American Concrete Institute International (ACI):
 - .1 ACI CP-1(13), Technical Workbook for ACI Certification of Concrete Field Testing Technician-Grade 1
 - .2 ACI Manual of Concrete Practice including the following:
 - .1 ACI 303R-12, Guide to Cast-in-Place Architectural Concrete Practice
 - .2 ACI 303.1R-97, Standard Specification for Cast-In-Place Architectural Concrete
- .2 American Society for Testing and Materials (ASTM):
 - .1 ASTM C33/C33M-13, Standard Specification for Concrete Aggregates
 - .2 ASTM C171-07, Standard Specification for Sheet Materials for Curing Concrete
 - .3 ASTM C260-10a, Standard Specification for Air-Entraining Admixtures for Concrete

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- .4 ASTM C295/C295M-12, Standard Guide for Petrographic Examination of Aggregates for Concrete
 - .5 ASTM C309-11, Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
 - .6 ASTM C494/C494M-13, Standard Specification for Chemical Admixtures for Concrete
 - .7 ASTM C618-12a, Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
 - .8 ASTM C881/C881M-10, Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete
 - .9 ASTM C1059/C1059M-99(2008), Standard Specification for Latex Agents for Bonding Fresh to Hardened Concrete
 - .10 ASTM D1752-04a (2008), Standard Specification for Preformed Sponge Rubber Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction
 - .11 ASTM E154-08a (2013)e1, Standard Test Methods for Water Vapour Retarders Used in Contact with Earth Under Concrete Slabs, on Walls, or as Ground Cover
 - .12 ASTM E1155-96 (2008), Standard Test Method for Determining FF Floor Flatness and FL Floor Levelness Numbers
 - .13 ASTM E1643-11 Standard Practice for Selection, Design, Installation and Inspection of Water Vapor Retarders used in Contact with Earth or Granular Fill under Concrete Slabs
 - .14 ASTM E1745-11, Standard Specification for Plastic Water Vapour Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs
- .3 Canadian Standards Association (CSA):
 - .1 CAN/CSA A23.1-09/A23.2-09, Concrete Materials and Methods of Concrete Construction/Test Methods and Standard Practices for Concrete
 - .2 CAN/CSA A23.3-04 (R2010), Design of Concrete Structures
 - .3 CAN/CSA A3000-08, Cementitious Materials Compendium (Consists of A3001, A3002, A3003, A3004 and A3005)
 - .4 CSA W186-M1990 (R2012), Welding of Reinforcing Bars in Reinforced Concrete Construction
 - .4 Ontario General Contractors Association/Ready Mixed Concrete Association of Ontario (OGCA/RMCAO):
 - .1 Best Practices Guidelines for Concrete Construction
- 1.04 ADMINISTRATIVE REQUIREMENTS
- .1 Delegated Design: Retain Delegated Design Professional Engineer to determine mix design complying with the requirements of the Building Code and the Contract Documents and as follows:
 - .1 Certify that mix design for each type of concrete will produce specified properties.
 - .2 Certify that plant, equipment and materials used in concrete comply with requirements of CSA A23.1.
 - .3 Include alternate mix designs when characteristics of materials, project conditions, weather, test results, or other circumstances warrant adjustments.
 - .2 Pre-Construction Meeting: Conduct pre-construction and pre-placement meetings at project site in accordance with Section 01 00 06 – General Requirements: Project Meetings following recommendations for meeting attendees and topics listed in OGCA/RMCOA Best Practices Guidelines for Concrete Construction.

1.05 SUBMITTALS

- .1 Provide required information in accordance with Section 01 00 06 – General Requirements: Submittals.
- .2 Informational Submittals: Provide the following when requested by the Consultant:
 - .1 Mix Design: Submit copies of design mixes for each concrete mix required for the project, signed and sealed by Delegated Design Professional Engineer, to the Prime Consultant, the City, the Contractor, the Engineer of Record (if different from the Prime Consultant), and the Testing Agency.
 - .2 Quality Plan: Submit Quality Plans prepared by Contractor, concrete supplier, and concrete installer according to CSA A23.1, Annex J.
 - .3 Material Certificates: Submit certificates prepared by an approved testing agency indicating that concrete materials comply with requirements of CSA A23.1/A23.2 and CSA A3000 and requirements of this specification and the Drawings before commencing any work and when any change in materials or source of supply is proposed.
 - .4 Source Quality Control Submittals:
 - .1 Mix Design: Submit five (5) copies of design mixes for each concrete mix required for the project; design mix will be distributed to the Prime Consultant, the City, the Contractor, the Engineer of Record (if different from the Prime Consultant), and the inspection and testing agency.

1.06 QUALITY ASSURANCE

- .1 Regulatory Requirements: Provide materials and workmanship conforming to CAN/CSA A23.1/A23.2 and CSA A3000, including the following, unless modified by the requirements of the Contract Documents:
 - .1 General requirements, submittals, quality assurance documents
 - .2 Acceptance of structure, and protection of in-place concrete
 - .3 Formwork and form accessories
 - .4 Steel reinforcement and supports
 - .5 Concrete mixtures
 - .6 Handling, placing, and constructing concrete
- .2 Qualifications: Provide proof of qualifications when requested by Consultant:
 - .1 Installer: Use an experienced installer who has completed concrete Work similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.
 - .2 Delegated Design Professional Engineer: Retain a professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in ascertaining mix design and supplementary cement mixtures similar to those indicated for this Project.
 - .3 Manufacturer: A firm experienced in manufacturing ready-mixed concrete products complying with CSA A23.1, CSA A23.2 and CSA A3000 requirements for production facilities and equipment.
 - .4 Inspection and Testing Agency Qualifications: An independent testing agency, acceptable to authorities having jurisdiction and Consultant, qualified according to CSA A23.1, CSA A23.2 and CSA C3000 to conduct the testing indicated:
 - .1 Personnel conducting site tests shall be a qualified Concrete Site Testing Technician, Grade 1, in accordance with ACI CP-1 or an equivalent certification program.

- .5 Source Limitations: Obtain each type or class of cementing material of the same brand from the same manufacturer's plant, each aggregate from one source, and each admixture from the same manufacturer.
- .6 Welding: Qualify procedures and personnel in accordance with Section 03 20 00.
 - 1.

2. PRODUCTS

2.01 MATERIALS

- .1 Cement Type: In accordance with CSA A23.1, and as specified on the Drawings.
- .2 Fly Ash: Pozzolanic admixture meeting requirements of CSA A3001, Type CI or F, added in quantities required to meet specified concrete performance properties and as follows:
 - .1 Adjust mix design and curing regime to meet CSA A23.1 requirements for concrete made with high volume supplementary cementing materials (HVSCM).
- .3 Concrete Admixtures: Certified by manufacturer to contain water soluble chloride ions that are not detrimental to concrete durability indicated by mass of cementing material and that are compatible with other admixtures and cementing materials as follows:
 - .1 Notify Consultant in advance of mix design submission where calcium chloride containing admixtures are being proposed for use on the project; submit proof that concrete will not be damaged or have other deleterious effects by inclusion of these admixtures.
 - .2 Air Entraining Admixture: CAN/CSA A23.1/A23.2 and ASTM C260.
 - .3 High Range, Water Reducing Admixture: ASTM C494, Type F.
- .4 Water: Meeting requirements of CSA A23.1/A23.2.
- .5 Aggregate: Meeting requirements of CSA A23.1/A23.2, containing no shale, and as follows:
 - .1 Normal Density Fine Aggregate: Nominal maximum aggregate size in accordance with CSA A23.2-1A, uniformly graded to maintain Workability and control water bleed out, as indicated on Drawings.
 - .2 Normal Density Coarse Aggregate: Aggregate selected from Group I or Group II Grading Classifications, to suit design mix, in accordance with CSA A23.2-13A, nominal maximum aggregate sizes and applications as indicated on Drawings.
 - .3 Ironstone content of aggregates in exposed interior or exterior concrete subject to intermittent or continuous wetting shall not exceed the following, when tested to ASTM C295-90:
 - .1 Coarse Aggregate: maximum 1% by mass
 - .2 Fine Aggregate Retained on 2.5 mm Sieve: maximum 1.5% by mass

2.02 ACCESSORY MATERIALS

- .1 Concrete Bonding Agents: Not permitted unless reviewed by Consultant.
- .2 Joint Filler Strips:
 - .1 Floor Isolation Joints: ASTM D1751, bituminous impregnated fibreboard, or ASTM D1752, cork or self-expanding cork, 13 mm thick minimum.
 - .2 Edge Joint Filler: ASTM D1751, bituminous impregnated fibreboard, 13 mm thick minimum.
 - .3 Joint Sealants Filler: Refer to Section 07 92 00 for resilient joint fillers and sealants for movement, expansion and control joints.

.3 Sealants:

- .1 Control Joint Sealant: As specified in Section 07 92 00.
- .2 Saw Cut Sealant: As specified in Section 07 92 00.
- .3 Backing Rod: As specified in Section 07 92 00.

2.03 CURING MATERIALS

.1 Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete for temporary protection during hot, dry and windy conditions:

- .1 Submit to Consultant for review prior to use.

.2 Moist Curing Aids:

- .1 Absorptive Cover: AASHTO M182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 305 g/m² dry.
- .2 Moisture-Retaining Cover: ASTM C171, polyethylene film or white burlap-polyethylene sheet.
- .3 Water: Potable.

2.04 VAPOUR RETARDERS

.1 Plastic Sheet Moisture Suppression Membrane: Plastic sheet in accordance with ASTM E1745; include manufacturer's recommended seam tape, pipe boots and vapour proofing mastic forming a complete system in accordance with ASTM E1643.

2.05 REPAIR MATERIALS

.1 Repair Underlayment for areas to receive finish flooring: Cement based, polymer modified, self levelling product that can be applied in thicknesses from 3 mm and that can be feathered at edges to match adjacent floor elevations:

- .1 Cement Binder: Portland cement or hydraulic or blended hydraulic cement as defined in CSA A3000.
- .2 Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
- .3 Aggregate: Well graded, washed gravel, 1.5 mm to 3 mm Ø or coarse sand as recommended by underlayment manufacturer.
- .4 Compressive Strength: Not less than 30 MPa at 28 days when tested according to CSA A23.1/A23.2.

.2 Repair Topping (for areas not receiving finish flooring): Traffic bearing, cement based, polymer modified, self levelling product that can be applied in thicknesses from 6 mm:

- .1 Cement Binder: Portland cement or hydraulic or blended hydraulic cement as defined in CSA A3000.
- .2 Primer: Product of topping manufacturer recommended for substrate, conditions, and application.
- .3 Aggregate: Well graded, washed gravel, 3 mm to 6 mm Ø or coarse sand as recommended by topping manufacturer.
- .4 Compressive Strength: Not less than 40 MPa at 28 days when tested according to CSA A23.1/A23.2.

2.06 CONCRETE MIX DESIGN

.1 Design ready-mix concrete conforming to CSA A23.1/A23.2, and to achieve performance properties contained in table located on Drawings.

- .2 Select mix designs based on historical test data or trial batches that statistically demonstrate conformance to the specified requirements.
- .3 Indicate amounts of mix water to be withheld for later addition at Project site
- .4 Site mix concrete is permitted for placements not exceeding 1 m³ and for core filling of non-load bearing masonry and bond beams.
- .5 Maximum slump may be increased beyond specified range by the use of chemical admixtures subject to prior written acceptance by Consultant.
- .6 Air content range and slump shall be verified at the point of discharge from the delivery equipment, measured prior to addition of plasticizing agents.
- .7 Add an air entraining admixture to all concrete exposed to the weather or in contact with the ground, producing entrained air in accordance with CSA A23.1, Table 4; air entraining admixture is not required for interior slabs on grade.
- .8 Obtain Consultant's approval before using chemical admixtures other than those specified in this Section.
- .9 Do not use chloride-based setting accelerators.

3. EXECUTION

3.01 EXAMINATION

- .1 Project Conditions: Verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed prior to placing concrete.
- .2 All reinforcing must be in place and reviewed by Contractor and Subcontractor's quality control representative before placing concrete; completeness of reinforcing is the responsibility of the Contractor.

3.02 CONCRETE PLACING: GENERAL

- .1 Place concrete to CSA A23.1/A23.2 and as further described in this Section.
- .2 Provide Consultant a minimum of 24 hours notice of intention to place concrete.
- .3 In preparation for placing concrete, remove all sawdust, debris, ice and snow from interior of forms, and clean reinforcing steel of form release agent.
- .4 Do not add water to concrete during delivery or during placement, unless written acceptance has been provided by Consultant; water may only be permitted at the Project site subject to the limitations of CSA A23.1/A23.2:
 - .1 Do not add water to concrete if high range water reducing admixtures form a part of the Concrete mix design.
- .5 Deposit concrete continuously or in layers to prevent new concrete being placed on concrete that has hardened enough to cause seams or planes of weakness; provide construction joints as specified where a section cannot be placed continuously; deposit concrete to avoid segregation.
- .6 Deposit and consolidate concrete for floors and slabs in a continuous operation; within limits of construction joints, until placement of a panel or section is complete:
 - .1 Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.

- .2 Maintain reinforcement in position on chairs during concrete placement.
 - .3 Screed slab surfaces to correct elevations.
 - .4 Install, protect and repair underslab moisture suppression sheets; place sheets in position with longest dimension parallel with direction of pour in accordance with CSA A23.1 and ASTM E1643; lap joints 150 mm and seal penetrations using membrane manufacturer's recommended tape and mastics.
 - .5 Slope slabs on grade to floor drains to prevent puddles in any spot; form floor slopes to regular, even grades.
- .7 Time lapse between the introduction of cement into the concrete mixes and final placement of the concrete into the forms shall not exceed 120 minutes.

3.03 TOLERANCES

- .1 Finish floor slabs to tolerances listed in Section 03 35 00, and formed surfaces to tolerances listed in Section 03 11 00 and Section 03 33 00, unless specifically indicated otherwise.
- .2 Horizontal Surfaces: Comply with CSA A23.1 for slab and floor finish classifications and tolerances listed in Section 03 35 00 and as listed below:
 - .1 Class A: Non-architectural critical floors such as mechanical spaces, electrical room and sidewalks, meeting requirements for CSA A23.1 slab finishing having overall F-number of $F_F 20 \times FL 15$ measured in accordance with ASTM E1155 diagonally across floor bays.

3.04 SLAB-ON-GRADE JOINTS

- .1 Construct joints true to line with faces perpendicular to surface plane of concrete.
- .2 Construction Joints: Locate and install so as not to impair strength or appearance of concrete, at locations indicated on Drawings or as reviewed by Consultant.
- .3 Isolation Joints: Unless noted otherwise, install joint-filler strips at junctions with slabs-on-grade and vertical surfaces, such as column pedestals, grade beams, and other locations, as indicated:
 - .1 Extend joint filler strips full width and depth of joint, terminating flush with finished concrete surface, unless otherwise indicated.
 - .2 Where the slab is required to restrain the wall from movement against earth pressure, place the slab before back-filling the opposite side of the wall; cast slab flush against wall without use of joint filler strip.
- .4 Contraction (Control) Joints in Slabs-on-Grade: Form weakened plane contraction joints as follows:
 - .1 Sawed Joints: Form contraction joints cutting a 3 mm wide joint into concrete.
- .5 Saw-cutting shall generally be completed within 12 hours of placing concrete without tearing, abrading, or otherwise damaging surface of concrete and before concrete develops random contraction cracks.

3.05 PROTECTION

- .1 Protect fresh and immature concrete from surface drying and injurious degradation due to adverse weather conditions such as wind, precipitation and from excessive cold or hot temperatures.
- .2 Protection must be planned and available before each concrete placement is started.
- .3 Protect the exposed surface of concrete when the rate of surface moisture evaporation determined from Annex D of CSA A23.1/A23.2 exceeds $0.50 \text{ kg/m}^2/\text{h}$.

- .4 Protective measures may include fog misting, application of evaporation retarders, wind breaks, and similar measures.
- .5 Temperature related concrete provisions of CSA A23.1/A23.2 will apply when there is a likelihood that the air temperature will fall below 5°C or rise above 27°C; vent exhaust gases from hydrocarbon fired heaters, if used, directly to the outside.
- .6 Protect exposed concrete members from staining or becoming coated with concrete arising from form mortar leakage, concrete spillage, and corrosion of reinforcing, or fluid leakage from equipment.

3.06 CONCRETE CURING

- .1 Curing materials and equipment must be planned and available for all concrete placements.
- .2 Begin curing immediately following the placing and finishing operations.
- .3 Provide temperature and moisture conditions for the period of time necessary for concrete to develop the required properties and according to CSA A23.1.
- .4 Formed Surfaces: If removing forms before end of curing period, continue curing by one or a combination of methods listed below.
- .5 Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces, by one or a combination of the following methods:
 - .1 Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
 - .1 Water ponding
 - .2 Continuous water sprinkling
 - .3 Absorptive cover, water saturated, and kept continuously wet; cover concrete surfaces and edges with 300 mm lap over adjacent absorptive covers.
 - .2 Moisture Retaining Cover Curing: Cover concrete surfaces with moisture retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 300 mm, and sealed by waterproof tape or adhesive; immediately repair any holes or tears during curing period using cover material and waterproof tape.

3.07 LOADING OF STRUCTURE

- .1 Provide a minimum of 7 days of curing to structural slabs prior to any loading.
- .2 Limit loading of structural slabs-on-grade to 2.4 kN/m² until the concrete has achieved specified 28-day strength.

3.08 SLEEVES, HOLES AND OPENINGS

- .1 Do not place any sleeves, holes or openings in structural concrete other than shown on the structural Drawings; submit locations of sleeves, holes and openings not shown on Drawings to Consultant for review at least one (1) week prior to proceeding with the Work.
- .2 Submit locations of proposed cutting or coring through hardened concrete to Consultant for review at least one (1) week prior to proceeding with the Work; the following conditions apply to cutting or coring of holes:
 - .1 Locate all reinforcement in the area of the proposed hole prior to cutting.
 - .2 Core drill holes up to 150 mm diameter; review proposed methods for cutting larger holes with Consultant before proceeding.

.3 Drill upwards if necessary to avoid visible spalling of concrete where slabs have an exposed soffit.

.3 Patch openings left in the construction and around pipes or ducts using mortar of the same proportions as the surrounding work; reinforce with welded wire fabric if necessary.

3.09 SITE QUALITY CONTROL (CONTRACTOR'S ROLE)

.1 Provide a system of quality control to ensure that the minimum standards specified in this Section and related Sections are attained.

.2 Provide and maintain facilities for temporary storage of concrete test cylinders as required by the City's independent testing agency.

.3 Bring to the attention of Consultant any defects in the work or departures from the Contract Documents that may occur during construction; Consultant will decide upon corrective action and state recommendations in writing.

.4 Consultant's general review during construction and inspection and testing by Independent Inspection and Testing Companies reporting to Consultant are both undertaken to inform City of Subcontractor's performance and shall in no way augment Contractor's quality control or relieve them of contractual responsibility:

.1 Advise the Consultant a minimum of 48 hours notice prior to the placement of concrete. Failure to give adequate notice may cause the Consultant to classify the work as defective.

.2 Concrete shall not be placed until the reinforcement and its placement has been inspected by the Contractor's and Subcontractor's quality control representatives.

.3 Correct defects and irregularities to the satisfaction of the Consultant, at no cost to the City.

.5 Acceptance of Structure: Failure to comply with requirements that control strength and durability will result in the structure being considered potentially deficient; a structure will be considered potentially deficient when:

.1 Concrete is not as specified

.2 Reinforcing steel size, quantity, position, quality or arrangement is not as specified or detailed

.3 Improper curing

.4 Inadequate protection of concrete from extremes of temperature during early stages of hardening and strength development

.5 Mechanical injury from fire, construction overload or premature removal of forms

.6 Poor workmanship

.7 Failure to provide 48 hours notification to Consultant for review of formwork and reinforcement before placing concrete

.8 Concrete not within dimensional tolerances

.9 Strength evaluation tests and analysis:

.1 Consultant may order an independent testing firm to obtain cores, X-rays, or similar non-destructive tests.

.2 Consultant may order a load test or analysis, or both as defined by CSA A23.3 Section 20, if the non-destructive tests are impractical or inconclusive.

.3 Reinforce by additional construction or replace as directed by Consultant at Subcontractor's own expense for concrete judged inadequate by structural analysis or by results of load tests.

- .4 Subcontractor shall pay the cost of testing or analysis that is required to demonstrate the adequacy of the structure which does not meet the requirements for strength or which has been placed before formwork and reinforcing have been reviewed by Consultant.
- .5 Consultant may order additional testing at any time even though the required tests indicate that the strength requirements have been met; in this instance City will pay for those tests that meet the specified requirements and Subcontractor shall pay for those that do not.

3.10 SITE QUALITY CONTROL (CITY'S ROLE)

- .1 Quality Audit (Inspection and Testing by City): Contractor and Subcontractors must coordinate their activities with the City's inspection and testing agency; costs for inspection and testing will be paid for by the City directly; Contractor and Subcontractors shall include coordination costs only, include only costs inspection and testing required by the Contractor and Subcontractors for their Quality Assurance and Quality Control requirements.
- .2 Inspection and Testing Agency Coordination: City's inspection and testing agency will be required to coordinate with the Subcontractors for notification requirements regarding the timing of testing and inspections, and as follows:
 - .1 Coordinate inspection and testing activities with Subcontractors and Contractor; be aware of current work schedule and bring to the attention of the Consultant any testing or inspection requirement apparently being overlooked.
 - .2 Coordinate work of this Section with Section 01 00 06 – General Requirements: Quality Control; notify Consultant of non-compliant workmanship or materials.
 - .3 City will pay for initial cost of concrete testing for Quality Audit Testing performed by third party inspection and testing agency only.
- .3 Additional tests may be directed by the Consultant, or requested by the Contractor or the Subcontractor:
 - .1 Costs of tests requested by the Consultant will be paid by the City.
 - .2 Costs of tests requested by the Contractor will be paid by the Contractor.
 - .3 Costs of tests requested by the Subcontractor will be paid by the Subcontractor.
 - .4 Any retesting or core testing required as a result of the original test failing will be borne by the Contractor and assigned to the appropriate Subcontractor.

3.11 REPAIR

- .1 Remove and replace concrete that does not comply with requirements in this Section, at no charge to the City.
- .2 Repair all broken and chipped concrete; submit repair procedure to Consultant before proceeding with repair work.
- .3 Repair shrinkage and expansion cracks occurring in walls and slabs; submit repair procedure to Consultant before proceeding with repair work.

END OF SECTION

1. GENERAL**1.01 SUMMARY**

- .1 This Section specifies architecturally exposed concrete, including formwork, reinforcement accessories, concrete materials, concrete mix design, placement procedures, and finishes.
- .2 Provision of custom fabricated elastomeric form liners for texturing architecturally exposed concrete and form liner accessories including, but not limited to, fasteners, sealants, rustication and backup strips, form release agents, and sealers.
- .3 Read this section in conjunction with Section 03 31 00 – Structural Concrete; successful completion of work of this section requires high levels of experience and positive cooperation of all parties involved with concrete placement including, but not limited to, the architect Consultant, design engineer, formwork specialist, formwork assembly crews, concrete supplier and Contractor.

1.02 RELATED REQUIREMENTS

- .1 Section 03 11 00 – Concrete Forming and Accessories: General cast-in-place concrete formwork materials and methods relating to non-architecturally exposed concrete.
- .2 Section 03 20 00 – Concrete Reinforcing: Common concrete reinforcing materials relating to concrete for the project.
- .3 Section 03 31 00 – Cast-In-Place Concrete: Structural and general cast-in-place concrete construction, including formed and unformed finishes for non-architecturally exposed concrete finishes.
- .4 Section 03 35 00 – Concrete Finishing: Schedule of concrete finish abbreviations.
- .5 Section 07 92 00 – Joint Sealants: Elastomeric joint sealants in contraction and other joints in architecturally exposed concrete.

1.03 DEFINITIONS

- .1 The following definitions apply to the Architecturally Exposed Concrete specification:
- .2 Architecturally Exposed Concrete (AEC): Concrete that is exposed to view on surfaces of the completed structure or building and that requires special concrete materials, formwork, placement, or finishes to obtain specified architectural appearance, using personnel experienced in the work required by this Section.
- .3 Design Reference: Picture designated by Consultant in the Contract Documents that indicates acceptable surface quality and appearance of architecturally exposed concrete.

1.04 REFERENCE STANDARDS

- .1 American Concrete Institute (ACI):
 - .1 ACI 117-10, Specification for Concrete Construction and Materials, and as modified in this Section
 - .2 ACI 301-10, Specifications for Structural Concrete
 - .3 ACI 303.1-97, Standard Specification for Cast-in-Place Architectural Concrete
 - .4 ACI 303R-04, Guide to Cast-in-Place Architectural Concrete
 - .5 ACI 347-04, Guide to Formwork for Concrete

- .2 American Society for Testing and Materials (ASTM):
 - .1 ASTM C94/C94M-13a, Standard Specification for Ready-Mixed Concrete
 - .2 ASTM C150/C150M-12, Standard Specification for Portland Cement
 - .3 ASTM C311/C311M-13, Standard Test Methods for Sampling and Testing Fly Ash or Natural Pozzolans for Use in Portland-Cement Concrete
 - .4 ASTM C595/C595M-13, Standard Specification for Blended Hydraulic Cements
 - .5 ASTM C881/C881M-10, Standard Specification for Epoxy Resin Base Bonding Systems for Concrete
 - .6 ASTM C920-11, Standard Specification for Elastomeric Joint Sealants
 - .7 ASTM C979/C979M-10, Standard Specification for Pigments for Integrally Colored Concrete
 - .8 ASTM C1059/C1059M-99(2008), Standard Specification for Latex Agents for Bonding Fresh To Hardened Concrete
- .3 Canadian Standards Association (CSA):
 - .1 CSA S269.1 1975(R2003), Falsework for Construction Purposes
- .4 Refer to Section 03 31 00 for applicable reference standards; materials, procedures, and requirements specified in Section 03 31 00 apply to AEC specified in this Section, except as specifically modified to meet required tolerances, textures and finishes.

1.05 ADMINISTRATIVE REQUIREMENTS

- .1 Pre-Construction Meeting: Conduct pre-construction meeting at Project site to comply with requirements in Section 01 00 06 – General Requirements: Project Meetings; meeting will address following items require representatives of each entity directly concerned with AEC to attend including but not limited to, the following:
 - .1 Contractor,
 - .2 Subcontractor,
 - .3 Concrete formwork manufacturer,
 - .4 Concrete formwork installer,
 - .5 Ready-mix concrete manufacturer,
 - .6 Testing agency, and
 - .7 Consultant.
- .2 Agenda for pre-construction meeting will include; but not be limited to, the following topics:
 - .1 Layout and appearance of form liners.
 - .2 Consultant's design criteria and expected results.
 - .3 Concrete formwork and ready-mix concrete manufacturers proposed materials to produce required concrete textures and finishes.
 - .4 Concrete mixes and admixtures required to achieve concrete finishes, specifically addition of super plasticizers to concrete mix to achieve sufficient flow required to reduce honeycombing, bug holes and other reductions in surface quality and appearance.
 - .5 Cold and hot weather concreting procedures.
 - .6 Curing procedures.
 - .7 Placement of construction joints.
 - .8 Types of forms and form removal limitations.
 - .9 Reinforcement accessory installation.
 - .10 Concrete repair procedures.
 - .11 Acceptable tolerances for out-of-plumb, flat or level, and placement of formwork.
 - .12 Protection of AEC from work of following trades through a formalized education process.

.13 Meeting will also discuss and propose solutions for architectural formwork and range of expected architectural finishes, cold and hot weather concreting procedures, curing procedures, elimination of construction joints, forms and form removal limitations, reinforcement and accessory installation, concrete repair procedures, methods for creating 90° edge profiles, and protection of AEC.

.3 Coordination: Coordinate with subsequent components of the Work and inform all personnel that use of permanent or staining markers such as felt tip markers, wax crayons, lead pencils and similar writing instruments will not be permitted on finished AEC surfaces.

1.06 SUBMITTALS

.1 Make submittals in accordance with Section 01 00 06 – General Requirements: Submittals.

.2 Action Submittals: Provide the following submittals before starting any work of this Section:

- .1 Product Data: Submit product data for each type of manufactured material and product indicated.
- .2 Shop Drawings: Submit shop drawings of formwork indicating formwork form facing joints, rustications, construction and contraction joints, form joint sealant details, form tie location and patterns, inserts and embedment, cut outs, cleanout panels, and other items that visually affect AEC.
- .3 Samples: Submit samples for each of the following materials:
 - .1 Form Facing Panel: 300 mm x 300 mm of each different form facing material.
 - .2 Form Ties: 1 of each different type.
 - .3 Chamfers and Rustications: 1 of each different profile.
 - .4 Sample Panel: Submit AEC samples for verification, cast vertically, approximately 450 mm x 450 mm x 50 mm thick, of finishes, colours, and textures to match the design reference sample.

.3 Informational Submittals: Provide the following submittals when requested by the Consultant:

- .1 Design Mix: Submit design mixes for each concrete mix, including alternate mix designs when characteristics of materials, project conditions, weather, test results, or other circumstances warrant adjustments.
- .2 Certificates: Submit material test reports from a qualified testing agency indicating and interpreting test results of the following for compliance with requirements indicated, based on comprehensive testing of current materials:
 - .1 Cementitious materials and aggregates.
 - .2 Admixtures.
 - .3 Curing compounds.
 - .4 Repair materials.
- .3 Concrete Placement Schedule: Submit concrete placement schedule before starting AEC placement operations including, but not limited to, location of form joints, construction joints and expansion joints.
- .4 Minutes of Site Meetings: Submit minutes of prefabrication and pre-installation conference.

1.07 QUALITY ASSURANCE

.1 Refer to Section 03 31 00 for quality assurance requirements; use only personnel having experience in setting formwork and providing finished AEC; provide proof of experience when requested by Consultant.

.2 Consultant's Design Reference:

- .1 AEC will use custom fabricated forms to provide a surface texture based on deep cleft, split face limestone of various sizes and configurations, and have overlaid fossil impressions of engineering and mathematical formulae as directed by the Consultant.
- .2 Surface profile of custom formwork will be limited to ± 25 mm from mean concrete thickness with a total variation not to exceed 50 mm between adjacent high and low points.
- .3 The following image portrays the design intent, but does not indicate the actual surface profile or patterning.
- .4 Architectural cast-in-place concrete will use prefabricated forms to provide a surface texture based; with finished concrete placed in a single application using forming materials and placement methods that reduce the probability of paste bleed-out, air inclusions and other form imperfections.
- .5 Form concrete edges, profile of rustications and reveals with 90° profile; edges and profiles if required shall not exceed 13 mm; provide methods to correct chamfers where required for formwork removal back to 90° profile.
- .6 Architecturally exposed concrete vertical surfaces are defined as follows:



1.

Figure 1 – Concrete Finish CF-1, Smooth Form Finish: Smooth formed surfaces free from bug holes larger than 4 mm, with no honeycombing, staining and paste wash down from subsequent concrete pours for multi-staged placement; and having evenly spaced form tie holes.

1.08

MOCK-UPS

- .1 Sample Panels: Build sample panels to demonstrate aesthetic effects in accordance with Section 01 00 06 – General Requirements: Quality Control for mock-ups and as follows:
 - .1 Sample panels will be reviewed for:
 - .1 Methods of curing, surface smoothness, texture, and coatings, as applicable; retain samples of cements, sands, aggregates, and colour additives used in mock-up for comparison with materials used in remaining Work.

- .2 Damage part of an exposed face surface for each finish, colour, and texture, and demonstrate materials and techniques proposed for repair of tie holes and surface blemishes to match adjacent undamaged surfaces; Consultant will be present during damage and repair demonstration.
 - .3 Colour, texture, and quality of concrete surfaces.
 - .4 Relationship of formed reveals and rustications, continuity of formed features around corners.
 - .5 Quality of formed joints and profiles, and treatment of chipped or broken edges.
 - .6 Aesthetic qualities of workmanship.
 - .7 Other material and construction qualities specifically accepted by Consultant in writing.
 - .8 Obtain Consultant's acceptance of sample panels before casting AEC.
 - .9 Maintain sample panels during construction in an undisturbed condition as a standard for judging the completed Work.
-
- .2 Damage part of an exposed face surface for each finish, colour, and texture, and demonstrate materials and techniques proposed for repair of tie holes and surface blemishes to match adjacent undamaged surfaces; Consultant will be present during damage and repair demonstration.
 - .3 Erect sample panels adjacent and parallel to surfaces where AEC will form a part of the completed construction.
 - .4 Store reviewed sample panels on site in a protected location until completion of the work of this Section for use as a comparison to installed materials.
 - .5 Clean exposed faces of sample panels with proprietary concrete cleaner to illustrate cleaning techniques and control of efflorescence.
-
- .2 Mock-ups: Construct mock-ups to verify selections made after review of sample panels to demonstrate aesthetic effects and set quality standards for materials and execution in accordance with Section 01 00 06 – General Requirements: Quality Control for mock-ups and as follows:
 - .1 Build mock-up of typical wall area as indicated on Drawing, using wall construction that will not be architecturally exposed in final construction and using contract materials, methods and workmanship:
 - .1 Incorporate formwork accessories and minimum one vertical and one horizontal form liner joint.
 - .2 Include concrete mix, forming system, form release agents, placement rate, form pressures, joint sealing, vibrating and stripping practices.
 - .3 Demonstrate patching and repair procedures for spalled concrete, and voids caused by honeycombing or bug holes.
 - .2 Include mock-ups for each AEC finish indicating final construction and appearance.
 - .3 Protect reviewed mock-ups from construction activities until completion of work of this Section.
 - .4 Mock-ups will be reviewed for:
 - .1 Colour, texture, and quality of concrete surfaces.
 - .2 Relationship of formed reveals and rustications, continuity of formed features around corners.
 - .3 Quality of formed joints and profiles, and treatment of chipped or broken edges.
 - .4 Aesthetic qualities of workmanship.
 - .5 Mock-ups found acceptable by the Consultant may become part of the completed Work if undisturbed at time of Substantial Performance.

- .3 Damage part of an exposed face surface for each finish, colour, and texture, and demonstrate materials and techniques proposed for repair of tie holes and surface blemishes to match adjacent undamaged surfaces; Consultant will be present during damage and repair demonstration.
- .4 Review and acceptance of sample panels and mock-ups does not constitute approval of deviations from the Contract Documents contained in sample panels and mock-ups unless Consultant specifically notes such deviations in writing.
- .5 Remove and replace sample panels and mock-ups considered as not acceptable by the Consultant; Work installed and determined as not acceptable will administered as a construction deficiency with payment for deficient work withheld until corrected in a manner directed by the Consultant.

2. PRODUCTS

2.01 MANUFACTURERS

- .1 Basis-of-Design Materials: Products named in this Section were used as the basis-of-design for the project; manufacturers listed as additional acceptable materials and that offer similar products may be incorporated into the work of this Section provided they meet the performance requirements established by the named products.
- .2 Additional Acceptable Materials Manufacturers: Subject to compliance with performance requirements specified in this Section; as established by the Basis-of-Design Materials, use any of the listed manufacturers' products in accordance with Section 01 00 06 – General Requirements: Substitutions and Product Options; following manufacturer's do not require submission of a request for substitutions provided required shop drawing and product data submissions are submitted before starting any work of Section:
 - .1 Dayton Superior, Symons
 - .2 Doka, The Formwork Specialists
- .3 Substitutions: Consultant may consider additional manufacturers having similar products to Acceptable Materials Manufacturers listed above during the construction period, provided they meet the performance requirements established by the named products and provided they submit requests for substitution in accordance with Section 01 00 06 – General Requirements: Substitutions and Product Options before starting any work of this Section:
 - .1 Do not use substitute materials to establish Bid Price.
 - .2 Substitutions that appear as a part of the project without review and acceptance by the Consultant will be rejected, and replaced with one of the specified materials.
 - .3 Greenstreak Plastic Products Co.
 - .4 MEVA Formwork Systems Inc.
 - .5 PERI Formwork Systems Inc.
 - .6 Scott System Form Liners
 - .7 Titan Formwork Systems

2.02 FORMWORK MATERIALS

- .1 Wall Formwork: Premanufactured formwork systems designed specifically to minimize imperfections in concrete finish and provide symmetrical and consistent joint and tie arrangements as indicated on Drawings for AEC, engineered to withstand fresh concrete pressure, and as follows:
 - .1 Basis-of-Design Materials: PERI Formwork Systems, MAXIMO Panel Wall Formwork

- .2 Formwork Tie System: Purpose made concrete formwork tie system using removable, reusable ties consisting of permanent spacer tubes, sealing rings and cones to provide protection from percolating water, forming a part of the concrete formwork system for AEC as follows:
 - .1 Basis-of-Design Materials: PERI Formwork Systems, DK Reusable Tie Rod System and Seals.
- .3 Tie Hole Fill: Precast concrete, cone shaped to fit concrete tie hole profile to form a shadow joint and as follows:
 - .1 Basis-of-Design Materials: PERI Formwork Systems, DK Architectural Concrete Cone System.
- .4 Form Release Agent: Proprietary, non-volatile material that will not stain the concrete or impair the subsequent application of finishes or coatings to the surface of concrete, derived from agricultural sources, non-petroleum containing, low or no VOC material; formulate form release agent with rust inhibitor for steel form facing materials.

2.03 FORM FACING MATERIALS

- .1 Standard Form Facing Panels: Form facing material requirements specified in Section 03 31 00 and as follows:
 - .1 Form-Facing Panels for As-Cast Finishes: Exterior-grade plywood panels, non-absorptive, that will provide continuous, true, and smooth AEC surfaces, HDO DFP Plywood having mill applied release agent and edge sealed.
- .2 Custom Form Facing Panels for As Cast Finishes: Reinforced elastomeric, custom form liner that will provide continuous, true, and smooth AEC surfaces, provided in largest practicable sizes to minimize number of joints, fabricated from accepted layouts, and as follows:
 - .1 Design form liners for multiple use for the duration of the project.
 - .2 Provide special forming materials to produce form surfaces with face design, texture, arrangement, and configuration to match Consultant's Design Intent.
 - .3 Design liner strength to accommodate form pressures for concrete type being used.
 - .4 Design support of large or deep patterns that may deform under concrete forming pressures.
 - .5 Acceptable Materials:
 - .1 Greenstreak Plastic Products Co.
 - .2 Scott System Inc.
 - .3 Symons/Dayton Superior of Canada

2.04 ACCESSORIES

- .1 Form Joint Tape: Compressible foam tape, pressure sensitive, AAMA 810.1, minimum 6 mm thick.
- .2 Form Joint Sealant: Elastomeric sealant complying with ASTM C920, Type M or S, Grade NS, that adheres to form joint substrates as specified in Section 07 92 00.
- .3 Sealer: Penetrating, clear, polyurethane wood form sealer formulated to reduce absorption of bleed water and prevent migration of set retarding chemicals from wood.
- .4 Surface Retarder: Chemical liquid set retarder, for application on form facing materials, capable of temporarily delaying final hardening of newly placed concrete surface to depth of reveal specified.
- .5 Form Ties: Factory fabricated, internally disconnecting ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal:

- .1 Provide ties with tapered tie cone spreaders that, when removed, will leave holes not larger than 19 mm in diameter on concrete surfaces.
- .2 Provide internally disconnecting ties that will leave no metal closer than 38 mm, after exposing aggregate, from the AEC surface.
- .6 Water Repellent: High performance, solvent free silane surface treatment, clear penetrating, vapour permeable water repellent designed for above grade use, providing permanent protection that does not coat or discolour the surface appearance of concrete:
 - .1 Basis-of-Design Materials: Evonik Degussa Protectosil BH-N
- .7 Anti-Graffiti Treatment: Waterborne, zero VOC silane-based vapour permeable, non-sacrificial anti-graffiti treatment designed to protect surfaces and allow easy removal of spray paint, solvent and water based paints and coatings, permanent marker, ink and bituminous materials:
 - .1 Basis-of-Design Materials: Evonik Degussa Protectosil Antigrffiti

2.05 REINFORCEMENT

- .1 Steel Reinforcement and other requirements for reinforcement accessories in accordance with Section 03 31 00.

2.06 CONCRETE MATERIALS

- .1 Portland Cement: Normal type GU, grey colour, of same type, brand, and source for entire project with normal weight fine aggregates sized to fit profile of custom form liners, refer to Section 03 31 00 for additional concrete materials, aggregates, admixtures and curing materials.
- .2 Colour Pigment: In accordance with ASTM C979/C979M, synthetic mineral oxide pigments or coloured water reducing admixtures; colour stable non-fading, and resistant to lime and other alkalis; colour as selected by Consultant from manufacturer's full range.

2.07 REPAIR MATERIALS

- .1 Bonding Agent: ASTM C1059/C1059M, Type II, non-re-dispersible, acrylic emulsion or styrene butadiene.
- .2 Epoxy Bonding Adhesive: ASTM C881/C881M, two component epoxy resin, capable of humid curing and bonding to damp surfaces, of class and grade to suit requirements, and as follows:
 - .1 Types I and II, non-load bearing, IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.

2.08 CONCRETE MIXES

- .1 Prepare design mixes for each type and strength of AEC determined by either laboratory trial mix or site test databases.
- .2 Use a qualified independent testing agency for preparing and reporting proposed concrete mix designs for the laboratory trial mix basis.
- .3 Proportion concrete mix for compressive strength and properties as indicated on Concrete Schedule on Drawing S0.01.
- .4 Mix Design Engineering: Refer to Section 03 31 00 for mix design engineering requirements, provide mix design as follows:
 - .1 Provide mix design suitable for AEC, providing minimal air pockets, bug holes and honeycombing.

- .2 Provide information relating to super plasticizers used to increase flow rate of low slump concrete mixes.
- .3 Provide appropriate aggregate size to suit formwork profile and surface finishing requirements.

3. EXECUTION

3.01 FORM LINER PREPARATION

- .1 Verify lines and levels of formwork and form liner patterns are within allowable tolerances before placing concrete.
- .2 Clean liner before each use on multiple use liners.
- .3 Replace damaged liner where continued use or repair would negatively impact the aesthetics of the concrete finish.
- .4 Apply form liner compatible release agent at rate recommended by manufacturer.
- .5 Schedule concrete pour soon after application of release agent to avoid precipitation, dust, and debris.
- .6 Protect reinforcing steel from exposure to release agents.

3.02 FORMWORK

- .1 Coordinate formwork, embedded items, and shoring and re-shoring work with Section 03 31 00.
- .2 AEC Finish: Match Consultant's design reference sample, identified and described in item 1.07.2.3 above.
- .3 Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces:
 - .1 Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces, unless otherwise indicated.
 - .2 Maintain uniformity of special finishes over construction joints.
- .4 As Cast Formed Finishes:
 - .1 Rough Formed Finish: As cast concrete texture imparted by form facing material with tie holes and defective areas repaired and patched. Remove fins and other projections exceeding ACI 347 limits for class of surface specified.
 - .2 Smooth Formed Finish: As cast concrete texture imparted by form facing material, arranged in an orderly and symmetrical manner with a minimum of seams:
 - .1 Repair and patch tie holes and defective areas.
 - .2 Remove fins and other projections exceeding 3 mm in height.
- .5 Form Liner Finish:
 - .1 Cast panel against form liners placed, secured, and sealed over formwork panels to produce a textured surface free of pockets, streaks, and honeycombs.
 - .2 Produce a surface appearance of uniform colour and texture.
 - .3 Locate tie holes as indicated on the Drawings.

3.03 TOLERANCES

- .1 Limit deflection of form facing panels to a minimum of 1/400th of its span and limit surface irregularities defined by ACI 347 as abrupt or gradual as follows:
 - .1 Class A: 3 mm within 3660 mm from grade.
 - .2 Class B: 6 mm above 3660 mm.
- .2 Fabricate forms for easy removal without hammering or prying against concrete surfaces:
 - .1 Provide crush or wrecking plates where stripping may damage cast in place surfaces.
 - .2 Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.
 - .3 Kerf rustications, keyways, reglets, recesses, and similar profiles for to aid removal and minimize damage to edges of concrete work.
 - .4 Do not use rust stained steel form facing material.
- .3 Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible:
 - .1 Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar.
 - .2 Locate temporary openings in forms at inconspicuous locations.
- .4 Coat contact surfaces of wood rustications and chamfer strips with sealer before placing reinforcement, anchoring devices, and embedded items.
- .5 Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the work, determine sizes and locations from trades providing such items.
- .6 Clean forms and adjacent surfaces to receive concrete; remove chips, wood, sawdust, dirt, and other debris just before placing concrete.
- .7 Retighten forms and bracing before placing concrete to prevent mortar leaks and maintain proper alignment.

3.04 FORM LINER ACCESSORY INSTALLATION

- .1 Form rustication lines located as indicated by nailing rustication strips to formwork within tolerances recommended by CSA S269.1.
- .2 Tightly form corners indicated on drawings as indicated on Drawing; provide smooth, solid, unbroken, continuous lines corner chamfers, which are uniformly straight; do not chamfer corners.

3.05 REINFORCEMENT AND INSERTS

- .1 Generally in accordance with Section 03 31 00 for fabricating and installing steel reinforcement.
- .2 Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

3.06 REMOVING AND REUSING FORMS

- .1 Formwork for walls and similar parts of the Work, that does not support weight of concrete may be removed after cumulatively curing at not less than 10°C for 24 hours after placing concrete, provided concrete is hard enough to not be damaged by form removal operations and provided curing and protection operations are maintained:
 - .1 Schedule form removal to maintain surface appearance that matches accepted mock-ups.

- .2 Leave formwork that supports weight of concrete in place until concrete has achieved at least 70% of 28 day design compressive strength; remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.
- .3 Clean and repair surfaces of forms to be reused in the Work:
 - .1 Do not use split, frayed, delaminated, or otherwise damaged form facing material.
 - .2 Apply new form release agent.
- .4 When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints:
 - .1 Align and secure joints to avoid offsets.
 - .2 Do not use patched forms for AEC surfaces.

3.07 JOINTS

- .1 Install construction joints true to line with faces perpendicular to surface plane of AEC so strength and appearance of concrete are not impaired, and as follows:
 - .1 Place joints perpendicular to main reinforcement.
 - .2 Continue reinforcement across construction joints, unless otherwise indicated.
 - .3 Align construction joint within rustications attached to form facing material.
 - .4 Space vertical joints in walls as indicated.
 - .5 Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.
 - .6 Use epoxy bonding adhesive at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
 - .7 Obtain acceptance from Consultant where locations are not indicated.
- .2 Form weakened plane contraction joints true to line with faces perpendicular to surface plane of AEC so strength and appearance of concrete are not impaired; obtain acceptance from Consultant where locations are not indicated.
- .3 Locate joints for beams, slabs, joists, and girders in the middle third of spans; offset joints in girders a minimum distance of twice the beam width from a beam girder intersection.
- .4 Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs; place reveal joint at horizontal joint locations; obtain acceptance from Consultant where locations are not indicated.

3.08 CONCRETE MIXING

- .1 Ready Mixed Concrete: Measure, batch, mix, and deliver AEC in accordance with CSA A3000 and provide batch ticket information:
 - .1 When air temperature is between 30°C and 32°C, reduce mixing and delivery time from 90 to 75 minutes.
 - .2 When air temperature is above 32°C, reduce mixing and delivery time to 60 minutes.

3.09 CONCRETE PLACEMENT

- .1 Verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed before placing concrete.
- .2 Place concrete in accordance with the requirements of Section 03 31 00.
- .3 Deposit concrete continuously between construction joints; deposit concrete to avoid segregation; deposit concrete so that form pressures do not exceed 48 kPa.

- .4 Keep concrete lifts less than 600 mm.
- .5 Thoroughly vibrate concrete to achieve good consolidation, and eliminate entrapped air to minimizing voids:
 - .1 Internally vibrate through to previous lift to avoid lift lines.
 - .2 Avoid vibrator contact with the form liner.

3.10 REPAIR OF SURFACE DEFECTS

- .1 Repair surface defects in accordance with applicable requirements of ACI 303.1.
- .2 Repair surface defects immediately after form removal; surface defects are defined as:
 - .1 Form tie holes.
 - .2 Air voids or pockets.
 - .3 Bug holes with a nominal diameter or depth greater than 6 mm.
 - .4 Honeycombed areas and rock pockets.
 - .5 Visible construction joints.
 - .6 Fins and burrs.
- .3 Repair surface defects using tightly bonded patching materials resulting in concrete surfaces having uniform color and texture, matching adjacent surfaces, and free of shrinkage cracks, and as follows:
 - .1 Fill bug holes larger than 6 mm in diameter or depth; chip out and fill bug holes larger than 13 mm in diameter.
 - .2 Remove honeycombed and other defective concrete down to sound concrete.
 - .3 Saw cut edges perpendicular to the surface or slightly undercut; feather edges will not be permitted.
 - .4 Dampen area being patched overlapping surrounding areas by a minimum of 150 mm to prevent absorption of water from the patching mortar into concrete.
- .4 Cut out to solid surface behind reinforcing steel to provide suitable key lock for patching mortar where rock pockets or similar defects or voids expose steel reinforcement so that patching mortar envelopes exposed reinforcing steel.
- .5 Bond patching mortar to concrete with bonding grout or epoxy adhesive brushed deeply into concrete surfaces in accordance with patching mortar manufacturer's instructions:
 - .1 Colour match patching mortar to surrounding concrete when dry; determine proportion of white portland cement and colourant by trial mixes and test areas before starting repairs to actual defective areas.
 - .2 Compact mortar into place and strike off to leave patch slightly higher than surrounding surface.
 - .3 Leave patch undisturbed for at least 1 hour before being finally finished to permit initial shrinkage.
 - .4 Keep patched area damp for 7 days to allow damp cure.
- .6 Neatly finish patched surfaces to match adjacent surrounding surface texture of concrete; grind or fill surfaces to produce level and plumb, true planes.
- .7 Ream, patch and finish form tie holes flush with adjacent surface for walls exposed in finished work; use a plunger type injection gun or other suitable device to completely fill holes passing entirely through walls.
- .8 Cut out honeycombs and rock pockets that are too large and unsatisfactory for mortar patching to solid surface, keyed and packed solid with matching concrete to produce firm bond and flush surface; patch shall match texture of adjacent surfaces where exposed in finished work.

- .9 Remove and reapply repair work in exposed locations that does not match the texture and colour of surrounding adjacent surfaces or that is not performed to workmanship standards established by sample panels and mock-ups until repair work conforms with specified requirements.
- .10 Cure completed repairs the same as for AEC as specified in Article 3.11 below.

3.11 CONCRETE CURING

- .1 Protect freshly placed concrete from premature drying and excessive cold or hot temperatures in accordance with ACI 301.1.
- .2 Begin curing immediately from applying as cast formed finishes to concrete; cure by one or a combination of the following methods that will not mottle, discolour, or stain concrete:
 - .1 Moisture Curing: Keep exposed surfaces of AEC continuously moist for not less than seven days with the following materials:
 - .1 Water.
 - .2 Continuous water fog spray.
 - .3 Absorptive cover, water saturated and kept continuously wet. Cover concrete surfaces and edges with 300 mm lap over adjacent absorptive covers.
 - .2 Moisture Retaining Cover Curing: Cover concrete surfaces with moisture retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 300 mm, and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period; use cover material and waterproof tape.
 - .3 Curing Compound: Mist concrete surfaces with water. Apply curing compound uniformly in continuous operation by power spray or roller in accordance with manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.

3.12 SITE QUALITY CONTROL

- .1 Generally in accordance with requirements for site quality control requirements specified in Section 03 31 00.

3.13 PROTECTION AND CLEANING

- .1 Protect corners, edges, and surfaces of AEC from damage; use guards and barricades.
- .2 Protect AEC from staining, laitance, and contamination during remainder of construction period.
- .3 Clean AEC surfaces after finish treatment to remove stains, markings, dust, and debris.
- .4 Wash and rinse surfaces in accordance with concrete finish applicator's written recommendations:
 - .1 Protect other Work from staining or damage due to cleaning operations.
 - .2 Do not use cleaning materials or processes that could change the appearance of AEC finishes.
- .5 Protect surfaces of AEC from marks arising from subsequent components of work; use of felt tip markers and other forms of permanent marker or staining materials will not be permitted on completed AEC.

3.14 SEALERS AND COATING

- .1 Apply penetrating surface sealant as follows:
 - .1 Apply solution directly as supplied by manufacturer with no dilution or alteration of any kind.

- .2 Surfaces shall be dry, ambient temperature not less than 4°C and not more than 36°C, and no wind.
 - .3 Apply solution using approved spray equipment at rate in accordance with manufacturer's written instructions.
- .2 Apply anti graffiti coating sealant in accordance with manufacturer's written instructions and as follows:
- .1 Cure concrete and concrete repairs a minimum of 28 days.
 - .2 Apply solution in a three-coat application using approved spray equipment at rate in accordance with manufacturer's written instructions.
 - .3 Protect non-porous surfaces from overspray.

END OF SECTION

1. GENERAL**1.01 SUMMARY**

- .1 Work of this section specifies concrete floor finishing techniques and includes floor finishing treatments, testing and measurement for floor flatness and levelness, and trowelling, levelling, and floating of floor surfaces ready for applied finishes; and includes treatment of formed concrete surfaces to achieve specified surface characteristics for non-architecturally finished concrete.

1.02 RELATED REQUIREMENTS

- .1 Section 03 31 00 – Cast-in-Place Concrete: Requirements for concrete testing, and floor flatness and levelness requirements; requirements for curing methods and length of cure.
- .2 Section 09 30 00 – Tiling

1.03 DEFINITIONS

- .1 The following definitions apply to the Concrete Finishing specification:
- .2 Floor Types: Types of concrete floor slabs based on their intended use, methods of finishing and finish materials applied to flooring as required to achieve Finishing Class listed below, and as follows:
 - .1 Single Course Floor: Floors placed in a single course with final finishing applied to properly levelled concrete.
- .3 Finish or Finishes: Materials applied to finished concrete surface, such as stained or coloured concrete, carpet, resilient flooring or ceramic tile.
- .4 Finishing Class: Methods, tools and equipment employed to achieve levelness or surface flatness for shored slabs and slabs-on-grade and as follows:
 - .1 F0-Finishing: Not used.
 - .2 F1-Finishing: Not used.
 - .3 F2-Finishing: Floors having overall F-number of $F_F 25 \times F_L 20$; meeting requirements for CSA A23.1 Class B slab finishing.
 - .4 F3-Finishing: Floors having overall F-number of $F_F 30 \times F_L 25$; no similar CSA A23.1 slab finishing.
 - .5 F4-Finishing: Floors having overall F-number of $F_F 35 \times F_L 25$; meeting requirements for CSA A23.1 Class C slab finishing.
 - .6 F5-Finishing: Not used.
 - .7 F6-Finishing: Not used.

1.04 REFERENCE STANDARDS

- .1 American Society for Testing and Materials (ASTM):
 - .1 ASTM E1155-96 (2008), Standard Test Method for Determining FF Floor Flatness and FL Floor Levelness Numbers
- .2 American Concrete Institute (ACI):
 - .1 ACI 117-10, ACI Manual of Practice: Specifications for Tolerances for Concrete Construction and Materials, and Commentary
 - .2 ACI 302.1R-04, ACI Manual of Practice: Guide for Floor and Slab Construction

- .3 Canadian Standards Association (CSA):
- .1 CSA A23.1/A23.2-09, Concrete Materials and Methods of Concrete Construction

1.05 ADMINISTRATIVE REQUIREMENTS

- .1 Coordination: Coordinate a meeting between the Contractor, Subcontractor responsible for concrete placement, and the City to determine Work Site Quality Control testing section borders and sample measurement line locations, method of measurement, and accuracy requirements of measuring devices.
- .2 Pre-Construction Meetings: Arrange meeting with Contractor, Subcontractor for work of this Section and other Subcontractors affected by work of this Section as follows:
- .1 Hold meeting on Work Site a minimum of 1 month prior to placing concrete floor finishes.
- .2 Review building envelope and ambient conditions.
- .3 Review specified methods and materials.
- .4 Review work of other sections affected by this Section including applied finishes.
- .5 Confirm joint details and layout.
- .6 Confirm quality assurance inspection procedures.
- .7 Confirm floor flatness, slab finishing and requirements of finishes installed to slabs, and other issues governing installation of concrete finishing materials.

1.06 SUBMITTALS

- .1 Provide required information in accordance with Section 01 00 06 – General Requirements: Submittals.
- .2 Action Submittals: Provide the following submittals before starting any work of this Section:
- .1 Product Data: Submit copies of purchase orders and packing slips indicating the quantity of materials required for the project, and include a copy of the manufacturer's recommended coverage rate.
- .2 Shop Drawings: Submit shop drawings indicating proposed construction joints, isolation joints, expansion joints (exterior) and contraction joints before preconstruction meeting ready for discussion and confirmation.
- .3 Informational Submittals: Provide the following submittals during the course of the work:
- .1 Submit results for floor surface flatness and levelness to demonstrate compliance with specified tolerances; record the following information on a drawing indicating floor slab layout, column locations and slab penetrations:
- .1 Layout of test section borders with an identification number for each test section.
- .2 Indicate number and direction of sample measurement lines used in each test section, the starting and stopping locations and identification number that relates to the test section number.
- .3 Indicate elevations of all sample reading points.
- .4 Indicate profile curvature between all reading points separated by 600 mm.
- .5 Indicate variance from estimated flatness and levelness at each measuring point tolerances using associated 90% confidence interval in parentheses, for example $F_F 25 (23.0 \text{ to } 27.0)$, and as follows:
- F_F estimate for each test sample.
 - F_F composite for each test section.
 - F_L estimate for each test sample.
 - F_L composite for each test section (combined test samples).
 - List calculated overall F -Number results for the entire test surface as a whole number not containing a confidence interval.

1.07 PROJECT CLOSEOUT SUBMISSIONS

- .1 Operation and Maintenance Data: Submit manufacturer's written instructions for cleaning and maintenance procedures; include complete list of cleaning products required for on-going maintenance, and name of original installer and contact information in accordance with Section 01 00 06 – General Requirements: Closeout Submissions.

1.08 QUALITY ASSURANCE

- .1 Qualifications: Provide proof of qualifications when requested by City:
 - .1 Installers: Use skilled workmen experienced in concrete finishing methods similar in complexity and extent to that required for the Work of the Contract.

2. PRODUCTS**2.01 MANUFACTURERS**

- .1 Acceptable Materials Manufacturers: Subject to compliance with requirements specified in this Section; where multiple listings of manufacturers occur, use any of the following listed manufacturers' products in accordance with Section 01 00 06 – General Requirements: Substitutions and Product Options including the following:
 - .1 Ardex Engineered Cements
 - .2 Curecrete Chemical Company
 - .3 Dayton Superior
 - .4 Euclid Chemical Company
 - .5 Evonik Industries
 - .6 L & M Construction Chemicals
 - .7 L.M. Scofield Company
 - .8 MAPEI Canada Inc.
 - .9 Sika Canada Ltd.
 - .10 W.R. Meadows of Canada
- .2 Substitutions: City may consider additional manufacturers having similar products to Acceptable Materials Manufacturers listed above during the construction period, provided they meet the performance requirements established by the named products and provided they submit requests for substitution in accordance with Section 01 00 06 – General Requirements: Substitutions and Product Options before starting any work of this Section:
 - .1 Do not use substitute materials to establish Bid Price.
 - .2 Substitutions that appear as a part of the project without review and acceptance by the City will be rejected, and replaced with one of the specified materials.

2.02 CONCRETE MATERIALS

- .1 Concrete Formwork, Reinforcement and Materials: Specified in accordance with Section 03 31 00.

2.03 LEVELLING MATERIALS

- .1 Underlayment: Cementitious, self levelling, single component, polymer modified underlayment with manufacturer's recommended primer and crack repair materials; for application thicknesses to a minimum feather edge to 13 mm; interior grade and as follows:
 - .1 Acceptable Materials:
 - .1 Ardex K 15 Premium Self Levelling Underlayment
 - .2 MAPEI Planipatch
 - .3 Sika Sikafloor Level 12
 - .4 W.R. Meadows Sure-Flo ST

- .2 Overlayment: Cementitious, self levelling, single component, polymer modified overlayment with manufacturer's recommended primer and crack repair materials; for application thicknesses to a minimum of 6 mm with additional aggregates recommended by manufacturer to achieve total thickness required; and as follows:
 - .1 Acceptable Materials:
 - .1 Ardex SD-T Cement Based Topping
 - .2 MAPEI Ultratop
 - .3 Sika Sikafloor Level 25
 - .4 W.R. Meadows Sure-Flo FT 100
 - .3 Patching and Flash Patching Materials: Cementitious based, polymer modified, fine aggregate, single component, rapid curing, early strength floor patching compounds having high adhesion with manufacturer's recommended primer and surface profile; for application in thicknesses to a minimum of 4 mm to 25 mm, and as follows:
 - .1 Acceptable Materials:
 - .1 Ardex SD-P
 - .2 MAPEI Mapicem 101
 - .3 Sika SikaQuick 1000
 - .4 W.R. Meadows Sealtight Meadow-Crete H

2.04 LIQUID APPLIED FINISHING MATERIALS

- .1 Liquid Applied Floor Hardener Materials (CD): Water based, sodium silicate type, chemically reactive, permanent treatment, penetrating sealer and hardener; non-toxic, non-flammable, surface densification and anti-dusting treatment having low or no VOC and as follows:
 - .1 Acceptable Materials:
 - .1 Curecrete, Ashford Formula
 - .2 Euclid Chemical Company, Euco Diamond Hard
 - .3 L & M Construction Chemicals, Seal Hard
 - .4 Sika Sikafloor 3S
 - .5 W.R. Meadows, Sealtight Liqui-Hard
 - .2 Penetrating Water Repellent Treatment for Concrete Base: Liquid applied penetrating treatment, clear water based vapour permeable silane/siloxane micro emulsion formulated to prevent water and chloride intrusion into concrete surfaces and as follows:
 - .1 Acceptable Materials:
 - .1 Evonik Industries, Protectosil AQUA-TRETE EM
 - .2 L & M Construction Chemicals, Hydopel WB
 - .3 L.M. Scofield, Repello

3. EXECUTION

3.01 WORKMANSHIP

- .1 Prepare floor slabs in accordance with Table 22 of CSA A23.1, ACI 302.1R and as modified by this specification.

3.02 EXAMINATION

- .1 Repellent Installation Verification: Prepare an area approximately 1000 mm x 1000 mm in an area not exposed in final construction as directed by the City and spray surface with water repellent treatment to determine application rate as required by manufacturer:
 - .1 Use coverage rate determined by pre-installation testing as a basis for application of water repellent treatments for the remainder of the project.

3.03 FORMED SURFACES

- .1 Unspecified Finish: Provide following finishes as applicable when finish of formed surfaces is not specifically indicated:
 - .1 Rough form finish for all concrete surfaces not exposed to public view.
 - .2 Smooth form finish for all concrete surfaces exposed to public view.
- 1. Refer to Section 03 31 00 for definition of formed surface finishes.

3.04 FINISHING VERTICAL SURFACES

- .1 Penetrating Wall Treatment Finish: Apply penetrating sealer to vertical surfaces after any patching, joint sealing or caulking is completed in accordance with manufacturer's written instructions and as follows:
 - .1 Protect adjacent surfaces from overspray.
 - .2 Use low pressure spraying equipment as practical; use brushes where overspray has potential to damage or affect adjacent surfaces.
 - .3 Maintain wet surface until treatment application is fully applied.

3.05 FINISHING FLOORS AND SLAB SURFACES

- .1 Finish floors and slabs in general conformance with CSA A23.1 and ACI 302.1R recommendations for screeding, re-straightening, and finishing operations for concrete surfaces; do not wet concrete surfaces while finishing.
- .2 Sealers and Curing Aids: Application of sealers and curing aids listed in Section 03 31 00 or forming a part of work referenced by other related requirements will not be permitted on floors receiving subsequent floor covering systems; application of sealers or curing aids will require re-profiling of the surface and application of cementitious topping by this Section that is acceptable to work affected.
- .3 Unspecified Finishing: Provide following finishing classes as applicable when finishing requirements for floors is not specifically indicated:
 - .1 Exterior Slabs: F2-Finishing Class with a broom finish.
 - .2 Interior Slabs: F3-Finishing Class with a trowelled finish.
- .4 Float Finishing: Consolidate surface; re-straighten, cut down high spots, and fill low spots; repeat float passes and re-straightening until surface is left with a uniform, smooth, granular texture and as follows:
 - .1 Finish to F2-Finishing Class when float is the final finish; provide additional finishing as indicated below for surfaces requiring additional flatness tolerances.
 - .2 Apply float finishing to surfaces receiving trowel finishing.
- .5 Trowel Finishing: Commence trowel finishing once float finishing is completed, after all bleed water has disappeared and when concrete has stiffened sufficiently to prevent working excess mortar to surface; use power driven floats or hand floating for areas that are inaccessible to power driven floats, and as follows:
 - .1 Finish to F3-Finishing Class.
 - .2 Apply a trowel finishing to surfaces exposed to view or covered with ceramic tile.
- .6 Trowel and Fine Broom Finishing: Apply trowel finishing to surfaces where large format porcelain tile is scheduled for installation by either thickset or thin set method; finish to F4-Finishing Class.

- .7 Broom Finishing: Apply broom finishing to exterior concrete platforms, steps, and ramps; slightly roughen trafficked surface by brooming perpendicular to main traffic route immediately after float finishing.
- .8 Liquid Applied Floor Hardener Finishing: Apply liquid floor densifier to surfaces in accordance with manufacturer's written instructions after curing of concrete, a minimum of 8 days after concrete placement or when sufficient free lime is available to react with sodium silicate.

3.06 WORK SITE QUALITY CONTROL

- .1 Testing and Measurements for Slabs-on-Grade: Make floor surface F_F and F_L measurements in accordance with CSA A23.1 within 72 hours of placement to confirm installation tolerances, and report results and corrective actions as indicated above for Informational Submittals.
- .2 Failed tests in excess the following floor surface F_F and F_L tolerances will require the Contractor to flash patch floor to achieve specified tolerance; example of tolerance failure:
 - .1 Slabs-on-Grade: Measurements in excess of 50% of the average flatness requirement will be considered as a failed test and will require flash patching.
- .3 Manufacturer's Site Services for Water Repellent Treatments: Provide manufacturer's written certification that surface preparation method and final condition meets requirements for manufacturer's warranty conditions as follows:
 - .1 Spray test water repellent treatments after surfaces are dried; recoat surfaces that show water absorption.
- .4 Non-Conforming Work: Repair concrete floor slabs where they exceed the tolerances listed above using the following methods:
 - .1 Floor Level Excess (High Spots): Grind and smooth surface areas that are above listed tolerances; limited to a maximum 5 mm of surface removal after which the Bird Bath procedure will be used to fill low areas.
 - .2 Floor Level Deficiency (Bird Baths): Saw cut perimeter of surface areas that are lower than listed tolerances to a minimum depth of 3 mm and as follows:
 - .1 Grind perimeter to a minimum of 6 mm to allow for flush flash patching.
 - .2 Roughen surface of flash patch area to a minimum ICRI CSP 5 – Medium Shotblast.
 - .3 Clean flash patch area and trowel in floor levelling mortar in accordance with manufacturers written instructions.
 - .4 Smooth and level surface of flash patch to match adjacent floor surfaces.
 - .3 Leave floors ready for applied floor finishes supplied and installed by other sections.

END OF SECTION

1. GENERAL**1.01 SUMMARY**

- .1 Provide a densified, dust and wear resistant finish for architecturally exposed steel trowel finished concrete slabs.
- .2 Concrete materials and finishing specified in this Section are intended to act as the primary finish for floors on the project; and as such, must be protected from contaminants and traffic that have potential to detract from the final appearance such as cutting oils, food or drinks, permanent markers, vehicles and other applied permanent finishes for the duration of construction.

1.02 RELATED REQUIREMENTS

- .1 Section 03 31 00 – Cast-in-Place Concrete: Confirm concrete curing methods and material requirements are compatible with products specified in this Section.
- .2 Section 03 35 00 – Concrete Finishing: Concrete placing and levelling requirements for steel trowel finished slabs.

1.03 DEFINITIONS

- .1 The following definitions apply to the Densified Concrete Floor Finishing specification:
- .2 Densified Concrete: Chemical hardening process that react with free lime contained at the concrete surface to provide a natural, dustproof and densified surface.

1.04 ADMINISTRATIVE REQUIREMENTS

- .1 Coordination: Coordinate with Section 03 31 00 for wet curing methods and that any liquid curing compounds; whether specified or not, and that may have been applied to concrete slabs is fully removed before starting application of concrete densifier agents specified in this Section.
- .2 Preconstruction Meeting: Arrange a preconstruction meeting including City, Contractor, Subcontractor for work of this Section and other components of the work to discuss effects and issues governing installation of polished concrete floor finishes including protection of concrete surfaces from marking pens, cutting oils and other deleterious materials that could damage the final finish.

1.05 SUBMITTALS

- .1 Provide required information in accordance with Section 01 00 06 – General Requirements: Submittals.
- .2 Action Submittals: Provide the following submittals before starting any work of this Section:
 - .1 Product Data: Submit manufacturer's product data for each material specified including recommended application rates and methods of installation.

1.06 PROJECT CLOSEOUT SUBMISSIONS

- .1 Operation and Maintenance Data: Submit manufacturer's written cleaning and maintenance instructions for applied finishes and instruct City in proper care and maintenance of specified floor finishes; include a complete list of floor care products that will be required for on-going maintenance and name of original installer and contact information in accordance with Section 01 00 06 – General Requirements: Closeout Submissions.

1.07 QUALITY ASSURANCE

- .1 Qualifications: Provide proof of qualifications when requested by City:
 - .1 Installers: Use skilled workmen experienced in concrete finishing methods similar in complexity and extent similar to that required for the project.

1.08 DELIVERY, STORAGE AND HANDLING

- .1 Delivery and Acceptance Requirements: Deliver materials to prevent damage to containers or bags, or damage from freezing or over heating; store materials in a clean, dry, heated location until ready for use.

1.09 WORK SITE CONDITIONS

- .1 Ambient Conditions: Install when area is clean and ready for finishing operations; having sufficient water, temporary heat and light, and adequate power and outlets for operation of floor grinding and polishing equipment and temperature is within manufacturers recommended range.

2. PRODUCTS**2.01 MANUFACTURERS**

- .1 Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include the following:
 - .1 Convergent Concrete Technologies
 - .2 L & M Construction Chemicals
 - .3 L.M. Scofield Company
 - .4 Prosoco Inc. Consolideck
 - .5 W.R. Meadows Canada

2.02 PERFORMANCE REQUIREMENTS

- .1 Volatile Organic Compound (VOC) Limitations: Provide products for each site applied coating used within the building envelope (interior side of weatherproofing system) complying with the VOC Limits established in South Coast Air Quality Management District Rule #1113, Architectural Coatings.

2.03 MATERIALS

- .1 Concrete Densifier and Chemical Hardener (CD): Ready-to-use, liquid applied anti-dusting treatment, concrete densifier and chemical hardener that does not require surface rinsing or brushing; water based, colourless liquid formulated with chemically reactive lithium-silicate compound having maximum VOC content or less than stated above, and as follows:
 - .1 Acceptable Materials:
 - .1 Euclid Chemical Company, Ultrasil Li+
 - .2 L & M Construction Chemicals, LiON Hard
 - .3 Prosoco, Consolideck LS/CS
 - .4 W.R. Meadows, Liqui-Hard Ultra

2.04 EQUIPMENT

- .1 Spray Equipment: Use manufacturer's recommended spraying equipment and nozzles required to achieve sufficient wetting and chemical reaction.

3. EXECUTION**3.01 EXAMINATION**

- .1 Examine areas to receive densified concrete treatments and confirm that surfaces are ready for installation of materials specified in this Section and that concrete is free from defects that affect proper execution of work of this Section.
- .2 Start work only when all defects have been corrected.

3.02 PREPARATION

- .1 Protect floor areas identified for polished concrete finishes from other trades, communicate to other trades that marking pens, cutting oils or contact from other substances deleterious to final finish will not be permitted.
- .2 Verify that floor surface is free from materials that could affect chemical hardening and polishing process; and that concrete is sufficiently cured to permit chemical hardening reaction.
- .3 Protect adjacent surfaces not designated to receive treatment; confirm that specified treatments can penetrate concrete surfaces.
- .4 Fill saw cut control joints with manufacturer recommended joint filler to prevent spalling and chipping of joint edges.

3.03 APPLICATION

- .1 Concrete Densifier: Apply liquid floor densifier to surfaces in accordance with manufacturer's written instructions after initial floating; cure concrete in accordance with manufacturer's recommended procedures for a minimum of 28 days until sufficient free lime is available to activate the chemical hardening process and as follows:
 - .1 Apply densifier at rate recommended by manufacturer.
 - .2 Do not dilute except as specifically stated by manufacturer.
 - .3 Squeegee puddles as they occur.
 - .4 Scrub surface to achieve a matte finish.
 - .5 Restrict foot traffic for a minimum 8 hours or longer as recommended by manufacturer.

3.04 CLOSEOUT ACTIVITIES

- .1 Demonstration: Train City's designated maintenance personnel in the care and upkeep of densified concrete treatment, based on written maintenance instructions provided in accordance with Section 01 00 06 – General Requirements: Project Closeout.

END OF SECTION

1. GENERAL**1.01 SUMMARY**

- .1 This section includes requirements for design, supply, delivery and installation of precast concrete architectural wall panels, copings and other scheduled items, and application of site applied penetrating surface sealant and joint sealants.
- .2 This section shall be responsible for reviewing shop drawings of structural steel supplier and coordinating information for installation of bracing, supports, inserts and similar accessories that are required for work under this contract and that shall be supplied and installed by other Sections of the Work.
- .3 These sections shall take delivery and cast into precast workboxes, inserts, and openings required by other Sections of the Work.
- .4 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.

1.02 RELATED REQUIREMENTS

- .1 Section 03 31 00 – Structural Concrete: Setting only of inserts or anchors required for architectural precast concrete.
- .2 Section 05 12 00 – Structural Steel Framing: Bracing and structural items required by this section, but supplied and installed by other work of the Project.
- .4 Section 05 50 00 – Metal Fabrications: Embed plates, lintels and structural items for substrates required by this section, supplied by this section, but turned over to other work of the Project for installation.
- .5 Section 07 21 13 – Board Insulation
- .6 Section 07 25 19 – Foamed-In-Place Insulation
- .7 Section 07 92 00 – Joint Sealants: Sealants and joint fillers.
- .8 Section 08 11 13 – Steel Doors and Frames
- .9 Section 08 41 13 – Aluminum Framed Entrances and Storefronts
- .10 Section 08 44 26 – Point Supported Glass Curtain Wall Assemblies

1.03 DEFINITIONS

- .4 The following definitions apply to the Precast Architectural Concrete specification:
- .5 Equal Dimensions: Precast panels and items indicating equal dimensions on the drawings shall be calculated to align with in-place structural elements followed by even division of the space between structural elements. This shall mean that precast items are evenly spaced between adjacent structural members, not necessarily evenly spaced across the entire wall assembly.

1.04 REFERENCE STANDARDS

- .4 American Society for Testing and Materials (ASTM International):
 - .1 ASTM A123/A123M-13, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
 - .2 ASTM C260-06, Standard Specification for Air-Entraining Admixtures for Concrete
 - .3 ASTM C494/C494M-08A, Standard Specification for Chemical Admixtures for Concrete
 - .4 ASTM D412-06AE1, Standard Test Methods for Vulcanized Rubber and Thermoplastic Rubbers and Thermoplastic Elastomers-Tension
 - .5 ASTM D2240-05, Standard Test Method for Rubber Property-Durometer Hardness
- .5 Canadian General Standards Board (CGSB):
 - .1 CAN/CGSB-1.40-97, Anticorrosive Structural Steel Alkyd Primer
 - .2 CAN/CGSB-1.181-99, Ready-Mixed Organic Zinc-Rich Coating
- .6 Canadian Precast Prestressed Concrete Institute (CPCI):
 - .1 CPCI Handbook
 - .2 CPCI Precast Concrete Certification Program for Architectural and Structural Precast Concrete Products and Systems
- .7 Canadian Standards Association (CSA Group):
 - .1 CAN/CSA A23.1-14/A23.2-14, Concrete Materials and Methods of Concrete Construction
 - .2 CAN/CSA A23.3-14, Design of Concrete Structures
 - .3 CSA A23.4-16, Precast Concrete - Materials and Construction
 - .4 CSA A283-06 (R2016), Qualification Code for Concrete Testing Laboratories
 - .5 CAN/CSA A3000-18, Cementitious Materials Compendium
 - .6 CSA G30.18-09, Carbon Steel Bars for Concrete Reinforcement
 - .7 CSA G40.20-13/G40.21-13, General Requirements for Rolled or Welded Structural Quality Steel Structural Quality Steel
 - .8 CSA W47.1-09 (R2014), Certification of Companies for Fusion Welding of Steel
 - .9 CSA W186-M1990 (R2016), Welding of Reinforcing Bars in Reinforced Concrete Construction
- .8 Precast/Prestressed Concrete Institute (PCI):
 - .1 PCI MNL 116-99, Quality Control for Plants and Production of Structural Precast and Prestressed Concrete Products
 - .2 PCI MNL 117-96, Quality Control for Plants and Production of Architectural Precast and Prestressed Concrete Products
 - .3 PCI MNL 120-04, PCI Design Handbook, 6th Edition

1.05 ADMINISTRATION REQUIREMENTS

- .4 Preinstallation Conference: Conduct conference at Project site to comply with requirements in Section 01 00 06 – General Requirements: Project Meetings, attended by Contractor, Consultant and the City to discuss the following:
- .5 Coordination: Coordinate installation of anchorages and embed plates with Section 03 31 00 and Section 05 50 00, as follows:
 - .1 Provide setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry.
 - .2 Deliver such items to Project site in time for installation.

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- .3 Provide anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, templates, instructions, and directions, as required, for installation.
 - .6 Coordinate with other work of this project and fabricate work of this section to accommodate specified tolerances.
- 1.06 SUBMITTALS
- .4 Provide required information in accordance with Section 01 00 06 – General Requirements: Submittals.
 - .5 Action Submittals: Provide the following submittals before starting any work of this Section:
 - .1 Shop Drawings: Submit shop drawings in accordance with CSA A23.3 and CSA A23.4 and, and as follows:
 - .1 Provide fully detailed and dimensioned drawings showing method of fastening and sealing and provisions made to receive work of other Sections.
 - .2 Indicate type of finish and other pertinent information on each shop drawing.
 - .3 Coordinate with reviewed shop drawings relating to interface elements and show exact location of inserts and anchors cast into precast concrete units for interface elements.
 - .4 Show system of identifying units for erection purposes on shop drawings and apply similar mark on precast concrete units at time of manufacture.
 - .5 Provide shop drawings to and obtain approvals from the authorities having jurisdiction prior to fabrication of the precast panels, when required by the authorities having jurisdiction.
 - .6 Informational Submittals: Provide the following submittals when requested by the Consultant:
 - .1 Certificates: Submit proof of certification prior to starting work of this section appropriate to the work of this section as follows:
 - .1 Class A Precast Concrete Products – Architectural; Type I Non-Prestressed.
 - .2 Design Notes: Submit relevant design data prepared by a registered structural engineer for review when requested by the Consultant, and as follows:
 - .1 Submit sketches and design calculations for non-standard connections.
 - .2 Design and detail connections; not detailed on the drawings, and required by the fabricator for the loads indicated on the drawing or ½ of uniformly distributed factored loads for laterally supported beams in the Handbook of Steel Construction.
- 1.07 QUALITY ASSURANCE
- .4 Regulatory Requirements: Materials and workmanship shall conform to CSA A23.4, and as follows:
 - .1 Conform to the requirements of the Alberta Building Code 2017, and local authorities having jurisdiction; design and provide reinforcement, anchors and supports as required by codes.
 - .5 Qualifications: Provide proof of qualifications when requested by Consultant:
 - .1 Manufacturers: Use architectural precast concrete manufacturers certified to CPCI Certification Program and meeting requirements of CSA A23.4; including appendices A and B, and with PCI MNL 116 and 117 certification requirements, and as follows:

- .1 Having experience in manufacturing precast architectural concrete units similar to those indicated for this Project and with a record of successful in-service performance.
 - .2 Having responsibility for engineering precast architectural concrete units to comply with performance requirements; including preparation of shop drawings and comprehensive engineering analysis by a qualified professional engineer.
 - .3 Have sufficient production capacity to produce required units without causing delay to the Work.
 - .4 Having membership in good standing with the Canadian Precast/Prestressed Concrete Institute (CPCI) and have a proven record and satisfactory experience in the design, manufacture and erection of precast concrete facing units of the type specified.
 - .5 Precast concrete manufacturer shall have adequate financing, equipment, plant and skilled personnel to detail, fabricate and erect the work of this Section as required by the Specification and Drawings.
 - .6 Precast concrete manufacturer shall have plant of adequate size to maintain the required delivery schedule.
- .2 Source Quality Control: Use same brand and source of cement and aggregate for entire project to ensure uniformity of colouration and other mix characteristics.

1.08 MOCK-UPS

- .4 Provide required sample panel and mock-ups in accordance with Section 01 00 06 – General Requirements: Quality Control, and as follows:
- .1 Sample Panels
 - .1 Produce sample panels before fabricating precast architectural concrete units, produce sample panels to establish the approved range of selections made under sample submittals.
 - .2 Produce a minimum of three (3) sets of full scale sample panels, approximately 1200 mm long by 1200 mm high, to demonstrate the expected range of finish, colour, and texture variations.
 - .3 Locate panels on site as directed by Consultant.
 - .4 Damage part of an exposed face surface for each finish, colour, and texture, and demonstrate materials and techniques proposed for repair of surface blemishes to match adjacent undamaged surfaces.
 - .5 Maintain sample panels during construction in an undisturbed condition as a standard for judging the completed Work.
 - .6 Demolish and remove sample panels when directed
 - .2 Mock-ups:
 - .1 Construct mock-ups before installing precast architectural concrete units to verify selections made under sample submittals and to demonstrate aesthetic effects and qualities of materials and execution.
 - .2 Construct mock-ups in the location and of the size as directed by Consultant.
 - .3 Notify Consultant seven (7) days in advance of dates and times when mock-ups will be constructed.
 - .4 Obtain Consultant's acceptance of mock-ups before starting fabrication.
 - .5 Damage part of an exposed face for each finish, colour, and texture, and demonstrate materials and techniques proposed for repairs to match adjacent undamaged surfaces.
 - .6 Maintain mock-ups during construction in an undisturbed condition as a standard for judging the completed work of this Section.
 - .7 Demolish and remove mock-ups when directed.

- .8 Acceptable mock-ups may become part of the completed work of this Section if undisturbed at time of Substantial Performance.

1.09 DELIVERY, STORAGE, AND HANDLING

- .4 Delivery and Acceptance Requirements: Precast concrete manufacturer shall accept full responsibility for delivery, handling and storage of units.
- .5 Storage and Handling Requirements: Deliver, handle and store precast concrete units in a near vertical plane at all times, and by methods approved by the manufacturer, and as follows:
 - .1 Store units to prevent contact earth or staining influences and to prevent units from resting on corners
 - .2 Remove defective units from site immediately; do not stockpile to prevent accidental use in final construction
 - .3 Construct easels for stacking units and place non-staining spacers between each unit; wrap wood with polyethylene
 - .4 Protect holes and reglets from water and ice during freezing weather

1.10 PROJECT CONDITIONS

- .4 Site Measurements: Verify dimensions by site measurements before fabrication and indicate measurements on shop drawings where precast concrete panels are indicated to fit together with other construction; coordinate fabrication schedule with construction progress to avoid delaying the Work.
- .5 Established Dimensions: Establish dimensions and proceed with fabricating precast concrete panels without site measurements where site measurements cannot be made without delaying the Work; coordinate construction to ensure that actual dimensions correspond to established dimensions; allow for shimming and fitting.

1.11 WARRANTY

- .4 Provide a written warranty in the name of the Owner warranting that the precast units will not spall, or show evidence of visible cracking resulting from inferior materials or workmanship by this section for a period of five (5) years from date of Substantial Performance.
- .5 Units showing such defects will be replaced and made good together with all work of other trades damaged during removal of defective precast at no expense to the Owner.

2. PRODUCTS

- .4 Design architectural wall panels to provide non-composite insulated panels having an RSI value of wall assembly as indicated on Drawing A0.01.

2.03 MOULD MATERIALS

- .4 Moulds: Provide moulds and, where required, form facing materials of metal, plastic, wood, or another material that is non-reactive with concrete and dimensionally stable to produce continuous and true precast concrete surfaces within fabrication tolerances and suitable for required finishes.
- .5 Form Liners: Units of face design, texture, arrangement, and configuration as indicated on the Drawings.
- .6 Architectural Precast Concrete Wall Panels:
 - .1 Basis-of-Design Product: Reckli 2/77 Tigris

2.04 REINFORCING MATERIALS

- .4 Reinforcing Steel: In accordance with CSA G30.18, Grade 400W.
- .5 Welded wire fabric: In accordance with CSA G30.18, Grade 400W.
- .6 Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire fabric in place according to PCI MNL 117; use plastic materials only.
- .7 Tie wire: Minimum 1.5 mm annealed wire.

2.05 CONCRETE MATERIALS

- .4 Cement, white cement, aggregates, water and admixture: in accordance with CSA A23.4 and CSA A23.1.
 - .5 Supplementary cementing materials: in accordance with CSA A23.5.
 - .6 Air entrainment admixture: in accordance with ASTM C260, refer to CSA A23.1, for location and exposure requirements.
 - .7 Use of calcium chloride is not permitted.
 - .8 Surface retardant: in accordance with ASTM C494.
 - .9 Water: To CSA A23.1/A23.2, clear potable.
 - .10 Water Reducing Admixture: ASTM C494, Type A.
 - .11 Chemical admixtures: To CSA A23.1/A23.2.
 - .12 Pozzolanic mineral admixtures: To CSA A23.5.
 - .13 Architectural Wall Panel Insulation: Rigid plastic insulation as specified in Section 07 21 13.
 - .14 Penetrating Surface Sealant: Spray solution, 40% (by volume) solution of alkyltrialhoxy silane in anhydrous isopropanol applied using low-pressure airless type spray equipment of 100-200 kPa application pressure with spray bar unit for large areas, and hand sprayer for small areas.
 - .1 Acceptable material:
 - .1 Harris Specialty Chemicals Inc., Hydrozo Clear 40
 - .2 Evonik Degussa Protectosil, Chem-Trete BSM 400
 - .15 Anti-Graffiti Treatment: Waterborne, zero VOC silane based vapour permeable, non-sacrificial anti-graffiti treatment designed to protect surfaces and allow easy removal of spray paint, solvent and water based paints and coatings, permanent marker, ink and bituminous materials:
 - .1 Basis-of-Design Materials: Evonik Degussa Protectosil Antigrffiti
 - .16 Joint Sealants: Non-sag, two component materials as specified in Section 07 92 00.
-
- 2.06 STEEL CONNECTION MATERIALS**
- .4 Plates, HSS, Pins: To CSA G40.20/G40.21, Grade 300W.
 - .5 Welding materials: in accordance with CSA W47.1 and CSA W186.

- .6 Galvanizing: For exterior steel items, steel in exterior walls, and items indicated for galvanizing; apply zinc coating by hot-dip process as follows:
 - .1 To ASTM A123/A123M, minimum zinc coating of 610 g/m²
 - .2 Galvanizing Repair Paint: High zinc dust content paint with dry film containing not less than 94% zinc dust by weight
- .7 Primer: For interior steel items, and high mass steel in non-weather exposed exterior locations as follows:
 - .1 Steel Primer: In accordance with CGSB 1.40.
 - .2 Zinc Rich Primer: In accordance with CGSB 1.181.
- .8 Accessories: Provide clips, hangers, plastic shims, and other accessories required to install precast architectural concrete units.

2.07 BEARING PADS

- .4 Provide bearing pads for precast architectural concrete units as follows:
 - .1 Elastomeric Pads: AASHTO M251, plain, vulcanized, 100% polychloroprene (neoprene) elastomer, moulded to size or cut from a moulded sheet, 50 to 70 Shore A durometer, minimum tensile strength 15.5 MPa per ASTM D412.
 - .2 High Density Plastic: Multimonomer, non-leaching, plastic strip.

2.08 GROUT MATERIALS

- .4 Sand-Cement Grout: Hydraulic cement and clean, natural sand. Mix at ratio of 1 part cement to 2½ parts sand, by volume, with minimum water required for placement and hydration capable of developing compressive strength of 40 MPa at 28 days.
- .5 Non-metallic, Non-shrink Grout: Premixed, non-metallic, non-corrosive, non-staining grout containing selected silica sands, hydraulic cement, shrinkage-compensating agents, plasticizing and water reducing agents, of consistency suitable for application.

2.09 CONCRETE MIXES

- .4 Use grey cement in facing matrix, as required to achieve aesthetic appearance required by Consultant as described under item 2.11 below.
- .5 Design mixes may be prepared by a qualified independent testing agency or by qualified precast plant personnel at precast architectural concrete fabricator's option.
- .6 Limit water soluble chloride ions to the maximum percentage by weight of cement permitted by CSA standard.
- .7 Normal Weight Concrete Face and Backup Mixes: Proportion mixes by either laboratory trial batch or site test data methods with materials to be used on Project, to provide normal weight concrete with the following properties:
 - .1 Compressive Strength (28 Days): 34.5 MPa
 - .2 Maximum Water-Cementitious Materials Ratio: 0.45

2.10 MOULD FABRICATION

- .4 Moulds: Accurately construct moulds, mortar tight, of sufficient strength to withstand pressures due to concrete placement operations and temperature changes and for pre-stressing operations.

.5 Maintain moulds to provide completed precast architectural concrete units of shapes, lines, and dimensions indicated, within fabrication tolerances specified.

.6 Edge and Corner Treatment: Uniformly chamfered.

2.11 PANEL FABRICATION

.4 Fabricate architectural precast concrete units in accordance with CSA A23.4, and as follows:

- .1 Identify pickup points of precast architectural concrete units and orientation in structure with permanent markings, complying with markings indicated on shop drawings.
- .2 Mark each precast unit to correspond to identification mark on shop drawings for location.
- .3 Mark each precast unit with the date cast.
- .4 Verify that surfaces to receive sealant are smooth and free of laitance to provide a suitable base for adhesion.
- .5 Verify that release agents do not deleteriously affect the sealing of the joints.
- .6 Cure concrete by moisture retention without heat or by accelerated heat curing using low pressure live steam or radiant heat and moisture.
- .7 Cast panels face down in accurate rigid moulds designed to withstand high frequency vibration.
- .8 Vibrate concrete continuously during casting until full thickness is reached.
- .9 Provide necessary holes and sinkages for flashings, anchors, cramps, and similar insert items.
- .10 Separately and accurately batch cement and aggregates uniformly by weight to ensure maintenance of even and uniform appearance.
- .11 Burn off lift cables paint and fill in where required if unit is damaged due to burn off.

.5 Fabricate anchorage hardware with sufficient anchorage and embedment to comply with design requirements, and as follows:

- .1 Accurately position for attachment of loose hardware, and secure in place during precasting operations.
- .2 Locate anchorage hardware where it does not affect position of main reinforcement or concrete placement.

.6 Provide loose steel plates, clip angles, seat angles, anchors, dowels, cramps, hangers, and other hardware shapes for securing precast architectural concrete units to supporting and adjacent construction.

.7 Cast slots, holes, and other accessories in precast architectural concrete units to receive windows, dowels, water stops, flashings, and other similar work as indicated.

.8 Fabricate and place reinforcement in accordance with recommendations in CPCI Manual of Standard Practice and PCI MNL 117 for fabricating, placing, and supporting reinforcement, and as follows:

- .1 Clean reinforcement of loose rust and mill scale, earth, and other materials that reduce or destroy the bond with concrete.
- .2 Accurately position, support, and secure reinforcement against displacement during concrete-placement and consolidation operations. Completely conceal support devices to prevent exposure on finished surfaces.
- .3 Place reinforcement to maintain at least 19 mm minimum coverage. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position while placing concrete. Direct wire tie ends away from finished, exposed concrete surfaces.
- .4 Install welded wire fabric in lengths as long as practicable. Lap adjoining pieces at least one full mesh and lace splices with wire. Offset laps of adjoining widths to prevent continuous laps in either direction.
- .5 Set reinforcing anchors and auxiliary items to details indicated on shop drawings.

- .6 Cast in anchors, blocking and inserts supplied by other work attached to precast concrete items, as required to accommodate their work.
 - .7 Permanently attach anchors and inserts to the reinforcing, where possible.
 - .8 Lift hooks shall be adequately sized to safely handle panels according to panel dimension and weight.
 - .9 Anchors and inserts shall be concealed where practical.
 - .9 Reinforce precast architectural concrete units to resist handling, transportation, and erection stresses.
 - .10 Mix concrete according to fabricators mix design requirements in this section. After concrete batching, no additional water may be added.
 - .11 Place face mix to a minimum thickness after consolidation of the greater of 25 mm or 1.5 times the maximum aggregate size, but not less than the minimum reinforcing cover.
 - .12 Place concrete in a continuous operation to prevent seams or planes of weakness from forming in precast concrete units, and in accordance with PCI MNL 117 for measuring, mixing, transporting, and placing concrete.
 - .13 Thoroughly consolidate placed concrete by internal and external vibration without dislocating or damaging reinforcement and built-in items, using equipment and procedures complying with PCI MNL 117.
 - .14 Discard precast architectural concrete units that are warped, cracked, broken, spalled, stained, or otherwise defective unless Consultant accepts repairs.
- 2.12 FINISH
- .4 Colour Factors:
 - .1 Cement Colour: White.
 - .2 Fine Aggregate: White Silica sand.
 - .3 Course Aggregate: 10 mm to 15 mm.
 - .5 Form Liner Finish:
 - .1 Smooth finish: As cast using smooth plastic form liners; with surfaces free of pockets, sand streaks, and honeycombs, with uniform colour and texture Polished and acid etched finish.
 - .6 Textured Finish:
 - .1 Acid Etched: Light to match Consultant's sample.
 - .7 Unexposed Surface Finish: Unexposed surfaces of precast architectural concrete units by float finish.
- 2.13 SOURCE QUALITY CONTROL
- .4 An independent inspection and testing company may be appointed by the Owner to verify compliance with the requirements of this Specification Section in accordance with Section 01 00 06 – General Requirements: Quality Control.
 - .5 Cooperate with the City's Inspection Agency to facilitate their work.
 - .6 Cost for inspection will be paid for directly by the City.

3. EXECUTION**3.02 EXAMINATION**

- .4 Examine substrates and conditions for compliance with requirements for installation tolerances, true and level bearing surfaces, and other conditions affecting performance. Proceed with installation only after unsatisfactory conditions have been corrected.
- .5 Do not install precast concrete units until supporting concrete or masonry has attained minimum design compressive strength.

3.03 INSTALLATION

- .4 Hand over items to be installed by Section 03 31 00, and coordinate timing with Contractor and as follows:
 - .1 Provide items in ample time to meet construction program.
 - .2 Supply layout drawings locating accurately the position of items being installed by other Sections of the work.
- .5 Erect precast work in accordance with CSA A23.4, and as follows:
 - .1 Set precast concrete units, straight, level and square.
 - .2 Non-cumulative Erection Tolerances:
 - .1 Joint Dimension: Nominal 15 mm \pm 6 mm.
 - .2 Joint Taper: Unit edges at joint not out of parallel greater than 0.6 mm in 300 mm, with cumulative total not greater than 3 mm total
 - .3 Edge Alignment: Alignment of panel edges not greater than 6 mm
 - .4 Offset in faces of adjacent panels not greater than 3 mm.
 - .5 Bowed Panels: Within allowable bowing tolerances, arranged so offset between adjacent panels does not exceed 6 mm
 - .3 Fasten units in place by welding wherever possible. Protect work from damage by weld splatter.
 - .4 Provide temporary erection anchorage for welded anchorage system.
 - .5 Tighten with equal torque; secure bolts with lock washers or tack weld nut to bolt, where bolts are used for installation.
 - .6 Clean site welds with wire brush and touch up with steel primer or zinc rich primer to match steel finish materials.
 - .7 Remove shims and spacers from joints between non-load bearing panels after fastening but before sealant is applied.
 - .8 Provide and install sufficient temporary bracing to brace precast concrete units adequately, at all stages of construction, so that units will safely withstand loads to which they may be subjected; keep temporary bracing in position until all connections have been completed.
 - .9 Apply joint sealant and backing to exterior and interior joints to provide a complete weather tight installation in accordance with Section 07 92 00; vent exterior joints.
 - .10 Apply penetrating surface sealant as follows:
 - .1 Apply solution directly as supplied by manufacturer with no dilution or alteration of any kind.
 - .2 Surfaces shall be dry, ambient temperature not less than 4°C and not more than 36°C, and no wind.
 - .3 Apply solution using approved spray equipment at rate in accordance with manufacturer's written instructions.

- .11 Apply anti graffiti coating sealant in accordance with manufacturer's written instructions and as follows:
 - .1 Cure concrete and concrete repairs a minimum of 28 days.
 - .2 Apply solution in a three coat application using approved spray equipment at rate in accordance with manufacturer's written instructions.
 - .3 Protect nonporous surfaces from overspray.

3.04 REPAIRS

- .4 Repair exposed exterior surfaces of precast architectural concrete units to match colour, texture, and uniformity of surrounding precast architectural concrete if permitted by Consultant.
- .5 Remove and replace damaged precast architectural concrete units if repairs do not comply with requirements.

3.05 CLEANING

- .4 Clean exposed surfaces of precast concrete units after erection to remove weld marks, other markings, dirt, and stains:
 - .1 Wash and rinse according to precast concrete fabricator's written recommendations. Protect other work from staining or damage due to cleaning operations.
 - .2 Do not use cleaning materials or processes that could change the appearance of exposed concrete finishes.

END OF SECTION

1. GENERAL**1.01 SUMMARY**

- .1 This Section includes general provisions and common work results applicable to work relating to the fabrication and erection of structural steel, steel decking, wind load bearing steel stud framing and metal fabrications.

1.02 REFERENCE STANDARDS

- .1 Canadian Standards Association (CSA):
 - .1 CSA G40.20-13/G40.21-13, General Requirements for Rolled or Welded Structural Quality Steel
 - .2 CSA S16-09, Design of Steel Structures
 - .3 CSA S136-12, North American Specification for the Design of Cold-Formed Steel Structural Members and Commentary
 - .4 CSA W47.1-09, Certification of Companies for Fusion Welding of Steel
 - .5 CSA W48-06, Filler Metals and Allied Materials for Metal Arc Welding
 - .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)
 - .8 CSA W178.1-08, Certification of Welding Inspection Organizations
 - .9 CSA W178.2-08, Certification of Welding Inspectors
- .2 Canadian Institute of Steel Construction (CISC):
 - .1 1995, Fundamentals of Structural Shop Drafting (Fifth Edition)
 - .2 2008, CISC Code of Standard Practice (Seventh Edition)
 - .3 May 2010, Handbook of Steel Construction (Tenth Edition)
- .3 Canadian Welding Bureau (CWB Group Industry Services):
 - .1 CWB 112E/04-1, Welding Symbols Study Guide
 - .2 CWB 113E/07-1, Weld Quality and Examination Methods Study Guide

1.03 DEFINITIONS

- .1 The following definitions apply to the Common Work Results for Metals specification:
- .2 Quality Audit: Tests, inspections, procedures and related actions performed by the City during and after execution of the Work using third party testing agency to establish that work complies with Contract Documents and are additional to the Quality Control and Assurance provided by the Contractor, or contract administration and reporting performed by City.
- .3 Quality Control: Tests, inspections, procedures, and related actions during and after execution of the Work by a third-party testing agency to evaluate that completed construction complies with requirements whose services do not include contract enforcement activities performed by City.
- .4 Quality Assurance: Activities, actions, and procedures performed before and during execution of the Work by the Contractor and Subcontractor to guard against defects and deficiencies and ensure proposed construction complies with requirements.
- .5 Delegated Design Professional Engineer: The professional engineer hired or contracted to the fabricator or manufacturer to design specialty elements, produce delegated design submittals and shop drawings to meet the requirements of the Project; who is registered in the province of the Work; and who is not the City's consultant.

- .6 Letters of Commitment and Compliance: Documents prepared by the delegated design professional engineer as recommended by APEGA's Responsibilities for Engineering Services for Building Projects.

1.04 ADMINISTRATIVE REQUIREMENTS

- .1 Coordination: Coordinate shop priming and finishing requirements with Section 05 05 19.
- .2 Testing and Inspections: City will appoint and pay for services of testing agency to perform testing and inspection of work of this Section:
 - .1 Notify City prior to commencement of fabrication work so testing and inspection may be properly scheduled and reviewed.
 - .2 City may request additional testing and inspection at Contractor's expense when defects are identified.
 - .3 Correct, or remove and replace structural steel with defects revealed by testing and inspection to the recommendations of the testing authority and to the approval of authorities having jurisdiction.
- .3 Sequencing: Sequence steel work to account for the following:
 - .1 Supply anchorage items embedded in or attached to other construction without delaying the Work.
 - .2 Deliver steel bearing plates and other devices built into concrete and masonry construction so as not to cause delay to the project.
 - .3 Schedule delivery of structural steel to Project site in quantities and at times to maintain continuity of installation.
 - .4 Schedule delivery of steel joists to Project site in quantities and at times to maintain continuity of installation.
- .4 Delegated Design Requirements: Design structural steel connections required by the Contract Documents to withstand design loadings indicated and in accordance with requirements of the Building Code and CAN/CSA S16 to resist forces, moments, shears and allow for movements indicated:
 - .1 Engage fabricator who utilizes registered professional engineer to prepare calculations, shop drawings, and other structural data for steel joists and connections not shown on drawings that comply with requirements of this Section.
 - .2 Retain registered professional engineer to ascertain and report fabrication and erection of work meets specific design criteria for materials referenced by Related Requirements.

1.05 SUBMITTALS

- .1 Provide required information in accordance with Section 01 00 06 – General Requirements: Submittals.
- .2 Action Submittals: Provide the following submittals before starting any work of this Section:
 - .1 Product Data: Submit following product test reports for steel deck materials, from qualified testing agency indicating each of following complies with requirements, based on comprehensive testing of current products:
 - .1 Provide product certificates signed by steel deck manufacturers certifying products provided comply with requirements of specifications and Building Code.
 - .2 Provide product data for mechanical and adhesive fasteners indicating load ratings and methods of installation.
 - .3 Provide product data for each type of product specified.

- .4 Provide product data for each type of coating and primer product that will receive subsequent architectural coatings.
- .3 Informational Submittals: Provide the following submittals during the course of the work:
- .1 Certificates: Submit two (2) certified copies of mill reports covering chemical and mechanical properties, and coating designation of steel used for this project.
- .2 Welder Qualifications: Submit evidence of welder qualifications specified in this Section.
- .3 Quality Management Plan: Written documents provided by the Contractor indicating quality assurance and activities undertaken by the Contractor including; but not limited to, the following:
- .1 Schedule of Tests and Inspections: Submit schedule of tests and inspections performed by the Subcontractor; prepared in tabular form and including the following:
- Specification section number and title
 - Description of test and inspection
 - Identification of applicable standards
 - Identification of test and inspection methods
 - Number of tests and inspections required
 - Time schedule or time span for tests and inspections
 - Entity responsible for performing tests and inspections
 - Requirements for obtaining samples
 - Unique characteristics of each quality assurance service
- .2 Reports: Submit written reports prepared by Contractor's inspection agency that includes the following:
- Date of issue
 - Project title and number
 - Name, address, and telephone number of testing agency
 - Dates and locations of samples and tests or inspections
 - Names of individuals making tests and inspections
 - Description of the Work and test and inspection method
 - Identification of product and specification section
 - Complete test or inspection data
 - Test and inspection results and an interpretation of test results.
 - Ambient conditions at time of sample taking and testing and inspecting.
 - Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
 - Name and signature of laboratory inspector.
 - Recommendations on re-testing and re-inspecting.
- .4 Delegated Design Submittals: Submit Letters of Commitment and Compliance in accordance with Section 01 33 50 – Delegated Design Submittals, and as follows:
- .1 At the onset of work of this section and prior to shop drawing submission, prepare and submit a Letters of Commitment, including a summary of the work covered by this section.
- .2 On completion of work of this section, prepare and submit a Letters of Compliance, including a summary of the work covered by this section.

- .3 Letters referred to in .1 and .2 above must cover all aspects of structural steel, and steel deck work including; but not limited to, design of connections and erection.
- .5 Source Quality Control Submittals: Submit following mill test reports signed by manufacturers certifying their products comply with following requirements when requested by the City:
 - .1 Structural steel, including chemical and physical properties.
 - .2 Bolts, nuts, and washers, including mechanical properties and chemical analysis.
 - .3 Direct tension indicators.
 - .4 Headed stud shear connectors.
 - .5 Twist-off tension control bolts or other alternative design bolts.

1.06 QUALITY ASSURANCE

- .1 Regulatory Requirements: Provide design, materials and fabrication in accordance with CSA S16, CSA S136 and Canadian Welding Bureau certification requirements including the following:
 - .1 Fabricator certified by CWB to CSA W47.1, Division 1 or 2.1.
 - .2 Perform welding inspection in accordance with CSA W178.1 and CSA W178.2.
 - .3 Perform resistance welding in accordance with CSA W55.3.
 - .4 Perform fusion welding in accordance with CSA W59.
 - .5 Fabricator will only be permitted to subcontract or sublet work of fabrication or installation to another CWB certified company.
 - .6 Installer must be CWB certified where they are directly subcontracted by the Contractor to same requirements as fabricator.
- .2 Qualifications: Provide proof of qualifications when requested by City:
 - .1 Retain Delegated Design Professional Engineer to design fabrication and erection of the Work of this Section in accordance with applicable Building Code and Contract Documents requirements including the following:
 - .1 Seal and signature to fabrication and erection documents and design submittals.
 - .2 Site review of installed components.
 - .3 Completion of Letters or Commitment and Compliance specified in Section 01 33 50.
 - .2 Fabricator: Use fabricator experienced in fabricating structural steel similar to that indicated for this Project and with record of successful in service performance, and sufficient production capacity to fabricate structural steel without delaying the Work.
 - .3 Installers: Use installers; if different than fabricator, experienced with structural steel work similar in material, design, and extent to that indicated for this Project; with record of successful in service performance; using welders certified by CWB for classification of work being performed; and having same certifications as required by CSA and CWB for fabricator.
- .3 Certifications: Provide proof of the following during the course of the Work:
 - .1 Welding Certificates: Comply with applicable CWB standards for classification of work being performed including following:
 - .1 Welding inspection: to CSA W178.
 - .2 Resistance welding: to CSA W55.3.
 - .3 Fusion welding: to CSA W59.

.2 Failure of fabricator and installer to maintain CSA and CWB requirements for certification will result in having their certification withdrawn in accordance with the contract that they sign with CSA and CWB, and considered as being in breach of Contract for the Work of the Project leading to decertification.

.4 Quality Management Plan: Provide inspections, testing and reports during the course of the work confirming that the work of steel fabrication and erection is conducted in accordance with the Contract Documents; the frequency of testing and inspection by the City's inspection and testing agency may be adjusted in consultation with the Contractor and City where the steel Subcontractor's own Quality Management Plan demonstrates its effectiveness during the course of the project.

1.07 DELIVERY, STORAGE, AND HANDLING

.1 Storage and Handling Requirements: Store materials to permit easy access for inspection and identification; keep steel members off ground by using pallets, platforms, or other supports; protect steel members and packaged materials from erosion and deterioration, and as follows:

- .1 Store fasteners in a protected place.
- .2 Clean and re-lubricate bolts and nuts that become dry or rusty before using.
- .3 Do not store materials on structure in manner that might cause distortion or damage to members or supporting structures.
- .4 Repair or replace damaged materials or structures as directed.

2. PRODUCTS

2.01 SUBSTITUTIONS

- .1 Use of structural steel sections other than those shown on the Drawings or listed in the Specifications will require a formal contract change unless written approval was obtained from the City by the fabricator before bid submission.
- .2 Similar products may be incorporated into the work of this Section provided they meet the performance requirements established by sections and profiles indicated on the drawings provided requests for substitution are submitted in accordance with Section 01 00 06 – General Requirements: Substitutions and Product Options.

2.02 MATERIALS

- .1 Welding Materials: Meeting requirements of CSA W48 and certified by CWB for intended use and materials.

2.03 FABRICATION

- .1 Shop Welding: Weld corners and seams continuously and as follows:
 - .1 Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - .2 Obtain fusion without undercut or overlap.
 - .3 Remove welding flux immediately.
 - .4 At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

2.04 SOURCE QUALITY CONTROL

- .1 Inspection and Testing: Refer to Section 05 08 10 for City's obligation to inspection and testing, which are additional to the Contractor's requirements under the Quality Management Plan for maintaining quality assurance.

3. EXECUTION

3.01 EXAMINATION

- .1 Report any discrepancy and potential problem areas to City for direction before commencing fabrication or erection.
- .2 Do not proceed with erection until unsatisfactory conditions have been corrected.

3.02 PREPARATION

- .1 Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads.
- .2 Verify that site safety measures are in place and personal protection equipment is worn in accordance with General Conditions of Contract before starting any work of this Section.

3.03 CONNECTION TO EXISTING WORK

- .1 Verify dimensions and condition of existing work; report any discrepancies and potential problem areas to the City before commencing with fabrication.

3.04 ERECTION

- .1 Erect structural steel in accordance with CAN/CSA S16 and CSA S136.
- .2 Obtain City's review before site cutting or altering any members.
- .3 Set structural steel accurately in locations and to elevations indicated on Drawings and reviewed shop drawings.
- .4 Site Welding: Perform welding work in accordance with CSA W59; do not weld, cut or abrade surfaces of exterior units that have been hot dip galvanized after fabrication and are for bolted or screwed site connections and as follows:
 - .1 Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - .2 Obtain fusion without undercut or overlap.
 - .3 Remove welding flux immediately.
 - .4 At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

3.05 SITE QUALITY CONTROL

- .1 Inspection and Testing: Refer to Section 05 08 10 for City's obligation to inspection and testing, which are additional to the Contractor's requirements under the Quality Management Plan for maintaining quality assurance.

END OF SECTION

1. GENERAL**1.01 SUMMARY**

- .1 This Section includes requirements regarding the appearance and surface preparation for non-exposed and exposed priming, and finishing of the following metal items and assemblies:
 - .1 Structural steel framing
 - .2 Steel deck
 - .3 Metal fabrications
 - .4 Site and Building Custom made furnishings.
 - .5 Point Supported Glass Fin Supports
- .2 Architecturally exposed structural steel welds require a higher degree of workmanship and finishing than standard exposed structural steel or metal fabrication components.
- .3 Architecturally exposed structural steel is identified on the Structural and Architectural Drawings as AESS3 level of finish identified in this Section; definitions for AESS applies equally to structural steel, and metal fabrications.
- .4 Architecturally exposed structural steel specifications and guidelines listed in this Section are based on recommended practices and procedures prepared by the Canadian Institute of Steel Construction (CISC).

1.02 RELATED REQUIREMENTS

- .1 Section 05 05 00 – Common Work Results for Metals
- .2 Section 05 12 00 – Structural Steel Framing: Priming and finishing steel framing.
- .3 Section 05 31 00 – Steel Decking: Site installation of shear connectors, requirements relating to exposed steel decking and its connections, fastener spacing and weld show through in areas where decking is visible in the finished structure and coordination of paint system requirements.
- .4 Section 05 50 00 – Metal Fabrications: Loose steel bearing plates and miscellaneous steel framing and assemblies.
- .5 Section 05 58 00 – Custom Metal Fabrications
- .6 Section 08 44 26 – Point Supported Structural Glass Curtain Wall Assemblies: Steel glass fin support.
- .7 Section 09 91 00 – Painting: Surface preparation and priming requirements, relating to architecturally exposed elements requiring finish painting.
- .8 Section 12 93 43 – Transit Specialties: Supply and installation of backless and backed benches with angled and horizontal seating designed specifically for use as transit seating.

1.03 DEFINITIONS

- .1 The following definitions apply to the Common Work Results for Metalwork Finishing specification:
- .2 Non-Exposed Standard Structural Steel: Structural steel that is concealed in final construction; that is not subject to weathering or aggressive conditions; and that does not require special coatings to prevent corrosion.

- .3 Exposed Standard Structural Steel: Structural steel that is exposed to view or concealed in final construction and is subject to weathering or aggressive conditions that require additional protection to prevent corrosion and loss of sectional area and identified as follows:
 - .1 Zone 0: Dry interior where structural steel is imbedded in concrete, encased in masonry, or protected by membrane or non-corrosive contact type fireproofing.
 - .2 Zone 1A: Enclosed interior, normally dry where risk of bare steel corrosion rate is considered low.
 - .3 Zone 1B: Enclosed interior, normally dry where risk of bare steel corrosion rate is considered moderate.
- .4 Architecturally Exposed Structural Steel: The following finish levels for architecturally exposed structural steel as defined by CISC Code of Standard Practice, Table 1 are required by this specification, and apply to all forms of steel structures and metal fabrications identified as follows:
 - .1 AESS1 Basic Elements: Steel structure requiring enhanced workmanship having surface preparation to SSPC-SP6, sharp edges ground smooth, continuous weld appearance, and using standard structural bolts and with weld spatters removed.
 - .2 AESS2 Feature Elements Viewed at a Distance greater than 6 metres: Steel structure requiring enhanced workmanship as listed above for AESS1 and having fabrication tolerances reduced to ½ of standard, fabrication marks not apparent and with welds uniform and smooth.
 - .3 AESS3 Feature Elements Viewed at Distance 6 metres and less: Steel structure requiring enhanced workmanship as listed above for AESS1 and AESS2 having mill marks removed, butt and plug welds ground smooth and filled, cross sectional abutting surfaces aligned, and joint gap tolerances minimized and all connections welded.

1.04 REFERENCE STANDARDS

- .1 American Society for Testing and Materials (ASTM):
 - .1 ASTM A123/A123M-13, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
 - .2 ASTM A780-01 (2006), Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
 - .3 ASTM D4417-03, Standard Test Methods for Field Measurement of Surface Profile of Blast Cleaned Steel
- .2 Canadian Standards Association (CSA):
 - .1 CSA W47.1-09, Certification of Companies for Fusion Welding of Steel
 - .2 CSA W48-01, Filler Metals and Allied Materials for Metal Arc Welding
 - .3 CSA W55.3-1965 (R1998), Resistance Welding Qualification Code for Fabricators of Structural Members Used in Buildings
 - .4 CSA W59-M1989 (R1998), Welded Steel Construction (Metal Arc Welding)
 - .5 CSA W178.2-1996, Certification of Welding Inspectors
- .3 Canadian Welding Bureau (CWB Group Industry Services):
 - .1 CWB 113E, 94-1, Weld Quality and Examination Methods Study Guide
- .4 Canadian Institute of Steel Construction (CISC):
 - .1 CISC Code of Standard Practice 7th Edition, 2009
- .5 The Society for Protective Coatings (SSPC)/National Association of Corrosion Engineers (NACE International):
 - .1 Coating Materials Guidelines

- .2 Surface Preparation Guidelines:
 - .1 SSPC-SP 1, Solvent Cleaning
 - .2 SSPC-SP2, Hand Tool Cleaning
 - .3 SSPC-SP3, Power Tool Cleaning
 - .4 SSPC-SP5/NACE No.1, White Metal Blast Cleaning
 - .5 SSPC-SP6/NACE No. 3, Commercial Blast Cleaning
 - .6 SSPC-SP10/NACE No.2, Near White Metal Blast SSPC-SP6/NACE
- .3 Application, Inspection and Quality Control Guidelines
 - .1 SSPC-QP 3, Standard Procedure for Evaluating Qualifications of Shop Painting Applicators
- .6 Master Painter's Institute (MPI):
 - .1 Architectural Painting Specification Manual
- .7 The National Association of Architectural Metal Manufacturers (NAAMM):
 - .1 AMP 505-88, Applied Coatings
 - .2 AMP 550-89, Metal Product Outline
 - .3 AMP 555-92, Code of Standard Practice for Architectural Metal Industry, including Miscellaneous Iron

1.05 ADMINISTRATIVE REQUIREMENTS

- .1 Pre-Installation Conference: Conduct a pre-installation conference at Project site before starting any work of this Section to review requirements for finishing architecturally exposed structural steel:
 - .1 Agenda for pre-installation conference will include, but not be limited to coordinate requirements for shipping, special handling, attachment of safety cables and temporary erection bracing, touch up painting, fabrication and erection procedures, and other requirements affecting metalwork finishing for the project.
- .2 Coordination: Coordinate coating requirements with affected Division 05 Sections with requirements specified for Section 09 91 00; establish responsibilities, pre-coating requirements and site finishing requirements.
 - .1 The use of bulk shop primers and temporary coatings for all exterior and interior architecturally exposed structural steel work will not be permitted unless it forms a part of a painting system specified in Section 09 91 00.
 - .2 Where non-complying primers are used, this section of work shall completely remove deficient primer from surfaces, and prepare and prime surfaces in accordance with the requirements of Section 09 91 00 for painted steel work at no additional cost to the City.
 - .3 Coordinate compatible shop primer for architecturally exposed structural steel with Section 09 91 00 as follows:
 - .1 This section will be responsible for surface preparation and application of compatible primer systems.
 - .2 Structural steel and metal fabrications fabricator may use painting contractor for application of primer provided that Bid Price is coordinated through Contractor.
 - .3 Metal fabricators will be responsible for applying primer to match shop applied materials at site welds, immediately after completion of welds.
 - .4 Section 09 91 00 will perform minor site touch-up and repair to priming system, and apply finish coats of paint.

- .5 This method of finishing has been specified to minimize primer and finish coating incompatibility, and to satisfy primer "open-time" limits for proper application of finish coats.
- .6 The primers specified are intended to form a part of a total system and shall be compatible with and be produced by the same manufacturer as the finish coats.
- .4 Coordinate installation of anchors for AESS members that connect to the work of other trades as follows:
 - .1 Furnish setting drawings, templates, and directions for installing anchors, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry.
 - .2 Deliver such items to the project site in time for installation.
 - .3 Indicate anchorage concepts shop drawings.

1.06 SUBMITTALS

- .1 Provide requested information in accordance with Section 01 00 06 – General Requirements: Submittals.
- .2 Action Submittals: Provide the following submittals before starting any work of this Section:
 - .1 Product Data: Submit product data for each type of coating products and primers that will receive subsequent architectural coatings indicating:
 - .1 Submit components and application procedures of the paint system as a single coordinated submittal and indicate compatibility and maximum recoat times for each product.
 - .2 Identify required surface preparation, primer, intermediate coat (if applicable) and finish coat.
 - .3 Coordinate submittal information with finish coat specified in Section 09 91 00.
 - .2 Shop Drawings: Submit shop drawings detailing fabrication of AESS components, as follows:
 - .1 Provide erection drawings clearly indicating which members are considered as AESS members.
 - .2 Include details that clearly identify requirements listed in for Fabrication and Erection; provide connections for exposed AESS consistent with concepts shown on the architectural or structural drawings.
 - .3 Indicate welds by standard CWB symbols, distinguishing between shop and site welds, and show size, length and type of each weld; identify grinding, finish and profile of welds as defined in this Section.
 - .4 Indicate type, size, finish and length of bolts, distinguishing between shop and site bolts; identify high strength bolted slip critical, direct tensioned shear/bearing connections; indicate which direction bolt heads should be oriented in final assembly.
 - .5 Clearly indicate which surfaces or edges are exposed and class of surface preparation.
 - .6 Indicate special tolerances and erection requirements as noted on the drawings or defined herein.
 - .7 Samples: Submit samples indicating welds and finishing techniques prior to starting any architecturally exposed welding and finishing work, as follows:
 - Submit sample of Hollow Structural Section (HSS) indicating AESS2 and AESS3 welds, using same sized section as detailed on Drawings.
 - Submit sample of Channel indicating AESS3 and AESS4 welds, using same sized section as detailed on drawings.

- Finish samples with primer listed in for use in this Section.
- Prepare samples free of tool marks, foundry identification marks, pits and scale and other defects detrimental to finished appearance.
- Sample will be used by the Consultant to determine acceptability of welds and surface preparation for architecturally exposed structural steel fabrications on site.
- Consultant may request modifications to the submitted sample; fabricator shall make the changes as indicated until acceptance is obtained from the Consultant.

.2 Informational Submittals: Provide the following submittals when requested by the City:

- .1 Certification: Submit SSPC certification listing qualifications of finish coating application for finish systems and type of work specified in this Section.

1.02 DELIVERY, STORAGE, AND HANDLING

- .1 Storage and Handling Requirements: Store materials to permit easy access for review and identification; store steel members off ground by using pallets, platforms, or other supports; protect steel members and packaged materials from erosion and deterioration.

2. PRODUCTS

2.01 METAL MATERIALS

- .1 Coordinate requirements of this Section with related requirements of referenced Division 5 – Metals technical specification sections.

2.02 NON-EXPOSED STANDARD STRUCTURAL STEEL

- .1 Clean and prepare structural steel surfaces in accordance environmental exposure class as follows:

- .1 Zone 0: Leave uncoated

2.03 SHOP FINISHING; EXPOSED STANDARD STRUCTURAL STEEL

- .1 Clean and prepare exposed structural steel surfaces in accordance with coating manufacturer's recommended profile and surface specification requirements; where they are more stringent than the minimums listed in this Section, and for the following environmental exposure classes:

- .1 Zone 0: Leave uncoated
- .2 Zone 1A: Shop prime using MPI INT 5.1R over minimum SSPC-SP6 ready for site applied single finish coat of high performance architectural latex specified in Section 09 91 00.
- .3 Zone 1B: Shop prime using MPI EXT 5.1L anti-corrosive zinc rich primer with epoxy intermediate coat over minimum SSPC-SP6 ready for site applied double finish coat of pigmented polyurethane specified in Section 09 91 00.

- .2 Do not prime exposed structural steel surfaces in the following conditions:

- .1 Surfaces that are embedded in concrete or mortar; prime partially embedded members to a depth of 50 mm only
- .2 Surfaces that will be site welded
- .3 Surfaces that will be high strength bolted with slip critical connections
- .4 Surfaces that will receive sprayed applied fire resistant material
- .5 Galvanized surfaces

- .3 Apply primer under cover, on dry surfaces only and when surface and air temperatures are at and rising, or above manufacturer's recommended minimum application temperature; and maintain temperature until primer is thoroughly cured.
- .4 Apply primer immediately after surface cleaning and priming in accordance with manufacturer's instructions and dry film thickness recommendations using methods as required to achieve full coverage of the following:
 - .1 Joints, corners, edges, and exposed surfaces
 - .2 Corners, crevices, bolts, welds, and sharp edges
 - .3 Apply second coat of shop primer to surfaces that will be inaccessible after assembly or erection; change colour of second coat.
- .5 Refer to Section 09 91 00 for coating and application requirements for application of site applied finishing systems.

2.04 GALVANIZING

- .1 Hot Dip Galvanized Finish: Hot dip galvanize in accordance with ASTM A123/A123M to locations indicated; 300 g/m² minimum zinc coating; galvanize components after assembly where size permits.

2.05 SHOP COATINGS

- .1 Zinc Rich Paint: Single component organic zinc anticorrosive primer in accordance with CAN/CGSB-1.181 and as follows:
 - .1 Clean metal to SSPC SP6-Commercial Blast Cleaning in accordance with surface preparation requirements and environmental exposure limitations listed in CAN/CGSB-1.181
 - .2 Apply one (1) coat zinc rich paint to all surfaces exposed after assembly to manufacturer's minimum dry film thickness.
 - .3 Apply coating immediately after cleaning
- .2 Isolation Coating: Acid and alkali resistant asphaltic paint to CAN/CGSB-1.108.
 - .1 Apply an isolation coating to contact surfaces of following components in contact with cementitious materials and dissimilar metals except stainless steel:
 - .1 Exterior components
 - .2 Interior components exposed to high humidity conditions
- .3 Use primer as prepared by manufacturer without thinning or adding admixtures. Paint on dry surfaces, free from rust, scale, grease, do not paint when temperature is below 7°C.
- .4 Do not paint surfaces to be site welded. Prime and apply first finish coat after site welding has been completed, immediately prior to applying final finish coat to completed assembly.

2.06 SHOP CONNECTIONS

- .1 Bolted Connections: Make in accordance with Section 05 05 00 and 05 12 00
 - .1 Provide bolt type and finish as specified in this section; align bolt heads as indicated on shop and erection drawings.
- .2 Welded Connections:
 - .1 Comply with requirements specified in Section 05 05 00 and 05 12 00.

- .2 Make appearance and quality of welds consistent with mock-up of metal fabrications in Section 05 58 00.
- .3 Assemble and weld built-up sections by methods that maintain alignment of members without warp exceeding tolerances of this section.

3. EXECUTION

3.01 EXAMINATION

- .1 Verify exposure of steel components, architectural or non-exposed, and finish assemblies as specified.
- .2 Report any discrepancy and potential problem areas to City for direction before commencing finishing operations.

3.02 APPLICATION OF PRIMERS AND COATINGS

- .1 Primer: Spray applied at fabrication shop by this Section, touch-up and recoating by Section 09 91 00, and as follows:
 - .1 Work primer into all corners
 - .2 Touch-up bare or worn areas on site after installation
 - .3 Leave surfaces unpainted as follows:
 - .1 Surfaces that are embedded in concrete or mortar; prime partially embedded members to a depth of 50 mm only.
 - .2 Surfaces that will be site welded.
 - .3 Surfaces that will be high strength bolted with slip critical connections.
 - .4 Surfaces that will receive sprayed applied fire resistant material.

3.03 ADJUSTING AND CLEANING

- .1 Site Touch-Up and Repair Shop Primer and Galvanized Finishes:
 - .1 Touch-Up Painting: Cleaning and touch-up painting of site welds, bolted connections, and abraded areas of shop paint shall be completed to blend with the adjacent surfaces in accordance with manufacturer's instructions as specified in Section 09 91 00.
 - .2 Galvanized Surfaces: Clean site welds, bolted connections, and abraded areas and repair galvanizing in accordance with ASTM A780.

END OF SECTION

1. GENERAL**1.01 SUMMARY**

- .1 This Section includes supply and installation requirements for post-installed structural anchors and fasteners
- .2 This section does not include incidental fastening that may be required for supporting, attaching or suspending non-structural steel related materials that are described in other specification sections and can include items such as architectural accessories; healthcare accessories; mechanical and electrical equipment; communications equipment; wood framing and blocking; doors, windows and louvers; and similar attached materials.

1.02 REFERENCE STANDARDS

- .1 American Society for Testing and Materials (ASTM):
 - .1 ASTM A510-08, Standard Specification for General Requirements for Wire Rods and Coarse Round Wire, Carbon Steel
 - .2 ASTM F593-13, Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs
 - .3 ASTM F1554-07a, Standard Specification for Anchor Bolts, Steel 36, 55, and 105-ksi Yield Strength
- .2 Canadian Standards Association (CSA):
 - .1 CSA S16-09, Design of Steel Structures, with Updates
 - .2 CSA G30.18-09, Carbon Steel Bars for Concrete Reinforcement

1.03 ADMINISTRATIVE REQUIREMENTS

- .1 Coordination: Provide fastenings attached to other construction without delaying the Work; provide setting diagrams, sheet metal templates, instructions, and directions for installation.

1.04 SUBMITTALS

- .1 Provide required information in accordance with Section 01 00 06 – General Requirements: Submittals.
- .2 Action Submittals: Provide the following submittals before starting any work of this Section:
 - .1 Product Data: Submit product data for each type of fastener, accessory and installation tool required for the project including the following:
 - .1 Manufacturer's written installation requirements and setting out diagrams.
 - .2 Type, size, and length of anchors and fastenings required for project.
 - .2 Samples: Submit sample of each type of anchor, fastener and accessory required for the project when requested by Consultant; samples will be returned to manufacturer for use on project after review is completed.
- .3 Informational Submittals: Provide the following submittals during the course of the work:
 - .1 Training Certificates: Provide training certificates or letter from manufacturer indicating that installers have been tested for the anchor and fastening requirements for the project.
 - .2 Material Certificates: Submit test reports signed by manufacturer certifying that materials supplied to the project meet the requirements established by the specified materials:
 - .1 Bolts, nuts, and washers including mechanical properties and chemical analysis.

1.

1.05 QUALITY ASSURANCE

.1 Qualifications: Provide proof of qualifications during the course of the work of this Section:

- .1 Manufacturer: Use a manufacturer that provides site personnel, technical assistance and training to installers; and on-site support during installation of post-installed anchors and fastenings.
- .2 Installer: Use installers that are trained by manufacturer's site engineer for project specific methods and limitations of anchor installation.

1.06 DELIVERY, STORAGE AND HANDLING

.1 Storage and Handling Requirements: Store materials to permit easy access for inspection and identification; store fasteners in a protected place; clean and relubricate nuts that become dry or rusty before use.

1.07 SITE CONDITIONS

.1 Ambient Conditions: Install adhesive anchors only when temperature of surfaces and surrounding air temperatures are within temperature range recommended in writing by fastener manufacturer.

2. PRODUCTS

2.01 MANUFACTURERS

.1 Basis-of-Design Materials: Products named in this Section were used as the basis-of-design for the project; manufacturers listed as additional acceptable materials and that offer similar products may be incorporated into the work of this Section provided they meet the performance requirements established by the named products.

.2 Additional Acceptable Materials Manufacturers: Subject to compliance with performance requirements specified in this Section; as established by the Basis-of-Design Materials, use any of the listed manufacturers' products in accordance Section 01 00 06 – General Requirements: Substitutions and Product Options; following manufacturer's do not require submission of a request for substitutions provided required shop drawing and product data submissions are submitted before starting any work of Section:

.1 Hilti Canada

.2 Substitutions: Consultant may consider additional manufacturers having similar products to Acceptable Materials Manufacturers listed above during the construction period, provided they meet the performance requirements established by the named products and provided they submit requests for substitution in accordance with 01 00 06 – General Requirements: Substitutions and Product Options before starting any work of this Section:

.1 Do not use substitute materials to establish Bid Price.

.2 Substitutions that appear as a part of the project without review and acceptance by the Consultant will be rejected, and replaced with one of the specified materials.

.3 Process listed above does not restrict the Contractor from submitting a request for substitution during construction in accordance with Section 01 00 06 – General Requirements: Substitutions and Product Options; however, substitutions becoming evident on site and that have not been reviewed and accepted through the process described above will be rejected, removed from site and replaced using the specified materials at no additional cost to the Project.

1.02 ADHESIVE FASTENERS

- .1 Rapid Setting Adhesive Anchor Rod System: Rapid setting adhesive anchoring system consisting of bond enhancing threaded rod; nut and washer matching anchor rod materials, and as follows:
 - .1 Anchor Rod Material: Carbon steel meeting requirements of ASTM A193
 - .2 Minimum Ultimate Tensile Strength: Nominal 460 MPa
 - .3 Nominal Diameter: As indicated
 - .4 Nominal Length: As Indicated
 - .5 Adhesive: Two component, injection type vinyl urethane methacrylate and cement with zinc coated steel
 - .6 Basis-of-Design Materials: Hilti HIT HY200 System
- .2 Rapid Setting Adhesive Reinforcing Bar System: Adhesive anchor system consisting of chisel pointed steel reinforcing bar and adhesive, and as follows:
 - .1 Reinforcing Bar Material: Deformed bars, Grade 400 in accordance with CSA G30.18
 - .2 Nominal Diameter: As indicated
 - .3 Nominal Length: As Indicated
 - .4 Finish: Plain
 - .5 Adhesive: Two component, injection type and cement
 - .6 Basis-of-Design Materials: Hilti HIT HY200-Rebar System

2. EXECUTION**2.01 EXAMINATION**

- .1 Verification of Conditions: Verify ability of concrete to withstand loading pressures before beginning of installation of products specified in this Section.
 - .1 Installation of products specified in this Section will denote acceptance of site conditions.

2.02 INSTALLATION

- .1 Prepare drilled holes, clean and dry holes, and install anchors and fastenings in accordance with manufacturer's written instructions as modified by directions from manufacturer's site engineer to suit project conditions.
- .2 Setting Structural Anchors and Fastenings: Set structural anchors and fastenings accurately in locations and to elevations indicated on Drawings; survey measure critical areas and components that align with other construction in accordance with Section 01 00 06 – General Requirements: Site Surveying and Laying Out.

2.03 SITE QUALITY CONTROL

- .1 Damaged Coatings: Refinish damaged zinc coatings by using zinc rich (minimum 90% zinc content when dry) in accordance with ASTM A780, Annex A2.
- .2 Post Installed Fastening Testing and Inspections: Observation requirements of structural fastenings in accordance with CSA S16 and requirements listed in Section 05 08 10.
- .3 Non-Conforming Work: Remove and replace non-conforming work at no additional expense to the Work using methods and materials acceptable to the Consultant.

END OF SECTION

1. GENERAL**1.01 INTENT**

- .1 This section is included for the information of the Contractor and steel Subcontractors so that they can coordinate their activities with the City's inspection and testing agency; costs for inspection and testing will be paid for by the City directly; Contractor and Subcontractors shall include coordination costs only, do not include any costs for actual inspection and testing.
- .2 Inspection and testing carried out by the City's inspection and testing agency is intended to confirm that the steel Subcontractors' own quality assurance and quality control procedures are functioning effectively:
 - .1 The steel Subcontractors' own quality assurance and quality control procedures shall be capable of confirming that the Work is performed in accordance with the Contract Documents.
- .3 Terms of reference for the inspection and testing services for structural steel and steel deck include; but are not limited to, the following:
 - .1 Inspection and testing agency is responsible for the review of work and reporting as to compliance to References and Contract Documents.
 - .2 The responsibility for quality of construction and compliance with Contract Documents rests solely with the Contractor.
 - .3 The City will make all engineering decisions with respect to rejection criteria and rework required.

1.02 RELATED REQUIREMENTS

- .1 Section 05 05 00 – Common Work Results for Metals: Quality Management Plan required by the steel Subcontractor for quality assurance requirements for the Project.
- .2 Section 05 05 23 – Post-Installed Fastenings: Observation and confirmation of installation requirements.
- .3 Section 05 12 00 – Structural Steel Framing: Coordination with steel materials requiring inspection and testing.
- .4 Section 05 31 00 – Steel Decking: Coordination with steel materials requiring inspection and testing.
- .5 Structural Drawings – Structural Steel Framing: Cold roll formed structural steel sections.

1.03 DEFINITIONS

- .1 The following definitions apply to the Steel Inspection and Testing specification:
 - .1 Quality Management Plan: Quality Management Plan performed by the steel Subcontractor capable of confirming that the work of steel fabrication and erection is conducted in accordance with the Contract Documents; City's Site and Source Quality Control requirements of this section does not replace or eliminate the requirement of the Subcontractor to perform their own Quality Management Plan.
 - .2 Site Quality Control: Inspections and testing performed during the installation of components and that is further defined as site assembled or installed work occurring as a part of execution; work that is not performed in the shop or off site.

- .3 Source Quality Control: Inspections and testing performed during fabrication of components and that is further defined as shop assembled or manufactured products; work that is not performed on site.

1.04 REFERENCE STANDARDS

- .1 Canadian Standards Association (CSA):
 - .1 CAN/CSA S16-09, Limit States Design of Steel Structures
 - .2 CAN/CSA G40.20-04, General Requirements for Rolled or Welded Structural Quality Steel
 - .3 CSA G40.21-04, Structural Quality Steel
 - .4 CSA W47.1-09, Certification of Companies for Fusion Welding of Steel
 - .5 CSA W55.3-08, Certification of Companies for Resistance Welding of Steel and Aluminum, Resistance Welding Qualification Code for Fabricators of Structural Members Used in Buildings
 - .6 CSA W59-03 (R2008), Welded Steel Construction (Metal Arc Welding)
 - .7 CSA W178.1-08, Certification of Welding Inspection Organizations
 - .8 CSA W178.2-08, Certification of Welding Inspectors
- .2 Canadian Welding Bureau (CWB Group Industry Services):
 - .1 CWB 113E/07-1, Weld Quality and Examination Methods Study Guide
- .3 Miscellaneous Applicable References:
 - .1 Alberta Building Code, 2014
 - .2 Division 01 – General Requirements
 - .3 Reviewed Shop Drawings

1.05 QUALITY ASSURANCE

- .1 Quality assurance requirements listed in this Section are specific to the City's inspection and testing agency; refer to technical specification sections for Subcontractor's quality assurance requirements.
- .2 Qualifications: Provide proof of qualifications when requested by City:
 - .1 Testing Agency: Inspection and testing agency shall be experienced in all aspects of the required work as described in this Section; and shall be independent from the Contractor, structural steel Subcontractor, open-web steel joist Subcontractor, steel deck Subcontractor, and the supplier of post-installed fastening systems.
 - .2 Testing and Inspection Personnel: Use personnel that have completed work of a similar scope and complexity to that required for this Project.
- .3 Certifications: Provide proof of the following during the course of the Work:
 - .1 Agency Welding Certificates: Provide proof indicating that inspection and testing agency is certified CSA W178.1 for welding inspection Building Category.
 - .2 Personnel Welding Certificates: Provide proof indicating that personnel examining welds and that are employed by the inspection and testing agency are Canadian Welding Bureau (CWB) certified Welding Inspectors or a person with equivalent qualifications.

2. PRODUCTS

2.01 REPORTS: GENERAL

- .1 Provide required information in accordance with Section 01 00 06 – General Requirements: Submittals.

- .2 Notify the City of non-compliant workmanship or materials within one (1) day of discovery.
- .3 Submit a report of each inspection detailing the following for each review:
 - .1 Name and certificate number of welders involved.
 - .2 Copy of welding procedure for all welds not pre-qualified by CSA W59.
 - .3 Identification mark of each member reviewed and compliance status.
- .4 Submit a final report summarizing previous reports and specifically stating a belief as to the compliance of the work, signed by the testing agency's inspector responsible for the testing and inspection program.
- .5 Submit copies of reports to:
 - .1 City
 - .2 Contractor
 - .3 Structural Steel Subcontractors
- .6 Prepare detailed monthly invoices addressed to the City and submit for review.

3. EXECUTION

3.01 TESTING: GENERAL

- .1 Inspection and Testing Agency Coordination: Inspection and testing agency is required to coordinate with the Subcontractors for notification requirements regarding the timing of testing and inspections, and as follows:
 - .1 Coordinate inspection and testing activities with Subcontractors and Contractor; be aware of current work schedule and bring to the attention of the City any testing or inspection requirement apparently being overlooked.
 - .2 Coordinate a common marking protocol for all parts or joints that have been reviewed and accepted.
 - .3 Coordinate work of this Section with Section 01 00 06 – General Requirements: Quality Control; notify City of non-compliant workmanship or materials within one (1) day of discovery.
- .2 Where stated in this Section, the frequency of inspection or testing is the initial frequency with which the testing and inspection agency shall perform their activities. As the Subcontractor's own quality assurance and quality control program demonstrates its effectiveness during the course of the project, the frequency of testing and inspection by the City's inspection and testing agency may be adjusted in consultation with the City and the Contractor:
 - .1 Immediately inform the City when sufficient number of shop or site visits are not clearly identified and make a recommendation for additional shop or site visits to form an opinion as to the compliance of the work.
 - .2 Immediately inform the City when fabrication and erection conditions are such that a reduced program of testing and inspections is deemed appropriate or an increased program of testing and inspection is deemed necessary to form an opinion as to the compliance of the work.
- .3 Additional tests may be directed by the City, or requested by the Contractor or the Subcontractor:
 - .1 Costs of tests requested by the City will be paid by the City.
 - .2 Costs of tests requested by the Contractor will be paid by the Contractor.
 - .3 Costs of tests requested by the Subcontractor will be paid by the Subcontractor.
- .4 Where the frequency of inspection and testing is not specifically stated in this Section, the City's inspection and testing agency shall make a recommendation to the City.

- .5 Identify with a distinguishing mark all parts or joints that have been reviewed and accepted.

3.02 SOURCE AND SHOP INSPECTION: FABRICATION

- .1 Fabrication is defined as shop assembled or manufactured items.

.2 Structural Steel:

- .1 Review correlated mill test certificates for compliance with specified material.
- .2 Review structural steel and confirm that steel is supplied by an acceptable source in accordance with the requirements of the Contract Documents; confirm that source of steel sections is clearly identified with raised lettering embossed on at least one face of the steel sections.
- .3 Randomly check member dimensions, thicknesses, lengths and fabrication details.
- .4 Check milling of columns and base plates.
- .5 Randomly examine dimensions for tolerance.
- .6 Examine coatings and application to verify compliance.

.3 Welding:

- .1 Review shop welding procedures and welders' qualification certificates for the processes required.
- .2 Perform 100% visual examination of all welds for size, length and workmanship.
- .3 Perform magnetic particle inspection of randomly selected welds (5 to 10% of connections).
- .4 Perform ultrasonic examination of 100% of complete penetration welds subject to tension and of 10% of those subject to compression.
- .5 Perform 100% visual examination of welds and workmanship of embedded plates.

.4 Reports: Report the following for each review of shop fabricated work:

- .1 Name and certificate number of welders involved.
- .2 Identification mark of members reviewed and compliance status.

3.03 SITE INSPECTION: STRUCTURAL STEEL

- .1 Review erectors welding procedures and welders' qualification certificates for the procedures required.
- .2 Examine steel for shipping and handling damage.
- .3 Randomly examine erected work for fit-up, dimensions, tolerances, alignment and plumbness; include checking by instrument a minimum of 10% of beams and 10% of columns for plumbness, alignment, and tolerance.
- .4 Review temporary bracing and stability of the steel frame during erection.
- .5 Perform the following inspections:
 - .1 100% visual examination of site welds for size, length and workmanship.
 - .2 Magnetic particle inspection of 100% of site welds for moment connections.
 - .3 Magnetic particle inspection of randomly selected other site welds (5 to 10% of connections).
 - .4 Ultrasonic examination of 100% of complete penetration welds subject to tension and of 10% of those subject to compression.
 - .5 Random verification that bolts are snug tight and that connected plies are in firm contact on 10% of bolted connections.
 - .6 Examine site applied coatings and application for compliance.
 - .7 Base plates and cap plates:

- .1 Check grouting of column base plates and bearing plates to confirm compliance. Inspect at least three columns to confirm correct grouting procedures are used.
- .2 Confirm that contact of base plates and levelling plates meets CAN/CSA S16 tolerances.
- .3 Check for full bearing of column sections to base and cap plates.
- .4 Check special bearing details of sliding expansion joint bearings.

- .8 Check reinforcement and work around all holes and openings authorized to be cut in the site.

3.04 SITE INSPECTION: STEEL DECK

- .1 Perform the following inspections:
 - .1 100% visual inspection to confirm deck type, profile and coating; obtain and review substantiating test data from Subcontractor.
 - .2 Random review of deck sheet thickness for 10% of deck.
 - .3 100% visual review of deck side fastening sheet to sheet and fastening to supporting structure.
 - .4 Visually inspect welds for size, spacing, and workmanship.
 - .5 Visually inspect fasteners for size, type, spacing, and workmanship.
 - .6 Examine condition of supporting members after steel deck has been welded to determine if supporting members were damaged.

3.05 SITE INSPECTION: POST-INSTALLED FASTENINGS

- .1 Perform the following inspections:
 - .1 Initial inspection: encompasses the first five (5) anchors of each type and size and consists of:
 - .1 training certificates of installers
 - .2 drill bit type and size
 - .3 hole depth
 - .4 hole cleaning technique
 - .5 anchor type, size, embedment and installation procedure, including adhesive expiration date and proper dispensing if applicable
 - .2 Subsequent installations of the same anchor size and type by the same personnel will proceed in the absence of the inspector, unless the inspector deems his presence is required, permanently or randomly.
 - .3 Any change in the anchor product being installed or the personnel performing the installation requires initial re-inspection by the inspector.

END OF SECTION

1. GENERAL

1.01 RELATED REQUIREMENTS

- .1 Section 05 05 00 – Common Work Results for Metals: Standard definitions, qualifications and quality requirements, administrative requirements, information exchange and standard submittal requirements, source and site quality control, and substitutions procedures relating to work of this Section.

1.02 DEFINITIONS

- .1 Refer to Section 05 05 00 for common definitions relating to work of this Section.

1.03 REFERENCE STANDARDS

- .1 American Society for Testing and Materials (ASTM):
 - .1 ASTM A123/A123M-13, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
 - .2 ASTM A780-09, Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
- .2 Canadian Institute of Steel Construction (CISC):
 - .1 1995, Fundamentals of Structural Shop Drafting (Fifth Edition)
 - .2 2008, CISC Code of Standard Practice (Seventh Edition)
 - .3 May 2010, Handbook of Steel Construction (Tenth Edition)
- .3 Canadian Standards Association (CSA):
 - .1 CSA S16-14, Design of Steel Structures

1.04 QUALITY ASSURANCE

- .1 Regulatory Requirements: Refer to Section 05 05 00 for fabricator and welding certifications required by Authority Having Jurisdiction.
 - .1 Testing Agency: Testing and inspections required to confirm the quality and integrity of the welded and bolted connections are the responsibility for the Engineer of Record for the project. The signage design engineer accepts no responsibility for the quality of the welds. Testing is recommended for all shop and field connections.

2. PRODUCTS

2.01 FABRICATION

- .1 Fabricate and assemble structural steel in shop to greatest extent possible, and as follows:
 - .1 Fabricate beams, columns and other members of continuous sections in accordance with CSA S16; do not splice pieces unless specifically shown on the Drawings or written authorization from Consultant.
- .2 Fabricate structural steel in accordance with CSA S16, reviewed fabrication and erection documents, and as follows:
 - .1 Camber structural steel members where indicated.
 - .2 Identify high strength structural steel and maintain markings until steel has been erected.
 - .3 Mark and match mark materials for site assembly.

- .4 Fabricate ends of columns and other members subjected to compression forces to transmit full cross-sectional capacity of column or member.
 - .3 Thermal Cutting: Perform thermal cutting by machine to greatest extent possible; smooth thermally cut edges being welded.
 - .4 Holes:
 - .1 Provide holes required for securing other work to structural steel framing and for passage of other work through steel framing members.
 - .2 Cut, drill, or punch holes perpendicular to steel surfaces; do not cut holes or enlarge holes by flame cutting.
 - .3 Drill holes in bearing plates.
 - .4 Provide weep holes 10 mm in diameter in tops and bottoms of all HSS columns.
- 2.02 FINISHING:
- .1 Galvanizing
 - .1 Hot Dip Galvanized Finish: Hot dip galvanize in accordance with ASTM A123/A123M to locations indicated; 300 g/m² minimum zinc coating; galvanize components after assembly where size permits.
- 3. EXECUTION**
- 3.01 EXAMINATION
- .1 Verify elevations of concrete and masonry bearing surfaces and locations of anchorages for compliance with requirements.
 - .2 Report any discrepancy and potential problem areas to Consultant for direction before commencing fabrication or erection.
 - .3 Do not proceed with erection until unsatisfactory conditions have been corrected.
- 3.02 PREPARATION
- .1 Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads.
- 3.03 ERECTION
- .1 Erect structural steel in accordance with CSA S16.
 - .2 Obtain Consultant's acceptance before site cutting or altering any members.
 - .3 Repair of Coatings: Site touch-up and repair galvanized finishes at bolts, welds and burned or scratched surfaces using zinc paint in accordance with ASTM A780.
 - .4 Setting Structural Steel: Set structural steel accurately in locations and to elevations indicated on Drawings and reviewed fabrication and erection documents; survey measure critical areas and components that align with other construction in accordance with Section 01 00 06.

END OF SECTION

1. GENERAL**1.01 SUMMARY**

- .1 This Section includes requirements for design of connections for structural steel, and fabrication, supply and installation of structural steel.
- .2 Architecturally exposed steel requires a higher degree of workmanship and finishing than standard structural steel components; coordinate finishing requirements with Section 05 05 19 – Common Work Results for Metalwork Finishing.

1.02 RELATED REQUIREMENTS

- .1 Special Provisions, Part 2 General Requirements – Site Surveys: Construction layout and surveying requirements for placement of structural steel framing.
- .2 Section 03 31 00 – Structural Concrete: Grout under column base plates and installation of anchor rods for column base plates.
- .3 Section 05 05 00 – Common Work Results for Metals: Standard definitions, delegated design requirements, qualifications and quality requirements, administrative requirements, information exchange and standard submittal requirements, source and site quality control, and substitutions procedures relating to work of this Section.
- .4 Section 05 05 19 – Common Work Results for Metalwork Finishing: Quality of welds; surface preparation and priming and galvanizing of structural steel framing and requirements for architecturally exposed steel.
- .5 Section 05 05 23 – Post-Installed Fastenings: Requirements for post installed structural anchor rods and fastenings.
- .6 Section 05 05 19 – Common Work Results for Metals: Fabricated metal assemblies consisting of plates, anchor rods, studs and other structural components embedded or cast into structural concrete.
- .7 Section 05 08 10 – Steel Inspection and Testing
- .8 Section 05 31 00 – Steel Decking
- .9 Section 05 50 00 – Miscellaneous Metal Fabrications: Loose steel bearing plates and miscellaneous steel framing.

1.03 DEFINITIONS

- .1 Refer to Section 05 05 00 for common definitions relating to work of this Section.

1.04 REFERENCE STANDARDS

- .1 American Society for Testing and Materials (ASTM):
 - .1 ASTM A36/A36M-12, Standard Specification for Carbon Structural Steel
 - .2 ASTM A108-13, Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished
 - .3 ASTM A123/A123M-13, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
 - .4 ASTM A153/A153M-09 Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
 - .5 ASTM A276-13, Standard Specification for Stainless Steel Bars and Shapes

- .6 ASTM A307-10, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength
- .7 ASTM A325-10e1, Standard Specification for Structural Bolts, Steel, Heat Treated, 120-105 ksi Minimum Tensile Strength
- .8 ASTM A490-12, Standard Specification for Structural Bolts, Alloy Steel, Heat Treated, 150 ksi Minimum Tensile Strength
- .9 ASTM A493-09, Standard Specification for Stainless Steel Wire and Wire Rods for Cold Heading and Cold Forging
- .10 ASTM A500/A500M-10a, Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
- .11 ASTM A563-07a, Standard Specification for Carbon and Alloy Steel Nuts
- .12 ASTM A780-09, Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
- .13 ASTM A992/992M-06a, Standard Specification for Structural Steel Shapes
- .14 ASTM F593-13, Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs
- .15 ASTM F1136-10, Standard Specification for Zinc/Aluminum Corrosion Protective Coatings for Fasteners

.2 Canadian Institute of Steel Construction (CISC):

- .1 1995, Fundamentals of Structural Shop Drafting (Fifth Edition)
- .2 2008, CISC Code of Standard Practice (Seventh Edition)
- .3 May 2010, Handbook of Steel Construction (Tenth Edition)

.3 Canadian Standards Association (CSA):

- .1 CSA G40.20-13/G40.21-13, General Requirements for Rolled or Welded Structural Quality Steel Structural Quality Steel
- .2 CSA S16-09, Design of Steel Structures
- .3 CSA W59-03 (R2008), Welded Steel Construction (Metal Arc Welding)

1.05 ADMINISTRATIVE REQUIREMENTS

- .1 Coordination: Coordinate work of other Sections and provide setting diagrams, templates, instructions and directions for installation of components supplied by this Section to other Sections of the Work as necessary for the completion of work of this Section and as follows:
 - .1 Fabrication: Provide welding quality and joint treatments for architecturally exposed structural steel in accordance with Section 05 05 19.
 - .2 Finishing: Provide shop priming and finishing requirements for architecturally exposed and standard exposed structural steel framing in accordance with Section 05 05 19.
- .2 Pre-Construction Meetings: Schedule and conduct a meeting at the Project site in accordance with Section 01 00 06 – General Requirements: Project Meetings with Subcontractor responsible for work of this Section, Subcontractor responsible for finish painting, and the Consultant to verify project requirements, fabricator's installation instructions and paint manufacturer's warranty requirements for surface preparation; coordinate with Section 05 05 19 for additional requirements.

1.06 SUBMITTALS

- .1 Provide required information in accordance with Section 01 00 06 – General Requirements: Submittals and additional information listed in Section 05 05 00.

- .2 Action Submittals: Provide the following submittals before starting any work of this Section:
- .1 Fabrication and Erection Drawings: Submit fabrication and erection drawings detailing fabrication of structural steel components for review by the Consultant based on CISC Code of Standard Practice including the following:
- .1 Submit the following documents prepared in accordance with CISC Standard Drafting Practices:
- Erection diagrams
 - Connection design details
 - Shop details
 - Erection procedures
 - Site work details
- .2 Include the following as a part of submission:
- Details of cuts, connections, splices, camber, holes, and other pertinent data.
 - Indicate welds using CWB symbols, distinguishing between shop and site welds, and show size, length, and type of each weld.
 - Type, size, and length of bolts, distinguishing between shop and site bolts; high strength bolted slip critical, direct tension, or tensioned shear/bearing connections.
 - Signature and seal of Delegated Design Professional Engineer that was responsible for preparation of fabrication and erection documents.
- .3 Informational Submittals: Provide the following submittals when requested by Consultant:
- .1 Source Quality Control Submittals: Submit design notes and calculations in accordance with Section 01 33 50 – Delegated Design Submittals.
- .2 Setting Diagrams: Provide setting diagrams, templates, instructions and directions for installation of components supplied by this section to other Subcontractors, and necessary for the completion of work of this Section.
- 1.07 QUALITY ASSURANCE
- .1 Regulatory Requirements: Refer to Section 05 05 00 for fabricator and welding certifications required by Authority Having Jurisdiction.
- .2 Qualifications: Provide proof of qualifications when requested by Consultant; refer to Section 05 05 00 for additional requirements and as follows:
- .1 Delegated Design Engineer: 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 Documents requirements including the following:
- .1 Seal and signature to fabrication and erection documents and design submittals
- .2 Site review of installed components.
- .3 Completion of Letters or Commitment and Compliance as specified in Section 01 33 50
- .2 Testing Agency: Testing and inspections will be conducted in accordance with Section 05 08 10.

2. PRODUCTS**2.01 DESIGN REQUIREMENTS**

- .1 Connections: Design connections using materials and fabrication methods in accordance with Section 05 05 00, using Delegated Design Professional Engineer responsible for providing submissions required by this Section.
- .2 Design Criteria: Fabricator is required to design and submit details for connections not otherwise detailed on the Drawings using loads and forces indicated on the Drawings and as follows:
 - .1 Loads and forces shown on Drawings are not factored, unless specifically indicated otherwise.
 - .2 Request from Consultant any loads and forces not shown on Drawings, but that may be required to detail connections.

2.02 MATERIALS

- .1 Rolled W-Sections: In accordance with CSA G40.20/G40.21, Grade 350W or ASTM A992, Grade 50
- .2 WWF Shapes: In accordance with CSA G40.20/G40.21, Grade 350W
- .3 Other Rolled Sections and Plates: In accordance with CSA G40.20/G40.21, Grade 300W
- .4 Hollow Structural Sections: In accordance with CSA G40.20/G40.21, Grade 350W, Class C.
- .5 Welding Materials: Refer to Section 05 05 00.
- .6 Post-Installed Anchors and Fastenings: Refer to Section 05 05 23.
- .7 Mechanical Fasteners: Bolts, nuts and washers as follows:
 - .1 Headed Bolts: Bolts meeting requirements of ASTM A325; Type 1, heavy hex steel structural bolts with matching heavy hex carbon steel nuts meeting requirements of ASTM A563 and as follows:
 - .1 Finish: Plain, uncoated or Hot-dip zinc coating meeting requirements of ASTM A153, Class C where indicated on Drawings.
 - .2 Washers: Provide washers meeting requirements of ASTM A36/A36M.

2.03 FABRICATION

- .1 Fabricate and assemble structural steel in shop to greatest extent possible, and as follows:
 - .1 Fabricate beams, columns and other members of continuous sections in accordance with CSA S16; do not splice pieces unless specifically shown on the Drawings or written authorization from Consultant.
 - .2 Provide 10 mm web stiffeners to both sides of beams over all supports unless specifically noted as being thicker on Drawings.
- .2 Fabricate structural steel in accordance with CSA S16, reviewed fabrication and erection documents, and as follows:
 - .1 Camber structural steel members where indicated.
 - .2 Identify high strength structural steel and maintain markings until steel has been erected.
 - .3 Mark and match mark materials for site assembly.

- .4 Fabricate ends of columns and other members subjected to compression forces to transmit full cross-sectional capacity of column or member.
- .5 Complete structural steel assemblies, including welding of units, before starting shop priming operations.
- .3 Fabricate Architecturally Exposed Structural Steel (AESS) in accordance with Section 05 05 19.
- .4 Thermal Cutting: Perform thermal cutting by machine to greatest extent possible; smooth thermally cut edges being welded.
- .5 Holes:
 - .1 Provide holes required for securing other work to structural steel framing and for passage of other work through steel framing members.
 - .2 Cut, drill, or punch holes perpendicular to steel surfaces; do not cut holes or enlarge holes by flame cutting.
 - .3 Drill holes in bearing plates.
 - .4 Provide weep holes 10 mm in diameter in tops and bottoms of all HSS columns.
- .6 Finishing:
 - .1 Provide shop-applied primer in accordance with Section 05 05 19.
 - .2 Provide hot dip galvanized finish in accordance with Section 05 05 19 to locations indicated on Drawings.

3. EXECUTION

3.01 EXAMINATION

- .1 Verify elevations of concrete and masonry bearing surfaces and locations of anchorages for compliance with requirements.
- .2 Report any discrepancy and potential problem areas to Consultant for direction before commencing fabrication or erection.
- .3 Do not proceed with erection until unsatisfactory conditions have been corrected.

3.02 PREPARATION

- .1 Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads.

3.03 ERECTION

- .1 Erect structural steel in accordance with CSA S16.
- .2 Obtain Consultant's acceptance before site cutting or altering any members.
- .3 Repair of Coatings: Site touch-up and repair shop primer and galvanized finishes at bolts, welds and burned or scratched surfaces using same primer as applied in shop and zinc paint in accordance with ASTM A780.
- .4 Setting Structural Steel: Set structural steel accurately in locations and to elevations indicated on Drawings and reviewed fabrication and erection documents; survey measure critical areas and components that align with other construction.

END OF SECTION

1. GENERAL

1.01 SUMMARY

- .1 This Section includes requirements for design of steel decking thickness based on indicated spans, and supply and installation of steel decking.

1.02 RELATED REQUIREMENTS

- .1 Section 05 05 00 – Common Work Results for Metals: Qualifications, testing and inspection requirements for this Section.
- .2 Section 05 08 10 – Steel Inspection and Testing
- .3 Section 05 12 00 – Structural Steel Framing
- .4 Section 05 50 00 – Miscellaneous Metal Fabrications: Framing for steel deck openings.
- .5 Section 07 25 13 – Air and Vapour Retarders: Installation of decking perimeter air and vapour retarder continuity materials.
- .6 Section 07 84 00 – Firestopping: Placing pre-manufactured firestop assemblies between underside of decking and rated assemblies.
- .7 Section 20 05 00 – Common Work Results for Mechanical: Deck openings required for pipe, exhaust and duct placement.
- .8 Section 23 05 29 – Hangers and Supports, Sleeves and Flashings for HVAC Piping and Equipment: Coordination with placement of threaded rods anchors, sleeves and block-outs for HVAC equipment.
- .9 Section 26 05 00 – Common Work Results for Electrical: Deck openings required for cable and wiring placement.

1.03 DEFINITIONS

- .1 Refer to Section 05 05 00 for common definitions relating to work of this Section.
- .2 The following definitions apply to the Steel Decking specification:
- .3 Minimum Uncoated Steel Thickness: Minimum uncoated thickness of lightweight steel framing shall be not less than 95% of the thickness used in the design for the framing system:
 - .1 Lesser thicknesses may be permitted at bends arising from the cold forming process.
 - .2 Metal thicknesses listed in this section are minimum uncoated steel thickness; exclusive of any subsequent coatings or treatments.

1.04 REFERENCE STANDARDS

- .1 American Society for Testing and Materials (ASTM):
 - .1 ASTM A108-13, Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished
 - .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 A780-09 Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings

- .2 Canadian General Standards Board (CGSB):
 - .1 CAN/CGSB 1.132-M90, Zinc Chromate Primer, Low Moisture Sensitivity
- .3 Canadian Sheet Steel Building Institute (CSSBI):
 - .1 CSSBI 10M-08, Standard for Steel Roof Deck
 - .2 CSSBI 12M-08, Standard for Composite Steel Deck
- .4 Canadian Standards Association (CSA):
 - .1 CSA S16-09, Design of Steel Structures
 - .2 CSA S136-12, North American Specification for the Design of Cold-Formed Steel Structural Members and Commentary
- .5 Steel Deck Institute (SDI):
 - .1 Diaphragm Design Manual, 3rd Edition, 2004
 - .2 Manual of Construction with Steel Deck, 2nd Edition, 2006

1.05 ADMINISTRATIVE REQUIREMENTS

- .1 Coordination: Coordinate installation of components installed by this Section that are supplied by other Sections of the Work; obtain setting diagrams, templates, instructions and directions, and that are necessary for the completion of work of this Section including the following:
 - .1 Placement of preformed firestopping systems
 - .2 Adjustment to placement of roof fall and travel restraint anchors to suit final design requirements
 - .3 Deck openings required for drains
 - .4 Supports, sleeves and flashings for piping and lines
 - .5 Placement of threaded rods anchors, and sleeves
 - .6 Deck openings required for cable and wiring placement
- .2 Coordination: Coordinate shop priming and finishing requirements with Section 05 05 19, and as follows:
 - .1 Coordinate installation of drains and openings for mechanical and electrical penetrations indicated on Mechanical and Electrical Drawings
 - .2 Coordinate locations of preformed firestopping systems specified in Section 07 84 00.

1.06 SUBMITTALS

- .1 In addition to submittal items listed in Section 05 05 00, submit in accordance with Section 01 00 06 – General Requirements.
- .2 Action Submittals: Provide the following submittals before starting any work of this Section:
 - .1 Product Data: Provide product data for each type of deck, accessory, and product indicated.
 - .2 Fabrication and Erection Documents: Submit erection diagrams indicating layout and types of steel decking, anchorage details, reinforcing channels, pans, steel deck openings, special jointing, accessories, and attachments to other construction; signed and sealed by Delegated Design Professional Engineer who was responsible for their preparation.
- .3 Informational Submittals: Provide the following submittals during the course of the work when requested by Consultant:

- .1 Certificates: Submit two (2) certified copies of mill reports covering chemical and mechanical properties, and coating designation of steel used for this project.
- .2 Source Quality Control Submittals: Submit design notes and calculations in accordance with Section 01 33 50 – Delegated Design Submittals.

1.07 QUALITY ASSURANCE

- .1 Regulatory Requirements: Refer to Section 05 05 00 for fabricator and welding certifications required by Authority Having Jurisdiction.
- .2 Qualifications: Provide proof of qualifications when requested by Consultant; refer to Section 05 05 00 for additional requirements and as follows:
 - .1 Delegated Design Engineer: 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 Documents requirements including the following:
 - .1 Seal and signature to fabrication and erection documents and design submittals
 - .2 Site review of installed components
 - .3 Completion of Letters or Commitment and Compliance as specified in Section 01 33 50
 - .2 Testing Agency: Testing and inspections will be conducted in accordance with Section 05 08 10.

1.08 DELIVERY, STORAGE, AND HANDLING

- .1 Delivery and Acceptance Requirements: Protect steel decking from corrosion, deformation, and other damage during delivery, storage, and handling.
- .2 Storage and Handling Requirements: Stack steel decking on platforms or pallets and slope to provide drainage; protect with a waterproof covering and ventilate to avoid condensation.

2. PRODUCTS

2.01 MANUFACTURERS

- .1 Basis-of-Design Materials: 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 and aesthetic requirements established by the named products and provided they submit requests for substitution in accordance with Section 00 21 – Instructions to Bidders; Proposed Substitutions a minimum of ten (10) days in advance of Bid Closing.
- .2 Acceptable Materials Manufacturers: Subject to compliance with requirements specified in this Section; where multiple listings of manufacturers occur, use any of the listed manufacturers' products in accordance with Section 01 00 06 – General Requirements: Substitutions and Product Options.
- .3 Substitutions: Consultant will accept additional manufacturers having similar products to Acceptable Materials or Basis-of-Design Materials listed in this Section provided they meet the performance requirements established by the named products and provided they submit requests for substitution in accordance with Section 01 00 06 – General Requirements: Substitutions and Product Options.

2.02 DESIGN REQUIREMENTS

- .1 Design materials and fabrication in accordance with Section 05 05 00, using Delegated Design Professional Engineer responsible for providing submissions required by this Section.
- .2 Design Criteria: Design steel decking of a depth and minimum base steel nominal thickness as indicated on the Drawings:
 - .1 Increase thickness if necessary to support loads shown on Drawings.
 - .2 Unless noted otherwise on Drawings, maximum live load deflection for floor steel decking shall be less than span/360.
 - .3 Refer to Drawings for steel decking profile and performance to carry lateral loads (diaphragm action).

2.03 MATERIALS

- .1 Galvanized Steel Sheet: Cold rolled sheet steel in accordance with CSA S136 and ASTM A653/A653M, Structural Steel (SS), Grade 230 (33) having a ZF275 zinc coating.
- .2 Mechanical Deck Fastenings: Self drilling, hex head screw fastener and washer; zinc galvanized finish manufactured specifically for fastening light gauge decking materials to heavy gauge structural steel and trusses; determine diameter and drill point type based on base steel designation and as follows:
 - .1 Basis-of-Design Materials: Hilti S-MD 12-24 x 1 5/8 M HWH 5 Racing Tip Screw
- .3 Powder Actuated Deck Fastenings: Zinc plated carbon steel powder actuated nail fastener and washer manufactured specifically for attaching nestable type steel decking to structural steel meeting requirements of CSSBI 10M; determine size and shot capsule based on material thicknesses required for installation and required diaphragm action, and as follows:
 - .1 Basis-of-Design Materials:
 - .1 Structural Steel Framing: Hilti X-ENP Series
- .4 Deck Side Lap Connectors: Self drilling, hex head screw connector, zinc galvanized finish manufactured specifically for fastening side laps of steel decks; crimping will not be an acceptable method of fastening, and as follows:
 - .1 Basis-of-Design Materials: Hilti SLC 02

2.04 FABRICATION

- .1 Steel Roof Deck: Fabricate panels, without top-flange stiffening grooves, in accordance with CSSBI 10M, and as follows:
 - .1 Span Condition: Triple span or more where practicable.
 - .2 Side Laps: Overlapped.

2.05 ACCESSORIES

- .1 Provide manufacturer's standard accessory materials for decking required for complete installation.
- .2 Flexible Closure Strips: Vulcanized, closed-cell, synthetic rubber.
- .3 Cover Plates, Cell Closures, Flashings and Other Sheet Metal Deck Accessories: Formed of the same material and zinc coating designation as the deck, minimum 0.76 mm thickness; of profile indicated or required for application.

- .4 Pour Stops and Girder Fillers, Column Closures, End Closures, Z-Closures, and Cover Plates
Steel sheet, minimum yield strength of 230 MPa, of same material and finish as deck, and of thickness and profile indicated or required for application.
- .5 Flat Sump Plate for Roof Drain: Single-piece steel sheet, 1.98 mm thick, of same material and finish as deck; cut holes site for proper placement of roof drain and clamps.

3. EXECUTION

3.01 EXAMINATION

- .1 Examine supporting frame and site conditions for compliance with requirements for installation tolerances and other conditions affecting performance.

3.02 PREPARATION

- .1 Locate bundles of steel decking materials to prevent exceeding service level design capacity of supporting members.
- .2 Install temporary shoring, if required to meet deflection limitations.

3.03 INSTALLATION

- .1 Install in accordance with the manufacturer's written instructions and the contract documents, plumb, true, level and rigid.
- .2 Shoot powder activated fasteners to fasten steel decking through flute corrugations to supporting steel; locate fasteners and install in accordance with steel decking manufacturer's and fastener manufacturer's written instructions and as follows:
 - .1 Span decking continuously over 3 or more spans wherever structural framing permits.
 - .2 Install closures and flashings at slab edges, walls, columns and openings for composite deck.
 - .3 Install cover plates for access holes and where steel decking units abut or change direction, and where noted specifically on the drawings.
- .3 Place steel decking on supporting frame and adjust to final position with ends accurately aligned and bearing on supporting frame before being permanently fastened:
 - .1 Do not stretch or contract side-lap interlocks.
 - .2 Install steel decking ends over supporting frame with a minimum end bearing of 38 mm for 38 mm deep steel decking and 76 mm for 76 mm deep deck, with end joints lapped.
 - .3 Cut and neatly fit steel decking and accessories around openings and other work projecting through or adjacent to decking.
- .4 Roof Deck:
 - .1 Roof Sump Plates: Install over openings in roof steel decking and fix flanges to top of deck; space welds not more than 300 mm apart with at least 1 weld at each corner.
 - .2 Install ridge and valley plates, finish strips, cover plates, end closures, and reinforcing channels in accordance with steel decking manufacturer's written instructions.

3.04 OPENINGS AND AREAS OF CONCENTRATED LOADS

- .1 Roof Deck Openings:
 - .1 No reinforcement required for openings cut in steel decking smaller than 150 mm square.
 - .2 Frame steel deck openings 150 mm square to 300 mm square as recommended by manufacturer.
 - .3 Cut and reinforce steel deck openings over 300 mm square and for areas of concentrated load in accordance with structural framing details.

3.05 CONNECTIONS

- .1 Install connections in accordance with CSSBI 10M and in accordance with design requirements for diaphragm action.

END OF SECTION

1. GENERAL**1.01 SUMMARY**

.1 This Section includes requirements for design of wall framing system to resist wind loads and account for building movements including; but not limited to, the following components:

- .1 Studs subjected to lateral wind loads
- .2 Top and bottom tracks
- .3 Bridging and bracing
- .4 Top and bottom track connections to main structure, including fabrications to accommodate main structure deflections; top of wall anchor allowing for dead load deflections during construction and live load deflections after construction
- .5 Head, sill and jamb members at wall openings
- .6 Framing component connections

1.02 RELATED REQUIREMENTS

- .1 Section 05 05 00 – Common Work Results for Metals
- .3 Section 06 10 53 – Miscellaneous Rough Carpentry: Miscellaneous wood blocking.
- .4 Section 06 16 43 – Gypsum Sheathing
- .5 Section 07 52 16– Torch Applied : Installation of vapour retarder continuity sheets installed as a part of steel framed parapet and curb construction.
- .6 Section 08 11 13 – Steel Doors and Frames
- .7 Section 08 41 13 – Aluminum Framed Entrances and Storefronts
- .8 Section 08 42 29.23 – Sliding Automatic Entrances
- .9 Section 09 21 16 – Gypsum Board Assemblies: Non-load bearing interior steel framing.

1.03 DEFINITIONS

- .3 The following definitions apply to the Wind Load Bearing Steel Stud Framing specification:
- .4 Minimum Uncoated Steel Thickness: Minimum uncoated thickness of lightweight steel framing shall be not less than 95% of the thickness used in the design for the framing system:
 - .1 Lesser thicknesses may be permitted at bends arising from the cold forming process.
 - .2 Metal thicknesses listed in this section are minimum uncoated steel thickness; exclusive of any subsequent coatings or treatments.

1.04 ADMINISTRATIVE REQUIREMENTS

- .3 Coordination: Coordinate work of this Section with work of other sections that may have items supported by or built into wind load bearing steel stud systems, including; but not limited to, doors, windows, architectural woodwork, pre-manufactured casework, plumbing fixtures, and electrical fixtures and panels.

1.05 REFERENCE STANDARDS

- .3 American Society of Mechanical Engineers International (ASME):
 - .1 ASME B18 Series Codes and Standards as referenced for specific screws, nuts, bolts and other fasteners

- .4 American Society for Testing and Materials (ASTM International):
 - .1 ASTM A307-04e1, Carbon Steel Bolts and Studs
 - .2 ASTM A653/A653M-18, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
 - .3 ASTM F3125/F3125M-18, Standard Specification for High Strength Structural Bolts, Steel and Alloy Steel, Heat Treated, 120 ksi (830 MPa) and 150 ksi (1040 MPa) Minimum Tensile Strength, Inch and Metric Dimensions
- .5 Canadian General Standards Board (CGSB):
 - .1 CAN/CGSB 1.181-99, Ready-Mixed Organic Zinc-Rich Coating
 - .2 CAN/CGSB 7.1-98, Lightweight Steel Wall Framing Components
- .6 Canadian Sheet Steel Building Institute (CSSBI):
 - .1 CSSBI 51-06, Lightweight Steel Framing Design Manual
 - .2 CSSBI S5-04, Guide Specification for Wind Bearing Steel Studs
 - .3 CSSBI S6-04, Guide Specification for Lightweight Steel Framing
- .7 Canadian Standards Association (CSA Group):
 - .1 CAN/CSA S16-14, Limit States Design of Steel Structures
 - .2 CSA S136-14, North American Specification for the Design of Cold-Formed Steel Structural Members and Commentary
 - .3 CSA W47.1-09(R2014), Certification of Companies for Fusion Welding of Steel
 - .4 CSA W59--18, Welded Steel Construction (Metal Arc Welding)

1.06 SUBMITTALS

- .3 Provide required information in accordance with [Specifier Selection Required].
- .4 Action Submittals: Provide the following submittals before starting any work of this Section:
 - .1 Product Data: Submit product data for mechanical fasteners, indicating sizes, shear, and pull-over loading capacity where applicable. Provide data indicating thickness and type of corrosion protection coating.
 - .2 Shop Drawings: Submit shop drawings clearly indicating all construction details including connections and anchor requirements. Indicate type, size and spacing of fastening devices. Indicate design loads; include seal and signature of a professional engineer registered in the Province of the Work for shop drawings requiring structural design.

1.07 QUALITY ASSURANCE

- .3 Qualifications: Provide proof of qualifications when requested by Consultant:
 - .1 Supplier: Use a manufacture capable of designing, fabricating and erecting of work of this Section in accordance with applicable Building Code and Contract Documents.
 - .2 Installer: Use welders certified by the Canadian Welding Bureau in accordance with CSA W47.1 for the type of work being performed; perform welding in accordance with CSA W59 and the requirements listed in Section 05 05 00 – Common Work Results for Metals.

1.08 DELIVERY, STORAGE, AND HANDLING

- .3 Delivery and Acceptance Requirements: Deliver steel stud framing clearly marked with core steel thickness by embossing, stamping with indelible ink or by colour coding.

- .4 Storage and Handling Requirements: Store materials flat, blocked off the ground in a manner to prevent kinking or permanent set; bent, kinked or twisted studs and track will be rejected.

2. PRODUCTS

2.02 DESIGN CRITERIA

- .3 Perform design, fabrication and erection of the work of this Section based on Limit States Design principles using factored loads and resistances, determined in accordance with CSA S136.
- .4 Conform to the requirements of indicated fire resistance ratings.
- .5 Design wall framing system capable of withstanding design loads within limits and under design loads as follows:
 - .1 Dead Loads: As indicated on Structural Drawing S0.01.
 - .2 Wind Loads: As indicated on Structural Drawing S0.01.
 - .3 Design framing systems to provide for movement of framing members without damage or overstressing, sheathing failure, connection failure, undue strain on fasteners and anchors, or other detrimental effects when subject to a maximum ambient temperature change of 70°C.
 - .4 Design framing system to maintain clearances at openings, to allow for construction tolerances, and to accommodate live load deflection of primary building structure upward and downward movement of 13 mm; or larger gap as may be required to accommodate structural movement.
 - .5 Design deflection detail so that free floating vertical members are restrained from horizontal movement by means of continuous bridging, nested or boxed tracks, or sliding or flexible web connections.
 - .6 Maximum allowable deflection under q50 sustained wind loading (with the appropriate importance factors for ULS and SLS shall be as follows:
 - .1 Behind panels – stud deflection limited to L/720.
 - .2 Behind or other finishes – stud deflection limited to L/360.
 - .7 Allow for movement of the structure; design lightweight steel framing end connections to accommodate roof deflections such that studs are not loaded axially; limit free play and movement in connections perpendicular to the plane of framing to ± 0.50 mm relative to the building structure.
 - .8 Design connections between light steel framing members using bolts, welding or sheet metal screws.
 - .9 Design bridging to prevent member rotation and member translation perpendicular to the minor axis, and as follows:
 - .10 Design for secondary stress effects due to torsion between lines of bridging.
 - .11 Collateral contribution of sheathing materials may be used to help restrain member rotation and translation perpendicular to the minor axis for wind bearing studs.] Design exterior wall framing to accommodate horizontal deflection without allowing for collateral contribution of sheathing materials.
 - .12 Design bridging at 1530 mm centres maximum, closer spacing may be required by design to satisfy structural requirements; spaced at even intervals over the span of the member.
- .6 Stud, sill and top track sizes and thicknesses, and fastening details indicated in this Section and on the Drawings shall be considered as minimums only, spacing indicated as maximum permissible, except where changes are required to meet design criteria, and as follows:
 - .1 Design head, sill and jamb members to frame openings larger than 100 mm in any dimension.
 - .2 Design components or assemblies to accommodate specified tolerances of the structure.

- .3 Sill and Top Tracks:
 - .1 Double track system, outer track flanges with depth to suit vertical deflection and width of studs.
 - .2 Sill tracks, minimum 33 mm deep flanges and width of studs.
- .4 Movement Connection Clips: Purpose made clip designed to allow structural member vertical movement and to transfer wind suction or pressure to structural frame.
- .5 Maximum design spacing of stud members shall not exceed 406 mm centres.
- .6 Maximum spacing for top and bottom track connections to the structure shall not exceed 810 mm centres.
- .7 Minimum design thickness for wall framing members shall be as follows or thicker when required to meet project performance requirements:
 - .1 64 mm: 33 (0.84 mm)
 - .2 92 mm: 33 (0.84 mm)
 - .3 101 mm: 33 (0.84 mm)
 - .4 140 mm: 33 (0.84 mm)
 - .5 152 mm: 43 (1.09 mm)
 - .6 184 mm: 54 (1.37 mm)
 - .7 203 mm: 54 (1.37 mm)
 - .8 Minimum thickness for walls supporting masonry veneer shall be 54 (1.37 mm) regardless of minimum thickness indicated above, or thicker as required to suit design conditions.
- .8 Bridging Channel: 1.09 mm minimum
- .9 Clip Angles: 1.37 mm minimum

2.03

MATERIALS

- .3 Wind Bearing Steel Framing Members and Accessories:
 - .1 Steel conforming to CSA S136 and shall be identified as to specification, type grade and mechanical properties; metal core thickness and spacing determined by delegated design professional engineer, hot dipped galvanized steel; roll formed with knurled flanges, and cut-outs for services and bracing
 - .2 Galvanizing conforming to ASTM A653/A653M to a minimum of Z180 for exterior wall assemblies; the Consultant may accept other coatings meeting or exceeding the corrosion protection listed upon written request to the Consultant.
 - .3 Colour Coding: In accordance with Lightweight Steel Framing Manual, published by Canadian Sheet Steel Building Institute.
- .4 Fasteners and Welds:
 - .1 Welding materials conforming to CSA W59; electrodes minimum 480 MPa tensile strength
 - .2 Bolts and nuts conforming to ASTM A307 or ASTM F3125, with washers and hot-dip galvanized finish.
 - .3 Metal to Metal: Sheet metal screws conforming to ASME 18, with minimum 0.008 mm thick galvanized coating and #8 Ø; self-drilling, self-threading, case hardened type; hex, pan, and low-profile head profile type to suit application; length sufficient to penetrate not less than 3 fully exposed threads beyond joined materials.
 - .4 Metal to Concrete: Drilled insert, minimum 6.4 mm Ø; do not use Powder Actuated Fasteners.
 - .1 Basis-of-Design Products: Hilti Kwik Con

- .5 Metal to Structural Steel: Secure track to structural steel over 8 mm thickness with proprietary fastening system:
 - .1 Acceptable Products: Hilti DX Fastening System with ENP2-21L15MX.
 - .2 Drilled Inserts: Steel, cadmium plated or hot-dip galvanized, sizes as indicated on drawings.

.5 Touch up Paint: Zinc-rich, to CAN/CGSB 1.181M

.6 Moisture Barrier: Insulating moisture resistant 6 mm thick foam strip x width of framing member, length as required:

- .1 Basis-of-Design Products: Dow Ethafoam 222

.7 Thermal Insulation: ASTM C 665, Type I, un-faced mineral-fibre blankets produced by combining glass or slag fibres with thermosetting resins.

3. EXECUTION

3.02 INSPECTION AND PREPARATION

.3 Confirm that flashings and waterproof membranes provided by other Sections are properly installed to divert moisture to exterior.

.4 Confirm that door and window frames are placed and securely braced in proper location.

3.03 ERECTION

.3 Fabrication and erection shall conform to the reviewed shop drawings; modifications required to accommodate on-site conditions, other than minor dimensional changes, shall be resubmitted by the delegated design professional engineer and reviewed with the Consultant for acceptance prior to proceeding with work.

.4 Provide continuous top and bottom tracks.

.5 Align exterior wall partition tracks at floor and underside of deck, isolate track from direct contact with concrete using moisture barrier.

.6 Cut bottom of studs square and set with full contact in bottom track; screw-fasten both flanges to sill track.

.7 Place studs vertically at not more than 50 mm from abutting walls, and at each side of openings and corners; position studs in tracks at floor and ceiling, unless noted otherwise.

.8 Cross-brace steel studs as required to provide rigid installation to delegated design engineer instructions; attach studs to lower ceiling track using specified fasteners.

.9 Cut members using saw or shear; flame cutting is not permitted.

.10 Provide minimum of three studs at corners; insulate exterior components not accessible from interior using mineral fibre insulation:

- .1 Place insulation equal to that specified for the field area of assemblies into non-accessible areas such as jamb and header assemblies, corners and wall to roof transitions.
- .2 Keep insulation dry after installation. Do not compress insulation.

.11 Provide cross studs secured to studs, and additional framing as required for support of fixtures mounted to walls.

- .12 Erection tolerances shall be as follows:
- .1 Erect steel studding to tolerance of ± 3 mm, non-cumulative from design spacing. Spacing in any case shall not exceed the requirements of the finishing materials.
 - .2 Out-of-plumb shall not exceed 1/500 of the member length.
 - .3 Out-of-straight (camber or sweep) shall not exceed 1/1000 of the member length.
 - .4 Track camber shall not exceed 1/1000 of member length.
 - .5 Studs shall seat into top and bottom tracks; gap between the end of the stud and the web of the track shall not exceed 4 mm for lightweight steel framing.
 - .6 Distance from centreline of last un-reinforced cut-out to end of framing member shall not be less than 305 mm.
- .13 Coordinate simultaneous erection of studs with installation of service lines; align web openings when erecting studs.
- .14 Coordinate erection of studs with installation of door/window frames and special supports or anchors for Work specified in other Sections.
- .15 Provide two studs extending from floor to ceiling at each side of openings wider than stud centres specified; secure studs together using sheet metal and screw fasteners.
- .16 Erect track at head of door openings and sills of sidelight/window openings to accommodate intermediate studs; secure track to studs at each end; install intermediate studs above and below openings in same manner and spacing as wall studs.
- .17 Install steel studs or furring channel between studs for attaching electrical and other boxes.
- .18 Perform welding in accordance with CSA W59; for material less than 3 mm thick, the effective throats of welds shall not be less than the thickness of the thinnest connect part:
- .1 Mechanically fasten all members having a thickness of 0.91 mm and less; weld or mechanically fasten members having thicknesses of 1.12 mm and greater
- .19 After erection, refinish damaged finishes, welds, fastener heads and nuts with zinc rich paint, in accordance with paint manufacturer's instructions.

3.04 FIXTURE ATTACHMENT AND ACCESS PANELS

- .3 Install all attachments within steel-stud partitions for fixtures being hung from or anchored to such partitions.
- .4 Install access doors to electrical or mechanical fixtures supplied under respective Sections.
- .5 Rigidly secure frames to furring or framing systems.

3.05 INSPECTION AND CERTIFICATION

- .3 The installation of the exterior steel stud walls shall be inspected periodically by the delegated design professional engineer responsible for the component selection and connection designs for conformance to the shop drawings and design intent in accordance with Section 05 05 00 – Common Work Results for Metals and Section 01 33 50 – Deferred Design Submittals.
- .4 Forward copies of inspection reports to Owner, Consultant, and the Trade Contractor responsible for the Work and the Contractor .
- .5 Prior to declaration of Substantial Performance, delegated design professional engineer shall submit a Letter of Compliance, signed and sealed in accordance with Section 01 33 50 – Delegated Design Submittals.

END OF SECTION

1. GENERAL

1.01 SUMMARY

- .1 This Section includes requirements for supply and installation of non-ornamental metal fabrications and miscellaneous metals required for installation of structural steel, decking and joist framing, and other structural components.

1.02 RELATED REQUIREMENTS

- .1 Section 05 05 00 – Common Work Results for Metals: Qualifications, testing and inspection requirements for this Section.
- .2 Section 05 05 19 – Common Work Results for Metalwork Finishing
- .3 Section 05 12 00 – Structural Steel Framing
- .4 Section 05 31 00 – Steel Decking
- .6 Section 06 10 53 – Miscellaneous Rough Carpentry
- .7 Section 06 40 00 – Shop Fabricated Architectural Woodwork: Concealed supports for shop finished carpentry.
- .8 Section 09 21 16 – Gypsum Board Assemblies: Wall supports for stub walls; placement of reinforcements for support of metal fabrications.
- .9 Section 09 91 00 – Painting

1.03 REFERENCE STANDARDS

- .6 American Society for Testing of Materials (ASTM):
 - .1 ASTM A36/A36M-12, Standard Specification for Carbon Structural Steel
 - .2 ASTM A53/A53M-12, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
 - .3 ASTM A123/A123M-13, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
 - .4 ASTM A153/A153M-05, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
 - .5 ASTM A276-13, Standard Specification for Stainless Steel Bars and Shapes
 - .6 ASTM A307-10, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength
 - .7 ASTM A500-10a, Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
 - .8 ASTM A563-07a, Standard Specification for Carbons and Alloy Steel Nuts
 - .9 ASTM A666-10, Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar
 - .10 ASTM A780-09, Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
 - .11 ASTM A786/A786M-05(2009), Standard Specification for Hot-Rolled Carbon, Low-Alloy, High-Strength Low-Alloy, and Alloy Steel Floor Plates
 - .12 ASTM B221-13, Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
 - .13 ASTM B633-11, Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel
 - .14 ASTM C1107/C1107M-13, Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)

- .15 ASTM D1187-97 (2002)e1, Standard Specification for Asphalt-Base Emulsions for Use as Protective Coatings for Metal
 - .16 ASTM F568M-07, Standard Specification for Carbon and Alloy Steel Externally Threaded Metric Fasteners
 - .17 ASTM F1554-07ae1, Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength
- .7 Canadian Standards Association (CSA):
- .1 CAN/CSA S16-09, Limit States Design of Steel Structures
 - .2 CSA G30.18-09, Carbon Steel Bars for Concrete Reinforcement
 - .3 CSA G40.20-13/G40.21-13, General Requirements for Rolled or Welded Structural Quality Steel Structural Quality Steel
 - .4 CSA W47.1-09, Certification of Companies for Fusion Welding of Steel
 - .5 CSA W55.3-08, Certification of Companies for Resistance Welding of Steel and Aluminum
 - .6 CSA W59-03, Welded Steel Construction (Metal Arc Welding) with Update
 - .7 CSA W178.1-08, Certification of Welding Inspection Organizations
- .8 Canadian General Standards Board (CGSB):
- .1 CAN/CGSB 1.40M-97, Primer, Structural Steel, Oil Alkyd Type
 - .2 CAN/CGSB 1.181M-99, Coating, Zinc Rich, Organic, Ready Mixed
- .9 The National Association of Architectural Metal Manufacturers (NAAMM):
- .1 AMP 555-92, Code of Standard Practice for Architectural Metal Industry, including Miscellaneous Iron
- 1.04 ADMINISTRATIVE REQUIREMENTS
- .6 Pre-Construction Meetings: Schedule and conduct a pre-installation conference at the project site with Contractor, Subcontractor responsible for fabrication and erection, Subcontractor responsible for finish painting, and the City to verify project requirements, fabricator's installation instructions and manufacturer's warranty requirements.
 - .7 Coordination: Coordinate with for requirements affecting this Section and as follows:
 - .1 Anchorages: Provide setting drawings, templates and directions for installing anchorages including sleeves, concrete inserts, anchor bolts, and items with integral anchors that are embedded in concrete, and deliver to site in time for installation.
 - .2 Priming and Galvanizing: Coordinate priming and galvanizing requirements with Section 05 05 19 for non-architecturally finished components.
 - .3 Architectural Finishing: Coordinate finishing requirements with paint systems specified in Section 09 91 00; failure to apply referenced primer will result in this section removing applied primer and recoating with specified material at no additional cost to City.
- 1.05 SUBMITTALS
- .6 In addition to submittal items listed in Section 05 05 00, provide required information in accordance with Section 01 00 06 – General Requirements: Submittals.
 - .7 Action Submittals: Provide the following submittals before starting any work of this Section:
 - .1 Product Data: Submit product data for the following:
 - .1 Non-slip aggregates and non-slip aggregate surface finishes
 - .2 Grout
 - .3 Fasteners

- .4 Prefabricated components
- .5 Paint and coating products

.2 Shop Drawings: Submit shop drawings indicating detailed fabrication and erection of each metal fabrication indicated in accordance with NAAMM AMP 555 including; but not limited to plans, elevations, sections, and details of metal fabrications and connections; show anchorage and accessory items.

.8 Informational Submittals: Provide the following submittals when requested by the City:

.1 Certificates: Submit certificates for the following:

- .1 Mill certificates signed by manufacturers of stainless steel sheet certifying that products provided are in accordance with requirements of this Section.
- .2 Copies of welding certificates for welding procedures and personnel in accordance with Section 05 05 00.

1.06 QUALITY ASSURANCE

.6 Regulatory Requirements: Perform structural welding, use personnel and qualify procedures in accordance with requirements listed in Section 05 05 00.

.7 Qualifications: Provide proof of qualifications when requested by City:

- .1 Fabricators: Use fabricator experienced in producing metal fabrications similar to those required for this project and with a record of successful in-service performance with sufficient production capacity to produce required units.
- .2 Personnel: Use welders qualified by Canadian Welding Bureau for classification of work being performed that are experienced in type and extent of work required for the project.

1.07 PROJECT CONDITIONS

.6 Site Measurements: Verify dimensions by site measurements before fabrication and indicate measurements on shop drawings where metal fabrications are indicated to fit walls and other construction; coordinate fabrication schedule with construction progress to avoid delaying the Work.

.7 Established Dimensions: Establish dimensions and proceed with fabricating metal fabrications without site measurements where site measurements cannot be made without delaying the Work; coordinate construction to ensure that actual dimensions correspond to established dimensions; allow for trimming and fitting.

2. PRODUCTS

2.02 SOURCE OF SUPPLY

.6 Steel Shapes and Sections: Sizes and configurations indicated on Drawings are conceptual and may represent materials that are not commonly available under the referenced standards; City will consider substitute materials having similar profiles or meeting different standards provided they meet or exceed the structural requirements of the detailed materials and provided the information is submitted with a request for substitution a minimum of ten (10) days in advance of Bid Closing.

2.03 MATERIALS

- .6 Metal Surfaces: Provide materials with smooth, flat surfaces without blemishes for metal fabrications exposed to view in the completed Work; do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness.
- .7 Ferrous Metals:
 - .1 Steel Plates, Shapes, and Bars: In accordance with CSA G40.20/G40.21, Grade 300W or ASTM A36/A36M.
 - .2 Hollow Structural Sections: In accordance with CSA G40.20/G40.21, Grade 350W, Class C or ASTM A500/A500M Grade C.
 - .3 Stainless Steel Sheet, Strip, Plate, and Flat Bars: In accordance with ASTM A666, Type 304.
 - .4 Stainless Steel Bars and Shapes: In accordance with ASTM A276, Type 304.
 - .5 Rolled Steel Floor Plate: In accordance with ASTM A786/A786M, rolled from plate meeting requirements for ASTM A36/A36M or ASTM A283/A283M, Grade C or D.
 - .6 Steel Tubing: Cold formed steel tubing in accordance with ASTM A500.
 - .7 Steel Pipe: In accordance with ASTM A53/A53M, standard weight (Schedule 40).
 - .8 Welding Rods and Bare Electrodes: Select according to CWB specifications for metal alloy welded.
- .8 Non-Ferrous Metals:
 - .1 Aluminum Extrusions: In accordance with ASTM B221, alloy 6063-T6.
 - .2 Aluminum Alloy Rolled Tread Plate: In accordance with ASTM B632/B632M, alloy 6061-T6.
- .9 Cementitious Materials:
 - .1 Grout:
 - .1 Non-Shrink, Metallic Grout: Factory packaged ferrous aggregate grout in accordance with ASTM C1107/C1107M, specifically recommended by manufacturer for heavy duty loading applications.
 - .2 Non-Shrink, Non-Metallic Grout: Factory packaged, non-staining, non-corrosive, non-gaseous grout in accordance with ASTM C1107/C1107M, specifically recommended by manufacturer for interior and exterior applications.
- .10 General Fasteners: Provide Type 316 stainless steel fasteners for exterior use and zinc plated fasteners with coating in accordance with ASTM B633, Class Fe/Zn 5, where built into exterior walls; select fasteners for type, grade and class required and selected from the following:
 - .1 Bolts and Nuts:
 - .1 Bolts: Regular hexagon head bolts, ASTM A307, Grade A or ASTM F568/F568M, Property Class 4.
 - .2 Nuts and Washers ASTM A563/A563M hex nuts and flat washers.
 - .2 Anchor Bolts: ASTM F1554, Grade 36.
 - .3 Machine Screws: ASME B18.6.3/B18.6.7M.
 - .4 Lag Bolts: ASME B18.2.1/B18.2.3.8M.
 - .5 Wood Screws: Flat head, carbon steel, ASME B18.6.1.
 - .6 Plain Washers: Round, carbon steel, ASME B18.22.1/B18.22M.
 - .7 Lock Washers: Helical, spring type, carbon steel, ASME B18.21.1/B18.21.2M.

- .11 Finishes: Finish metal fabrications in accordance with NAAMM Metal Finishes Manual for Architectural and Metal Products following recommendations for applying and designating finish after assembly and as follows:
- .1 Steel and Iron Finishes:
- .1 Galvanizing: Hot dip galvanize items as indicated in accordance with applicable standard following:
- Products: ASTM A123/A123M
 - Hardware ASTM A153/A153M
- .2 Preparation for Shop Priming: Prepare uncoated ferrous metal surfaces in accordance with minimum requirements indicated below for SSPC surface preparation specifications and environmental exposure conditions of installed metal fabrications:
- Exteriors SSPC Zone 1B: SSPC-SP6, Commercial Blast Cleaning.
 - Interiors SSPC Zone 1A: SSPC-SP3, Power Tool Cleaning.
- .2 Stainless Steel Finishes: Remove tool and die marks and stretch lines or blend into finish; grind and polish surfaces to match original finish; passivate and rinse surfaces after polishing, remove embedded foreign matter and leave surfaces chemically clean.
- .3 Applied Finishes: Apply finishes to uncoated surfaces of metal fabrications, except items with galvanized finishes and those to be embedded in concrete, sprayed-on fireproofing, in accordance with SSPC-PA1, Paint Application Specification No. 1; stripe coat corners, crevices, bolts, welds, and sharp edges and as follows:
- .1 Shop Primers: Provide primers that are compatible with paint systems specified in Section 05 05 19 and Section 09 91 00.
- .2 Galvanizing Repair Paint: High zinc dust content paint for regalvanizing welds in steel, in accordance with SSPC-Paint 20, coordinate requirements with Section 05 05 19.
- .3 Bituminous Paint: Cold applied asphalt mastic in accordance with SSPC-Paint 12; except containing no asbestos fibres, or cold applied asphalt emulsion in accordance with ASTM D1187.

2.04 FABRICATION

- .6 Shop Fabrication: Shear and punch metals cleanly and accurately, remove burrs; ease exposed edges to a radius of approximately 1 mm; form bent metal corners to smallest radius possible without causing grain separation or otherwise impairing work and as follows:
- .1 Fabricate joints exposed to weather in a manner to exclude water, or provide weep holes where water may accumulate.
- .2 Fabricate assemblies exposed to exterior conditions that allow for thermal movement resulting from ambient and surface temperatures by preventing buckling, opening up of joints, overstressing of components, failure of connections, and other detrimental effects.
- .3 Form exposed work true to line and level with accurate angles and surfaces and straight sharp edges.
- .4 Remove sharp or rough areas on exposed traffic surfaces.
- .7 Shop Welding: Weld corners and seams continuously and as follows:
- .1 Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
- .2 Obtain fusion without undercut or overlap.
- .3 Remove welding flux immediately.

- .4 At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- .8 Shop Assembly: Pre-assemble items in shop to greatest extent possible to minimize site splicing and assembly and as follows:
 - .1 Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible.
 - .2 Use exposed fasteners of type indicated; or if not indicated, Phillips flat-head countersunk screws or bolts.
 - .3 Locate joints where least conspicuous.
 - .4 Disassemble units only as necessary for shipping and handling limitations.
 - .5 Use connections that maintain structural value of joined pieces.
 - .6 Clearly mark units for reassembly and coordinated installation.
- .9 Anchorage Fabrication: Fabricate and space anchoring devices to secure metal fabrications rigidly in place and to support required loads; provide for anchorage of type indicated and suitable for supporting structure, and as follows:
 - .1 Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.
- .10 Custom Steel Curtain Wall Fin for Point supported glass assembly, primed and finish painted as indicated on the Drawings. Coordinate connection with Section 08 44 26 – Point Supported Structural Glass Curtain Wall Assemblies; Size and requirements as indicated on Structural Drawings.
- .11 Custom Stainless Steel U-Channels for Glazing: Form to profiles indicated on Drawing A6.02, and as follows:
 - .1 Coordinate base connection with Section 08 81 00; Cast U-Channels into concrete grade beam for base connection of glazing.
 - .2 Coordinate fastening requirements at head with Section 08 81 00; allow for a minimum 6 mm diameter fastener at 300 mm o.c into rolled angle supports. Allow for 6 mm self-tapping screw fasteners @ 150 mm o.c into cold formed steel stud tracks. Coordinate throat dimension to allow for glazing thicknesses, glazing accessories and roll in gaskets clearance dimensions.

3. EXECUTION

3.02 INSTALLATION

- .6 Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing metal fabrications to in-place construction. Include threaded fasteners for concrete inserts, toggle bolts, through bolts, lag bolts, wood screws, and other connectors.
- .7 Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels and as follows:
 - .1 Provide temporary bracing or anchors in formwork for items that are to be built into concrete, or similar construction.
 - .2 Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations.

- .8 Site Welding: Perform welding work in accordance with CSA W59; do not weld, cut or abrade surfaces of exterior units that have been hot dip galvanized after fabrication and are for bolted or screwed site connections and as follows:
- .1 Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - .2 Obtain fusion without undercut or overlap.
 - .3 Remove welding flux immediately.
 - .4 At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- .9 Corrosion Protection: Coat concealed surfaces of aluminum that will come into contact with grout, concrete, or dissimilar metals with bituminous paint applied to a high build thickness of 1.5 to 2 mm.

3.03 ADJUSTING AND CLEANING

- .6 Touch-Up of Shop Applied Primer: Immediately after erection, clean site welds, bolted connections, and abraded areas of shop coatings, and recoat exposed areas using same material as used for shop priming in accordance with SSPC-PA1 for touching up shop coated surfaces; apply by brush or spray to a minimum 0.05 mm dry film thickness.
- .7 Galvanized Surfaces: Clean site welds, bolted connections, and abraded areas and repair galvanizing in accordance with ASTM A780.

3.04 SCHEDULE OF COMPONENTS

- .6 The following listing of metal fabrications is provided by the City for the convenience of the Contractor every attempt has been made to provide a complete list metal fabrications; however, it and is not intended to be comprehensive listing, which is the Contractor's responsibility; list of metal fabrications includes; but is not limited to, the following:
- .1 Loose Bearing and Levelling Plates: Provide plates for steel items bearing on concrete construction; drill plates to receive anchor bolts and for grouting; galvanize plates after fabrication.
 - .2 Miscellaneous Framing and Supports: Structural steel shapes, plates, and bars of welded construction; galvanize where located in exterior construction; fabricated to sizes, shapes, and profiles necessary to receive adjacent construction retained by framing and supports; cut, drill, and tap units to receive hardware, hangers, and similar items including but not limited to the following:
 - .1 Steel framing and supports for vanities.
 - .2 Steel framing and supports for mechanical and electrical equipment.
 - .3 Steel framing and supports for applications where framing and supports are not specified in other Sections.
 - .4 Miscellaneous steel trim.
 - .5 Structural steel door frames.
 - .6 Steel floor plate and supports.
 - .3 Pipe Guard Posts (Bollards): Schedule 40 steel pipe, 150 mm diameter, having 6 mm thick steel cap; embedded 1200 mm into concrete pile with 915 mm exposed; prime paint finish. Provide 50 mm diameter steel pipe horizontals welded to verticals, attach horizontals to wall using continuous 76 mm x 6 mm wide flat bar plates and expansion anchors.

END OF SECTION

1. GENERAL

1.01 SUMMARY

- .1 This Section includes, but is not limited to the following, including accessories, fastenings, framing assemblies:

- .1 Fabricated Interior Steel sheet panels
- .2 Fabricated Exterior Steel Column Cladding
- .3 Fabricated Mechanical Shroud
- .4 Formed U-Channel for glazing
- .5 Fabricated Aluminum Splashblocks

1.02 RELATED REQUIREMENTS

- .1 Section 05 05 00 – Common Work Results for Metals
- .2 Section 08 11 13 – Steel Doors and Frames
- .3 Section 09 21 16 – Gypsum Board Assemblies: Back-up for wall or ceiling supported materials.
- .4 Section 09 91 00 – Painting
- .5 Division 23 - Heating Ventilating and Air Conditioning: Coordination with this Section and the provision of products, materials and labour for the integrated shroud Mock-Up requirement.
- .6 Division 26 – Lighting and Section 26 05 00 Common Work Results for Electrical: Coordination with this Section and the provision of materials, products and labour for the integrated shroud Mock-Up requirement.

1.03 DEFINITIONS

- .1 The following definitions apply to the Custom Metal Fabrications specification:
- .2 Site Dimensions: Actual dimensions measured on site and used by fabricator to construct required assemblies.
- .3 Established Dimensions: Dimensions derived from drawings or that can be reasonably determined from adjacent construction where actual dimensions required by components fabricated in this section are not available; dimensions shall have suitable tolerances so that assemblies can be adjusted on site to fit actual Site dimensions.

1.04 REFERENCE STANDARDS

- .1 American Society for Testing and Materials (ASTM):
 - .1 ASTM A167-99(2009), Stainless Steel and Heat-Resisting Chromium-Nickel Steel Plate, Sheet and Strip
 - .2 ASTM A276M-17, Standard Specification for Stainless Steel Bars and Shapes
 - .3 ASTM A312/A312M-13b, Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes
 - .4 ASTM A36/A36M-14, Standard Specification for Carbon Structural Steel

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- .5 ASTM A53/A53M-18, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
 - .6 ASTM A123/A123M-17, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
 - .7 ASTM A153/A153M-16a, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
 - .8 ASTM A307-14e1, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength
 - .9 ASTM A500M-18, Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
 - .10 ASTM A563-15, Standard Specification for Carbons and Alloy Steel Nuts
 - .11 ASTM A666-15, Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar
 - .12 ASTM A780M-09 (2015), Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
 - .13 ASTM A786/A786M-2015, Standard Specification for Hot-Rolled Carbon, Low-Alloy, High-Strength Low-Alloy, and Alloy Steel Floor Plates
 - .14 ASTM B209/B209M14, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
 - .15 ASTM B221-14, Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
 - .16 ASTM B633-19, Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel
 - .17 ASTM C1107/C1107M-17, Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)
 - .18 ASTM D1187M-97 (2018), Standard Specification for Asphalt-Base Emulsions for Use as Protective Coatings for Metal
 - .19 ASTM E488M-18, Standard Test Methods for Strength of Anchors in Concrete and Masonry Elements
 - .20 ASTM F568M-07, Standard Specification for Carbon and Alloy Steel Externally Threaded Metric Fasteners
 - .21 ASTM F1554-18, Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength
- .2 Canadian Standards Association (CSA):
- .1 CAN/CSA S16-14, Limit States Design of Steel Structures
 - .2 CSA G40.20-13/G40.21-13, General Requirements for Rolled or Welded Structural Quality Steel Structural Quality Steel
 - .3 CSA W47.1(R2014), Certification of Companies for Fusion Welding of Steel
 - .4 CSA W59-18, Welded Steel Construction (Metal Arc Welding) with Update
 - .5 CSA W178.1-18, Certification of Welding Inspection Organizations
- .3 Canadian General Standards Board (CGSB):
- .1 CAN/CGSB 1.40M-97, Primer, Structural Steel, Oil Alkyd Type
 - .2 CAN/CGSB 1.181M-99, Coating, Zinc Rich, Organic, Ready Mixed

- .4 The National Association of Architectural Metal Manufacturers (NAAMM):
 - .1 NAAAM-AMP 555-92, Code of Standard Practice for Architectural Metal Industry, including Miscellaneous Iron

1.

1.05 ADMINISTRATIVE REQUIREMENTS

- .1 Pre-Construction Meetings: Schedule and conduct a pre-installation conference at the project site in accordance with Section 01 00 06 – General Requirements: Project Meetings: meeting will address but not be limited to, verifying project requirements, fabricator's installation instructions and manufacturer's warranty requirements and require representatives of each entity directly concerned with integrated shroud to attend including but not limited to, the following:

- .1 Contractor
- .2 Sheet Metal Fabricator
- .3 Sheet Metal Installer
- .4 Mechanical Subcontractor
- .5 Electrical Subcontractor
- .6 Other subcontractors affected by work of this Section

- .2 Agenda for pre-construction meeting will include; but not be limited to, the following topics:

- .1 Layout and appearance of stainless steel finishes
- .2 Consultant's design criteria and expected results
- .3 Fabricators proposed methods of forming compound curves and methods for restoring stainless steel finishes
- .4 Integration of mechanical and electrical services into shroud covers, and requirements for maintaining accessibility for servicing and repairs
- .5 Placement and profile of joints and fastenings
- .6 Acceptable tolerances for out-of-plumb, flat or level, and placement of formed sheet metal fabrications
- .7 Protection of formed sheet metal fabrication work from following trades through a formalized education process.
- .8 Meeting will also discuss and propose solutions for range of expected architectural finishes

- .3 Coordinate with Section 05 05 19 – Common Work Results for Metalwork Finishing for additional requirements.

1.06 SUBMITTALS

- .1 Provide submittals in accordance with Section 01 00 06 – General Requirements: Submittals.

- .2 Action Submittals:

- .1 Product Data: Submit product data for products used in metal fabrications including; but not limited to, paint products, grout and fasteners.

- .2 Shop Drawings: Submit detailed shop and erection drawings of each custom metal fabrication including plans, elevations, sections, and details of custom metal fabrications and their connections and as follows:
 - .1 Show
 - .2 Submit qualification data for fabrication firm demonstrating their capabilities and experience.
 - .3 Show fabrication and installation of custom metal. Include plans, elevations, component details, framing and attachments anchorage to other Work and accessory items.
 - .4 Indicate materials and profiles of each custom metal member, fittings, joinery, and finishes.
 - .5 Include setting drawings, templates, and directions for installing anchor bolts and other anchorages.
 - .6 Welding Certificates: Submit copies of welder certificates signed by Contractor certifying that welders are certified and have the necessary experience to complete work specified in this Section.

1.07 MOCK-UPS

- .1 Construct mock-ups to verify selections and methods of fabrication to demonstrate aesthetic effects and set quality standards for materials and execution in accordance with Section 01 00 06 – General Requirements: Quality Control for mock-ups and as follows:
 - .1 Mechanical Shroud:
 - .1 Build mock-up of mechanical shroud, showing butt joints, using construction that will be architecturally exposed in final construction and using contract materials, methods and workmanship:
 - Incorporate accessories, joints, and mechanical and electrical services.
 - Demonstrate methods for forming compound curves, joints, restoration of stainless steel finishes to match straight sections.
 - .2 Protect reviewed mock-ups from construction activities until completion of work of this Section.
 - .3 Mock-ups will be reviewed for:
 - Quality of stainless steel finishes and fabrication
 - Relationship of formed panels and joints, and continuity of formed features around corners
 - Aesthetic qualities of workmanship
 - Mock-ups found acceptable by the Consultant may become part of the completed Work if undisturbed at time of Substantial Performance.
 - .2 Galvanized Splashpan:
 - .1 Construct finished mock-up to demonstrate aesthetic effects in accordance with Section 01 00 06 – General Requirements: Quality Control for mock-ups. Refer to Detail 6/A6.04 for details.

- .2 Review and acceptance of mock-ups does not constitute approval of deviations from the Contract Documents contained in mock-ups unless Consultant specifically notes such deviations in writing.
- .3 Remove and replace mock-ups considered as not acceptable by the Consultant; Work installed and determined as not acceptable will be administered as a construction deficiency with payment for deficient work withheld until corrected in a manner directed by the Consultant.

1.08 DELIVERY, STORAGE, AND HANDLING

- .1 Delivery and Acceptance Requirements: Deliver materials to the job site in good condition and properly protected against damage to finished surfaces.
- .2 Storage and Handling Requirements: Store materials in a location and in a manner to avoid damage:
 - .1 Store metal components and materials in a clean, dry location.
 - .2 Cover with waterproof paper, tarpaulin or polyethylene sheeting in a manner that will permit circulation of air inside the cover.
 - .3 Keep handling on-site to a minimum.
 - .4 Exercise care to avoid damage to finishes of material.
- .3 Store custom metal inside a well-ventilated area, away from uncured concrete and masonry, and protected from weather, moisture, soiling, abrasion, extreme temperatures, and humidity.

2. PRODUCTS

2.01 METALS

- .1 Metal Surfaces:
 - .1 General: Provide materials with smooth, flat surfaces without blemishes for metal fabrications exposed to view in the completed Work; do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness.
 - .2 Provide metals free from surface blemishes where exposed to view in finished unit. Exposed to view surfaces exhibiting pitting, seam marks, roller marks, stains, discolorations, or other imperfections on finished units are not acceptable.
 - .3 Steel sheets and Sections: Sizes and configurations indicated on Drawings are conceptual and may represent materials that are not commonly available under the referenced standards; City will consider substitute materials having similar profiles or meeting different standards provided they meet or exceed the structural requirements of the detailed materials and provided the information is submitted with a request for substitution a minimum of ten (10) days in advance of Bid Closing.
- .2 Stainless Steel: Grade and type designated below for each form required:
 - .1 Pipe: ASTM A312/A312M, Grade TP 304.
 - .2 Sheet, Strip, Plate, and Flat Bar: ASTM A666, Type 304.
 - .3 Bars and Shapes: ASTM A276, Type 304.

2.02 MISCELLANEOUS MATERIALS

- .1 Slotted Channel Framing: Cold formed metal channels with flange edges returned toward web and with 14 mm wide slotted holes in webs at 50 mm o/c, and as follows:
 - .1 Width of Channels: 41 mm.
 - .2 Depth of Channels: 41 mm.
 - .3 Metal and Thickness: Galvanized steel in accordance with ASTM A653/A653M, structural quality, Grade 230, with Z275 coating; 2.8 mm nominal thickness.
 - .4 Finish: Hot dip galvanized after fabrication.
 - .5 Acceptable Materials:
 - .1 Powerstrut Engineering Co., Inc.
 - .2 Unistrut Corporation
- .2 Threaded Rods: Stainless steel, threaded rods, washers and fasteners, Type 304
- .3 Welding Electrodes and Filler Metal: Type and alloy of filler metal and electrodes as recommended by producer of metal to be welded, complying with applicable CSA requirements, and as required for colour match, strength, and compatibility in fabricated items.
- .4 Fasteners: Use fasteners of same basic metal as fastened metal, unless otherwise indicated. Do not use metals that are corrosive or incompatible with materials joined:
 - .1 Provide concealed fasteners for interconnecting custom metal components and for attaching them to other work, unless exposed fasteners are unavoidable or are the standard fastening method.
- .5 Quarter Turn Cam Lock Fasteners: Stainless steel; 90° quick release; 10 mm diameter; non-ejecting fastener with folding bail handle, stainless steel retainer and reinforced mounting tabs providing detent in closed position, and as follows:
 - .1 Basis-of-Design Materials: DFCI Solutions Inc., ST-1200 Series
- .6 Stiffeners: 25 mm (1") x 25 mm (1") stainless steel, bonded to the full length of face sheet using double sided high bond isolating tape to prevent weather staining and frost lines to the face of the panel:
 - .1 Protect bonding tape with continuous bead of sealant on both sides of stiffeners, type as recommended by manufacturer.
- .7 Custom brushed Stainless Steel Mechanical Shroud: Custom-built form to profile, framed and mounted as indicated on Drawing A6.04.
 - .1 Mechanical shroud cladding meeting requirements of ASTM A167, cold rolled, annealed and pickled Type 304 with 4 directional satin finish.
 - .2 Exposed Fasteners stainless steel Type 304 meeting requirements of ASTM A167.
 - .3 Joints: Butt joints as indicated on Drawing A6.04.

2.03 EDGE PROTECTION

- .1 Custom fabricated 1.214 mm thick, profiled to fit around leading edges of doors as indicated on Typical Wall and Door Protection schedule indicated on Drawings.

- .2 Mounting: Flat head, countersunk screws through factory drilled mounting holes.

2.04 FINISHES

- .1 Finishes: Finish metal fabrications in accordance with NAAMM Metal Finishes Manual for Architectural and Metal Products following recommendations for applying and designating finish after assembly and as follows:

.1 Steel and Iron Finishes:

- .1 Preparation for Shop Priming: Prepare uncoated ferrous metal surfaces in accordance with minimum requirements indicated below for SSPC surface preparation specifications and environmental exposure conditions of installed metal fabrications:

- Interiors SSPC Zone 1A: SSPC-SP3, Power Tool Cleaning.

- .2 Applied Finishes: Apply finishes to uncoated surfaces of metal fabrications, except items with galvanized finishes and those to be embedded in concrete, sprayed-on fireproofing, or masonry in accordance with SSPC-PA1, Paint Application Specification No. 1; stripe coat corners, crevices, bolts, welds, and sharp edges and as follows:

- .1 Shop Primers: Provide primers that are compatible with paint systems specified in Section 05 05 19 and Section 09 91 00.
- .2 Galvanizing Repair Paint: High zinc dust content paint for regalvanizing welds in steel, in accordance with SSPC-Paint 20, coordinate requirements with Section 05 05 19.
- .3 Bituminous Paint: Cold applied asphalt mastic in accordance with SSPC-Paint 12; except containing no asbestos fibres, or cold applied asphalt emulsion in accordance with ASTM D1187.

.2 Stainless Steel Finishes:

- .1 Remove or blend tool and die marks and stretch lines into finish.
- .2 Satin Finish: Items scheduled or detailed for satin finish: grind and polish surfaces to produce uniform, directionally textured, polished finish indicated, free of cross scratches. Run grain with long dimension of each piece. Satin, Directional Polish: No. 4 finish.
- .3 When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

2.05 FABRICATION, GENERAL

- .1 Form custom metal to required shapes and sizes, with true curves, lines, and angles. Provide components in sizes and profiles indicated, but not less than that needed to comply with requirements indicated for structural performance.
- .2 Provide necessary rebates, lugs, and brackets to assemble units and to attach to other work. Drill and tap for required fasteners, unless otherwise indicated. Use concealed fasteners where possible.
- .3 Mill joints to a tight, hairline fit. Cope or mitre corner joints. Form joints exposed to weather to exclude water penetration. Weld and grind joints in countertops, smooth and flush.

- .4 Finish exposed surfaces to smooth, sharp, well defined lines and arris.
- .5 Drill and tap for required fasteners, unless otherwise indicated. Use concealed fasteners where possible:
 - .1 Mill joints to a tight, hairline fit.
 - .2 Cope or mitre corner joints.
 - .3 Form joints exposed to weather to exclude water penetration.
 - .4 Weld and grind joints in smooth and flush.
- .6 Finish exposed surfaces to smooth, sharp, well defined lines and arris.

2.06 CUSTOM STAINLESS STEEL U-CHANNELS FOR GLAZING

- .1 Form to profiles indicated on Drawing A6.02, and as follows:
- .2 Coordinate top and base connection with Section 08 81 00; Cast U-Channels into concrete curb for base connection of glazing. Allow for a minimum 6 mm diameter fastener at 300 mm o/c. into rolled angle supports
- .3 Coordinate throat dimension to allow for glazing thicknesses, glazing accessories and roll in gaskets clearance dimensions.

2.07 METAL PANEL (MP-1)

- .1 16 Gauge steel sheet secured to steel angles and assemblies as engineered by the Metal Supplier; counter sunk anchor system as indicated on the Drawings. Steel Plates, Shapes, and Bars: In accordance with CSA G40.20/G40.21, Grade 300W or ASTM A36/A36M.

2.08 EXTERIOR STEEL COLUMN CLADDING

- .1 16 Gauge steel sheet secured to steel angles and assemblies as engineered by the Metal Supplier; counter sunk anchor system as indicated on the Drawings. Steel Plates, Shapes, and Bars: In accordance with CSA G40.20/G40.21, Grade 300W or ASTM A36/A36M.
- .2 Custom fabricated galvanized steel 0.69 mm thick. Galvanizing Designation: Z275 applied evenly to both sides.

2.09 MECHANICAL SHROUD

- .1 Framed, ceiling suspended mechanical shroud cladding fabricated with 1.519 mm (0.0598 in) thick powdercoated steel sheet, formed profile as detailed in Drawing A6.04. Exposed Fasteners stainless steel Type 304 meeting requirements of ASTM A167.
- .2 Joints: Butt joints as indicated on Drawing A6.04.

2.10 GALVANIZED STEEL SPLASHPAN

- .1 Custom fabricated galvanized and painted splashpan, corrosion resistant formed and shaped, , 0.0092 inches thick, sized as indicated on Drawing A6.04
- .2 Mechanically anchored to the rainwater leader

- .3 Texture: Smooth
- .4 Finish: Prefinished.

3. EXECUTION

3.01 EXAMINATION

- .1 Verify that Site conditions are acceptable and are ready to receive work; starting work of this Section will indicate acceptance of conditions.

3.02 PREPARATION

- .1 Supply items required to be cast into concrete, and/or embedded in masonry with setting templates, to appropriate sections, including back plates for installations at steel stud and gypsum board assemblies.
- .2 Apply powder coatings in accordance with manufacturer's application instructions to cleaned and prepared surfaces using recommended dry film thicknesses, and allow coating to cure sufficiently before moving to site.
- .3 Dissimilar Metals: Paint bronze, nickel-silver, and aluminum components that come into contact with dissimilar metals with a heavy coat of a proper primer; coat exposed aluminum components that come into contact with cement or lime mortar, with zinc chromate.

3.03 INSTALLATION

- .1 Install material and products in accordance with approved shop drawings, and manufacturer's specifications and guidelines.
- .2 Perform cutting, drilling, and fitting required for installation of miscellaneous metal fabrications; set metal fabrication accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.
- .3 Erect work square, plumb, straight, and true, accurately fitted, with tight joints and intersections, and free from distortion or defects detrimental to appearance or performance.
- .4 Supply and install suitable means of anchorage, such as dowels, anchor clips, bar anchors, expansion bolts and shields, and toggles.
- .5 Exposed fastening devices to match finish and be compatible with material through which they pass.
- .6 Provide components, together with setting templates, for building by other trades in accordance with shop drawings and schedule.
- .7 Provide anchorage devices and fasteners where necessary for securing custom metal to in place construction.

- .8 Fit exposed connections accurately together to form tight, hairline joints or, where indicated, with uniform reveals and spaces for sealants and joint fillers. Where cutting, welding, and grinding are required for proper shop fitting and jointing of custom metal, restore finishes to eliminate any evidence of such corrective work.
- .9 Do not cut or abrade finishes that cannot be completely restored in the field. Return items with such finishes to the shop for required alterations, followed by complete refinishing, or provide new units as required.
- .10 Restore protective coverings that have been damaged during shipment or installation. Remove protective coverings only when there is no possibility of damage from other work yet to be performed at same location.
 - .1 Retain protective coverings intact; remove coverings simultaneously from similarly finished items.

3.04 ADJUSTING AND CLEANING

- .1 Touch-Up of Shop Applied Primer: Immediately after erection, clean site welds, bolted connections, and abraded areas of shop coatings, and recoat exposed areas using same material as used for shop priming in accordance with SSPC-PA1 for touching up shop coated surfaces; apply by brush or spray to a minimum 0.05 mm dry film thickness.
- .2 Galvanized Surfaces: Clean site welds, bolted connections, and abraded areas and repair galvanizing in accordance with ASTM A780.
- .3 Clean stainless steel by washing thoroughly with clean water and soap and rinsing with clean water. Polish.

3.05 PROTECTION

- .1 Protect finishes of custom metal from damage during construction period with temporary protective coverings approved by custom metal fabricator. Remove protective covering at the time of Substantial Completion.
- .2 Restore finishes damaged during installation and construction period so no evidence remains of correction work. Return items that cannot be refinished in the field to the shop; make required alterations and refinish entire unit or provide new units.

3.06 CLOSEOUT ACTIVITIES

- .1 Cleaning: Wash finished surfaces thoroughly using clean water and soap; rinse with clean water as installation is completed as directed by manufacturer and as follows:
 - .1 Do not use acid solution, steel wool, or other harsh abrasives.
 - .2 If stain remains after washing, remove finish and restore in accordance with [NAAMM Metal Finishes Manual](#).
 - .3 Finish must not be removed from anodized aluminum; re-anodizing can only be done by removing railing and returning it to the anodizer.
- .2 Repair of Defective Work: Remove stained or otherwise defective work and replace with material that meets specification requirements.

END OF SECTION

1. GENERAL**1.01 SUMMARY**

- .1 This section includes supply and installation fo formed metal fabrication, but is not limited to, the following:
 - .1 Fabricated Stainless Steel Column Cover
 - .2 Fabricated Stainless Steel Column Access Panel
 - .3 Fabricated Aluminum Trims
 - .4 Fabricated Aluminum Closures Panels

1.02 RELATED REQUIREMENTS

- .1 Section 05 05 00 – Common Work Results for Metals
- .2 Section 07 92 00 – Joint Sealants
- .3 Section 10 14 00 – Exterior Signage (Clock Tower)

1.03 SUBMITTALS

- .1 Provide submittals in accordance with Section 01 00 06 – General Requirements: Submittals.
- .2 Shop Drawings:
 - .1 Show fabrication and installation of custom metal. Include plans, elevations, component details, and attachments to other Work.
 - .2 Indicate materials and profiles of each custom metal member, fittings, joinery, finishes, fasteners, anchorages, and accessory items.
 - .3 Include setting drawings, templates, and directions for installing anchor bolts and other anchorages.
- .3 Samples:
 - .1 Provide following samples:
 - .1 1 sample stainless steel sheet: 150 mm x 150 mm x 2 mm thick
 - .2 1 sample aluminum sheet 150 mm x 150 mm painted black.
 - .3 1 sample aluminum sheet 150 mm x 150 mm painted custom colour. (ETS Blue as indicated in Section 10 14 00)

1.04 DELIVERY, STORAGE, AND HANDLING

- .1 Store custom metal inside a well ventilated area, away from uncured concrete and masonry, and protected from weather, moisture, soiling, abrasion, extreme temperatures, and humidity.

1.05 COORDINATION

- .1 Coordinate installation of anchorages for custom metal items. Furnish Setting Drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

2. PRODUCTS**2.01 METALS**

- .1 General: Provide metals free from surface blemishes where exposed to view in finished unit. Exposed to view surfaces exhibiting pitting, seam marks, roller marks, stains, discolorations, or other imperfections on finished units are not acceptable.
- .2 Stainless Steel: Grade and type designated below for each form required:
 - .1 Sheet: 2.0 mm, type 316 stainless steel, finish #4 directional.
- .3 Aluminum Sheets: 2.0 mm tension levelled, aluminum sheet in accordance with ASTM B209 and ANSI H35.1 alloy designation 5052-H32 or 3003-H14.

2.02 ACCESSORIES

- .1 Welding Electrodes and Filler Metal: Type and alloy of filler metal and electrodes as recommended by producer of metal to be welded, complying with applicable CSA requirements, and as required for colour match, strength, and compatibility in fabricated items.
- .2 Fasteners: Use fasteners of same basic metal as fastened metal, unless otherwise indicated. Do not use metals that are corrosive or incompatible with materials joined; as follows:
 - .1 Provide concealed fasteners for interconnecting custom metal components and trims for attaching them to other work, unless exposed fasteners are unavoidable or are the standard fastening method indicated on Drawings.
- .3 Steel Girts: Fabricated from minimum 1.21 mm base metal thickness galvanized steel to ASTM A653/A653M, Grade 230 with Z275 (G90) coating.
- .4 Steel Channels: Fabricated from minimum 1.21 mm base metal thickness galvanized steel to ASTM A653/A653M, Grade 230 with Z275 (G90) coating; finish material visible after assembly of wall panel shall be finished to match aluminum panels.
- .5 Isolation Tape: Manufacturers standard material for separating dissimilar metals from direct contact.
- .6 Trim and Enclosure: Core material, thickness, and finish to match formed metal fabrication material.
- .7 Stiffeners: 25 mm x 25 mm steel, bonded to the full length of face sheet using double sided high bond isolating tape to prevent weather staining and frost lines to the face of the panel:
 - .1 Protect bonding tape with continuous bead of sealant on both sides of stiffeners, type as recommended by manufacturer.
- .8 Sealant: One-part elastomeric polyurethane, polysulphide, or silicone rubber sealant as recommended by panel manufacturer in accordance with Section 07 92 00, type as recommended by manufacturer for specific end use, colour to match surface being applied to where exposed.
- .9 Bituminous Coating: Cold-applied asphalt mastic, in accordance with CGSB 1.108, compounded for 0.40 mm dry film thickness per coat with inert type non-corrosive compound free of asbestos fibres, sulphur components, and other deleterious impurities.

- .10 Gasket: 3 mm thick neoprene strip.

2.03 FABRICATION, GENERAL

- .1 Form custom metal to required shapes and sizes, with true curves, lines, and angles. Provide components in sizes and profiles indicated, but not less than that needed to comply with requirements indicated for structural performance.
- .2 Provide necessary rebates, lugs, and brackets to assemble units and to attach to other work. Drill and tap for required fasteners, unless otherwise indicated. Use concealed fasteners where possible.
- .3 Mill joints to a tight, hairline fit. Cope or mitre corner joints. Form joints exposed to weather to exclude water penetration. Weld and grind joints in countertops, smooth and flush.
- .4 Finish exposed surfaces to smooth, sharp, well defined lines and arris.
- .5 **Column Cover:** Shape sheet stainless steel into form as indicated on Drawings.
- .6 **Column Base:** Sheet stainless steel thickness as indicated, form base as configured.
- .7 **Removable Access Panel:** Sheet steel thickness as indicated, form as indicated. Smooth grind all welds
- .8 **Aluminum Trims:** Sheet Aluminum, thickness as indicated, form as indicated. Smooth grind all welds.
- .9 **Aluminum Closure Panel:** Sheet Aluminum, thickness as indicated, form as indicated. Smooth grind all welds.

2.04 FINISHES

- .1 Stainless Steel Finishes:
 - .1 Remove or blend tool and die marks and stretch lines into finish.
 - .2 **Brushed Finish:** Items scheduled or detailed for brushed finish: grind and polish surfaces to produce uniform, directionally textured, polished finish indicated, free of cross scratches. Run grain with long dimension of each piece. Brushed, Directional Polish: No. 4 finish.
 - .3 When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

2.05 ALUMINUM FINISHES

- .1 Powder Coat Finish:
 - .1 Polyester TGIC Free Coating: Polyester powder coating meeting requirements of AAMA 2604 and having proven gloss and colour retention, weather resistance and resistance to chalking as follows:
 - .2 Aluminum Surface Preparation: Multi-stage chromate pre-treatment in accordance with ASTM D1730, Type B, Method 5; or chromate free pre-treatment process acceptable to powder coating manufacturer.
 - .3 Stripe Coating: Strip coat edges and build up thickness before applying finish coatings
 - .4 Finish: Smooth

- .5 Gloss: as indicated
- .6 Basis-of-Design Materials: Tigerlac Super Durable Series 58

3. EXECUTION

3.01 INSTALLATION, GENERAL

- .1 Provide anchorage devices and fasteners where necessary for securing custom metal to in place construction.
- .2 Fit exposed connections accurately together to form tight, hairline joints or, where indicated, with uniform reveals and spaces for sealants and joint fillers. Where cutting, welding, and grinding are required for proper shop fitting and jointing of custom metal, restore finishes to eliminate any evidence of such corrective work.
- .3 Do not cut or abrade finishes that cannot be completely restored in the field. Return items with such finishes to the shop for required alterations, followed by complete refinishing, or provide new units as required.
- .4 Restore protective coverings that have been damaged during shipment or installation. Remove protective coverings only when there is no possibility of damage from other work yet to be performed at same location.
 - .1 Retain protective coverings intact; remove coverings simultaneously from similarly finished items.

3.02 CLEANING

- .1 Clean formed metals by washing thoroughly with clean water and soap and rinsing with clean water. Polish.

3.03 PROTECTION

- .1 Protect finishes of formed metals from damage during construction period with temporary protective coverings approved by custom metal fabricator. Remove protective covering at the time of Substantial Completion.
- .2 Restore finishes damaged during installation and construction period so no evidence remains of correction work. Return items that cannot be refinished in the field to the shop; make required alterations and refinish entire unit, or provide new units.

END OF SECTION

1. GENERAL

1.01 SUMMARY

- .1 This section includes requirements for supply and installation of dimensional lumber for miscellaneous blocking, sheathing, plywood backing panels and roof curb framing and blocking.

1.02 REFERENCE STANDARDS

- .1 American Wood Protection Association (AWPA):
 - .1 AWPA Book of Standards, 2012
- .2 Canadian Standards Association (CSA):
 - .1 CSA B111-1974 (R2003), Wire Nails, Spikes and Staples
 - .2 CAN/CSA O121-08, Douglas Fir Plywood
 - .3 CAN/CSA O141-05 (R2009), Softwood Lumber
 - .4 CAN/CSA O151-09, Canadian Softwood Plywood
 - .5 CSA O325-07, Construction Sheathing
 - .6 CSA O437 Series 93 (R2006) OSB and Waferboard
- .3 National Lumber Grading Authority (NLGA):
 - .1 NLGA Standard Grading Rules for Canadian Lumber, 2010

1.03 SUBMITTALS

- .1 Provide required information in accordance with Section 01 00 06 – General Requirements: Submittals.
- .2 Action Submittals: Provide the following submittals before starting any work of this Section:
 - .1 Product data: Submit manufacturer's product data for factory fabricated products indicating component materials and dimensions, and include construction and application specific details where required.

1.04 DELIVERY, STORAGE AND HANDLING

- .1 Delivery and Acceptance Requirements: Protect materials from weather in transit and on the jobsite.
- .2 Storage and Handling Requirements: Store materials using pallets or blocking 150 mm minimum from ground covered with protective waterproof sheets allowing for air circulation and ventilation under the covering, and as follows:
 - .1 Protect edges and corners of sheet materials from damage during handling and storage.
 - .2 Do not store seasoned materials under conditions that will cause moisture content to increase.
 - .3 Do not store NAUF(No-Added Urea Formaldehyde) products in contact with or in close proximity to other materials that may contain urea-formaldehyde and that have potential to contaminate NAUF products.

2. PRODUCTS**2.01 PERFORMANCE REQUIREMENTS**

- .1 Lumber Grades: Provide lumber products that are all sides finished (S4S) in nominal dimensions required for the project; grade-marked by accredited agencies of the Canadian Lumber Standards Accreditation Board and conform to Standard Grading Rules published by the National Lumber Grades Authority.
- .2 Panel Grades: Provide panel products that are grade-marked by agencies recognized by CSA O325 and National Institute of Standards and Technology, Voluntary Product Standard PS 2-04 Performance Standard for Wood-Based Structural-Use Panels as modified by other listed CSA panel standards.
- .3 Volatile Organic Compound Emissions: Use adhesives in composite lumber and panel products that have no added urea-formaldehyde and that are not volatile at normal occupied building temperature conditions.

2.02 MATERIALS

- .1 Miscellaneous Framing, Blocking and Strapping: Provide materials meeting CAN/CSA O141 and NLGA Rules having maximum moisture content at time of dressing of 19%, consisting of species group D (SPF) Construction Grade or better.
- .2 Sheathing: Provide plywood sheathing or oriented strand board at choice of Contractor, thickness as required by span rating and meeting requirements of CSA O325 and as follows:
 - .1 Plywood: Exterior Rated, Sheathing Grade square edged Douglas Fir or Canadian Softwood plywood meeting requirements of CSA O121 or CSA O151.
 - .2 Span Rated OSB: Exterior Rated, Sheathing Grade, oriented strand board or wafer board meeting requirements of CSA O437 SR 32/16.
- .3 Pressure Preservative Treated Lumber: Lumber graded as described above for Miscellaneous Framing and stamped for preservative retention in accordance standards listed in this Section in accordance with CAN/CSA O80.20M and AWPA U1; use only material having radius edges; minimum 6 mm and that is kiln dried to 19% moisture content or less after treatment.
- .4 Pressure Preservative Treated Plywood: Treated in accordance with CAN/CSA O80.9M using waterborne preservative to obtain minimum net retention of 4 kg/m³ of wood; use only plywood or laminated materials manufactured with exterior grade adhesives meeting requirements of CSA O121 or CSA O151; kiln dry plywood to moisture content of 15% or less after treatment.

2.03 ACCESSORIES

- .1 Site Applied Wood Preservative: Treatment manufacturer's required preservative wood treatment for touching up and repairing wood products, meeting requirements of CSA O80 series of standards, compatible with pressure preservative treated materials.
- .2 Nails, Brads and Staples: Steel nails meeting requirements of CSA B111, length to penetrate connecting solid wood materials and as follows:
 - .1 Exterior Work: Hot dipped galvanized.
 - .2 Interior High Humidity Work: Hot dipped galvanized.
 - .3 Interior Work: Electroplated zinc plated or cadmium plated.
 - .4 Pressure Treated Materials: Stainless steel.
- .3 Rough Hardware (Bolts, Nuts and Washers): Provide fasteners of size and type required for installation and as follows:

- .1 Ground Contact Materials: Stainless steel.
 - .2 Exterior Work: Hot dipped galvanized.
 - .3 Interior High Humidity Work: Hot dipped galvanized.
 - .4 Interior Work: Electroplated zinc plated or cadmium plated.
 - .5 Pressure Treated Materials: Stainless steel.
- .4 Wood Screws: Steel screws meeting requirements of ASME B18.6.1 and as follows:
- .1 Exterior Work: Galvanized, ceramic coated or stainless steel.
 - .2 Interior Work: Galvanized.
- .5 Screws for Fastening to Cold Formed Metal Framing: Steel screws meeting requirements of ASTM C954, except with wafer heads and reamer wings, length as recommended by screw manufacturer for material being fastened.
- .6 Fire Rated Intumescent Coating for Panel Boards:
- .1 Flame Spread Rating: 25 or less in accordance with ULC S102.
 - .2 Smoke Developed: 5 or less in accordance with ULC S102.
 - .3 Primer: As required by coating manufacturer for substrates forming a part of the finished assembly.
 - .4 Base Coat: Latex based, low VOC coating, white colour, flat gloss level; Class A listed.
 - .5 Finish Coat: Latex based, low VOC, high scrub resistant overcoat tinted for approximate match grey, within limits for added colourant required by manufacturer, semi-gloss finish; Class A listed.
 - .6 Basis-of-Design Materials: Flame Control No. 320A Flat White Latex with Flame Control No. 666A Overcoat.
- .7 General Purpose Adhesives: Gun grade, cartridge loaded adhesives meeting requirements of GS-36 for Commercial Adhesive, South Coast Air Quality Management District Rule 1168 and meeting requirements of CSA O112 having maximum VOC content of 70 g/L.

3. EXECUTION

3.01 INSTALLATION

- .1 Set miscellaneous rough carpentry to required levels and lines with members plumb, true to line, cut, and fitted; fit miscellaneous rough carpentry to other construction; scribe and cope as needed for accurate fit; locate furring, nailers, blocking, grounds, and similar supports as required attaching to other construction.
- .2 Roof Parapets and Plates: Construct wooden roof curbs around openings in the roof for vents, ducts, and other penetrations, for parapets and edge blocking using pressure preservative treated wood and as follows:
 - .1 Provide continuous wood backing for flashings.
 - .2 Provide solid wood or plywood sheathing and backing to receive membrane and metal flashings, conforming to ARCA Manual; fasten plywood sheathing securely to walls of parapets using mechanical fasteners; nails are not acceptable.
 - .3 Construct framing and blocking for membrane control joints conforming to ARCA Manual.
- .3 Pressure Preservative Treated Wood: Install pressure preservative treated wood in accordance with AWPA M4.

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- .4 Telecommunications and Data Panel Boards: Install 19 mm DFP G1S plywood on all walls in telephone and data rooms receiving wiring and equipment; minimum 1220 mm x 2440 mm panels on periphery walls over 300 mm wide, mounted 150 mm off of finished floor; coordinate installation and locations with Section 26 05 00 and as follows:
- .1 Paint panels with 2 coats of light coloured fire retardant paint finish; coat all sides of panels (back, front and sides) to meet the intent of fire rated panel requirements listed in CSA T530 and ANSI/TIA/EIA 569-B requirements.
- .5 Site Waste Reduction and Management: Select lumber sizes to minimize waste, reuse scrap lumber to the greatest extent possible and as follows:
- .1 Use scrap lumber for non-critical locations such as shims, bracing and blocking.
- .2 Do not leave any wood, shavings, sawdust, and similar components, on the ground or buried in fill; prevent sawdust and wood shavings from entering the storm drainage system.
- .3 Do not burn scraps that have been pressure treated; do not send pressure treated lumber to recycling centres, cogeneration facilities or waste-to-energy facilities.
- .4 Do not burn waste lumber on site.

END OF SECTION

1. GENERAL**1.01 SUMMARY**

- .1 This Section includes requirements for supply and installation of exterior grade gypsum sheathing panels for walls and soffits.

1.02 DEFINITIONS

- .1 The following definitions apply to the Gypsum Sheathing specification:
- .2 Refer to ASTM C11 for definitions of terms for gypsum board assemblies not defined in this Section or in other referenced standards.

1.03 REFERENCE STANDARDS

- .1 American Society for Testing and Materials (ASTM International):
 - .1 ASTM C11-17a, Standard Terminology Relating to Gypsum and Related Building Materials and Systems
 - .2 ASTM C954-15, Standard Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs from 0.033 in. (0.75 mm) to 0.112 in. (2.84 mm) in Thickness
 - .3 ASTM C1177/C1177M-13, Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing
 - .4 ASTM C1280-13a, Standard Specification for Application of Exterior Gypsum Panel Products for Use as Sheathing
- .2 Canadian Construction Association:
 - .1 Standard Construction Document CCA 82-2004, Mould Guidelines for the Canadian Construction Industry
- .3 Gypsum Association (GA):
 - .1 GA-253-16, Application of Gypsum Sheathing
 - .2 GA-254-17, Fire Resistant Gypsum Sheathing
- .4 Underwriters Laboratories of Canada (ULC):
 - .1 CAN/ULC S102-11, Surface Burning Characteristics of Building Materials and Assemblies

1.04 ADMINISTRATIVE REQUIREMENTS

- .1 Coordination with Air and Vapour Membranes: Coordinate with air and vapour membrane manufacturer and verify compatibility of exterior gypsum sheathing materials with membrane primers.

1.05 SUBMITTALS

- .1 Provide required information in accordance with Section 01 00 06 – General Requirements: Submittals.

1.06 DELIVERY, STORAGE, AND HANDLING

- .1 Delivery and Acceptance Requirements: Deliver materials in original packages, containers, or bundles bearing brand name and identification of manufacturer or supplier.

- .2 Storage and Handling Requirements: Store materials under cover, keep dry and protected against damage from weather, direct sunlight, surface contamination, corrosion, construction traffic, and other causes; stack gypsum panels flat and on sufficient spacers to prevent sagging, not in direct contact with floor surfaces.

1.07 SITE CONDITIONS

- .1 Ambient Conditions: Store and install materials specified in this Section in accordance with requirements of GA-253 Manual.
- .2 Protection from Mould and Mildew: Protect gypsum board from conditions that have probability of inoculating or causing mould growth during transportation and delivery, storage and handling, and installation in accordance with CCA 82.

2. PRODUCTS

2.06 MANUFACTURERS

- .1 Basis-of-Design Products: Products named in this Section were used as the basis-of-design for the project; manufacturers listed as additional Acceptable Products and that offer similar products may be incorporated into the work of this Section provided they meet the performance requirements established by the named products.
- .2 Acceptable Products Manufacturers: Subject to compliance with performance requirements specified in this Section, use any of the listed manufacturers' products in accordance with Section 01 00 06 – General Requirements: Substitutions and Product Options; following manufacturer's do not require submission of a request for substitutions provided required shop drawing and product data submissions are submitted before starting any work of Section:
 - .1 CertainTeed Saint-Gobain
 - .2 CGC Inc.
 - .3 Georgia-Pacific Canada, Inc.
- .1 Acceptable Alternative Products Manufacturers: Subject to compliance with requirements specified in this Section, products listed as Acceptable Alternative Products can be used to establish the Bid Price in addition to Acceptable Products; Acceptable Alternative Products are not required to make a formal request for Substitutions as described below, provided that information supporting specified performance requirements are submitted prior to ordering materials during construction as a part of the Submittals review process.
- .2 Substitutions: Consultant may consider additional manufacturers having similar products to Acceptable Products and Acceptable Alternative Products during the construction period, provided they meet the performance requirements established by the named products and provided they submit requests for substitution in accordance with Section 01 00 06 – General Requirements: Substitutions and Product Options before starting any work of this Section:
 - .1 Do not use substitute materials to establish Bid Price.
 - .2 Substitutions that appear as a part of the project without review and acceptance by the Consultant will be rejected, and replaced with systems using specified materials.

1.02 GYPSUM SHEATHING MATERIALS

- .1 Exterior Sheathing: Fibreglass matt faced gypsum based sheathing panels meeting requirements of ASTM C1177/C1177M, formulated specifically for exterior use in water managed building envelope systems in maximum lengths and widths practical to minimize joints in each area and to correspond with support system; and as follows:
 - .1 Thickness: As Indicated on Drawings
 - .2 Location: Exterior walls

- .3 Acceptable Materials:
 - .1 CertainTeed GlasRoc Exterior Sheathing
 - .2 CGC Securock Glass-Mat Sheathing
 - .3 Georgia Pacific DensGlass Sheathing
- .2 Fasteners: Corrosion resistant, ceramic-silicone resin coated self-drilling screws and as follows:
 - .1 Basis-of-Design Products: Ucan Fastening Products RUSPRO Coated Sheathing Screws
 - .2 For steel framing less than 0.0329 inch (0.835 mm) thick, attach sheathing with steel drill screws complying with ASTM C 1002.
 - .3 For steel framing from 0.033 to 0.112 inch (0.84 to 2.84 mm) thick, attach sheathing with drill screws complying with ASTM C 954.

2. EXECUTION

2.01 EXAMINATION

- .1 Verification of Conditions: Verify that substrates and other conditions affecting performance of installed sheathing are in accordance with manufacturer's written requirements before starting work of this Section.
 - .1 Correct unsatisfactory conditions; installation of products specified in this Section will denote acceptance of site conditions.

2.02 INSTALLATION

- .1 Vertical Installation: Install gypsum panels in accordance with ASTM C1280, GA-253 and manufacturer's written instructions and as follows:
 - .1 Form expansion joints to account for building movements using back-to-back framing members and edge trims, and a break in gypsum panel over structural movement joints and floor slab control joints as follows:
 - .1 Install expansion joints incorporating continuous air and vapour membranes and with sufficient gap to allow for projected building movements.
 - .2 Form expansion joints to meet fire ratings required for remainder of wall or soffit construction.
 - .2 Install and space fasteners in gypsum panels in accordance with referenced gypsum board application standard and manufacturer's written requirements.
- .2 Horizontal Installation: Install exterior soffit board ASTM C1280, GA-253 GA-254 and manufacturer's written instructions and as follows:
 - .1 Install gypsum soffit board perpendicular to supports, with end joints staggered and located over supports.
 - .2 Install with 6 mm open gap where panels abut other construction or structural penetrations.
 - .3 Fasten with corrosion resistant screws.
- .3 Sheathing joint and penetration treatment
 - .1 Seal sheathing joints, as required, according to sheathing manufacturer's written recommendations.

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- .2 If a weather seal is required before the application of a air and vapour membranes, apply silicone emulsion sealant on joints and trowel flat. Apply sufficient quantity of sealant to completely cover joints after troweling. Seal other penetrations and openings. Refer to air and vapour membrane manufacturer for installation instructions prior to application of sealant.
- .3 As an alternate to separate air and vapour membrane - apply glass-fiber mesh tape to fiberglass reinforced gypsum sheathing board joints, and apply and trowel silicone emulsion sealant to embed sealant in entire face of tape. Apply sealant to exposed fasteners with a trowel so fasteners are completely covered. Seal other penetrations and openings.
- .4 Water-Resistive Barrier:
- .1 Refer to Section 07 25 13 – Air and Vapour Membranes and coordinate compatibility of primers and membranes with glass faced gypsum core sheathing materials.

END OF SECTION

1. GENERAL**1.01 SUMMARY**

- .1 This section includes requirements for supply, fabrication, factory finishing and delivery to the job site, and installation of shop manufactured casework indicated on the drawings including, but not limited to, the following:
- .1 Decorative laminate finished shelving
 - .2 Solid surfacing material and countertops
 - .3 Shop finishing of shelving and washroom vanities
 - .4 Structural supports incorporated into shelving and washroom vanities

1.02 REFERENCE STANDARDS

- .1 Architectural Woodwork Standards referenced in this Section form the basis of the quality standards for materials and installation; materials standards and grading authorities referenced in this Section and listed in the Architectural Woodwork Standard are applicable where specifically referenced and are considered to form a part of and be applicable to this Section.
- .2 Architectural Woodwork Manufacturing Association of Canada (AWMAC):
- .1 AWMAC Architectural Woodwork Standards, 1st Edition, 2009
- .3 American Society for Testing and Materials (ASTM):
- .1 ASTM A666-10, Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar

1.03 ADMINISTRATIVE REQUIREMENTS

- .1 Coordination: Architectural woodwork Subcontractor and the Contractor are jointly responsible for the following items:
- .1 Coordinate delivery of casework components at a time when building and storage areas are sufficiently dry so that the casework will not be damaged by excessive changes in moisture content.
 - .2 Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of work specified in other Sections to ensure that interior casework can be supported and installed including; but not limited to, the following:
 - .1 Metal support brackets and fittings that are part of building structure
 - .2 Plumbing fixtures

1.04 SUBMITTALS

- .1 Provide required information in accordance with Section 01 00 06 – General Requirements: Submittals prior to fabrication; do not fabricate any work until required submittals are reviewed and accepted by the City.
- .2 Action Submittals: Provide the following submittals before starting any work of this Section:
- .1 Product Data: Submit product data for each type of product indicated including, but not limited to, the following:
 - .1 Finishing materials and processes
 - .2 Manufactured particleboard
 - .3 High pressure decorative laminate and adhesive for bonding decorative laminate
 - .4 Solid surfacing material

- .2 Shop Drawings: Submit shop drawings indicating location of each item referenced to actual site dimensions, dimensioned plans and elevations, large scale details and thickness of materials, attachment devices, blockings, scribe strip locations, locations of exposed fastenings and other components as applicable to the work of this Section.
- .3 Samples for Verification: Submit one (1) sample prior to fabrication of casework as follows; accepted samples will form the standard of acceptance for the remainder of the work:
 - .1 High Pressure Decorative Laminate Clad Panel Products: Laid-up on specified core material, 300 mm x 300 mm for each type, colour, pattern, and surface finish.
 - .2 Solid surfacing material: 150 mm square showing colour, type, pattern and surface finish.
 - .3 Solid surface counter corner trims and joint trims

1.05 PROJECT CLOSEOUT SUBMISSIONS

- .1 Submit maintenance data for applied finishes in accordance with Section 01 00 06 – General Requirements: Closeout Submissions.
- .2 Operation and Maintenance Data: Submit manufacturer's care and maintenance data, including repair and cleaning instructions in accordance with Section 01 00 06.00 – General Requirements: Closeout Submissions; Operations and Maintenance Data.

1.06 QUALITY ASSURANCE

- .1 Qualifications: Provide proof of qualifications when requested by City:
 - .1 Project Quality Standard: Architectural Woodwork Standard (AWS) published by the Architectural Woodwork Manufacturers Association of Canada, together with authorized additions and amendments will be used as a reference standard and forms part of this project specification.
 - .2 Installer: An experienced installer who has completed casework similar in material, design, and extent to that indicated and whose work has resulted in construction with a record of successful in-service performance.
 - .3 Fabricator: A firm experienced in producing casework similar to that indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

1.07 DELIVERY STORAGE AND HANDLING

- .2 Delivery and Acceptance Requirements: Deliver woodwork materials only when building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.

1.08 SITE CONDITIONS

- .1 Site Measurements: Verify dimensions by site measurements before fabrication and indicate measurements on Shop Drawings where casework is indicated to fit walls and other construction; coordinate fabrication schedule with construction progress to avoid delaying the Work; locate concealed framing, blocking, and reinforcements that support woodwork by site measurements before being enclosed and indicate measurements on Shop Drawings.
- .2 Established Dimensions: Establish dimensions and proceed with fabricating casework without confirmed site measurements where site measurements cannot be made without delaying the Work; coordinate with the construction to ensure that actual dimensions correspond to established dimensions; allow for trimming and fitting.

- .3 Ambient Conditions: Maintain area or room in which casework is being installed at a uniform temperature and humidity for 24 hours prior to, during and after installation in accordance with AWS for relative humidity and moisture content; provide additional lighting to maintain a minimum of 430 lx on surfaces and areas where casework is being installed.

1.09 WARRANTY

- .1 Manufacturer Warranty: Provide manufacturer's standard 10 year warranty against defects in materials and workmanship; including material and labour to repair or replace defective materials

2. PRODUCTS

2.07 MATERIALS

- .1 Use clean stock for each type of woodwork and quality grade specified in accordance with AWS.
- .2 Furring, Blocking, Shims, and Hanging Strips: Softwood or hardwood lumber, kiln dried to less than 8% moisture content.
- .3 Anchors: Select material, type, size, and finish required for each substrate for secure anchorage:
- .2 Provide nonferrous metal or hot-dip galvanized anchors and inserts on inside face of exterior walls and elsewhere as required for corrosion resistance.
- .3 Provide toothed steel or lead expansion sleeves for drilled-in-place anchors.
- .4 Lumber Materials: Provide lumber materials meeting requirements for moisture content and Custom Grade in accordance with AWS Section 3, and as follows:
- .2 Non-Exposed Softwood: Fabricator's option, meeting requirements of CAN/CSA O141, kiln dried; dressed 4 sides.
- .5 Panel Materials: Provide panel materials meeting requirements for moisture content and Custom Grade in accordance with AWS Section 4, and as follows:
- .2 Industrial Particleboard: Meeting ANSI 208.1 Grade M-3 for interior use, minimum 750 kg/m³ particleboard for countertops and shelves; clearly mark panels with grade mark in visible location; extruded particleboard having loose cores with voids will not be permitted; having no added urea formaldehyde:
- .1 Acceptable Materials:
- Vesta Particleboard, Flakeboard
 - Purekor Platinum Particleboard, Panel Source International
 - Encore SDF Sustainable Particleboard, SierraPine Ltd.
- .6 Decorative Laminate Finishes: Grades and applications in accordance with AWS Section 4, and as follows:
- .2 High Pressure Decorative Laminate (HPDL): Meeting CAN3 A172 or ANSI/NEMA LD3 composed of phenolic resin impregnated Kraft paper filler stock for Class 1 Decorative Laminate of Grade required by woodwork quality standard and as follows:
- .1 Self Edging Work: General Purpose Grade, HGS standard duty.
- .2 Backing Sheet Work: BKL backing material, thickness as recommended by manufacturer to prevent warpage of surfaces, sanded on one side; furniture finish, solid white colour

- .3 Acceptable Materials: Subject to compliance with requirements, manufacturers offering high pressure decorative laminates that may be incorporated into the Work include, but are not limited to, the following:
- Arborite
 - Arpa Arte Design
 - Formica
 - Lamin-Art
 - Nevamar
 - Pionite
 - Octolam
 - Wilsonart
- .3 Adhesives:
- .1 Decorative laminate: polyvinyl acetate or aliphatic resin in accordance with manufacturer's recommendation for curing under pressure for bonding to wood cores, water resistant type.
- .7 Solid Surface Countertops: Install solid surface countertops using skilled personnel specializing in the type of work indicated; solid surface accurately to conform to shape and dimensions required with exposed surfaces true:
- .2 Perform cutting and drilling not provided by supplier.
- .3 Do not use impact or hammer drills; use only diamond drill bits.
- .4 Carefully cut and fit edges and grind to a perfect fit in a manner that does not impair strength or appearance.
- .5 Machine polish exposed edges; do not use waxes, sealers or coatings.
- .6 Patching or other forms of concealment to cover defects in material or workmanship will not be permitted.
- .7 Identify the pattern direction on a concealed surface of each unit. Panels shall be cut generally parallel to the rift and panels shall be cut in the same direction.
- .8 Leading Edge Material: solid cast acrylic-polyester edge
- .9 Backsplash to countertop Transition: coved splash joint
- .8 Solid Surfacing Sheet: Cast, nonporous, filled polymer, with through body colour meeting requirements of NEMA LD 3, and having the following nominal properties:
- .2 Thickness: As indicated on Drawing VLW-0412-02-PE-A8.01.
- .3 Surface Burning Characteristics: in accordance with CAN/ULC S102 and as follows:
- .1 Flame Spread: Maximum 25
- .2 Smoke Developed: Maximum 25
- .3 Basis of Design: Wilsonart Solid Surface, Soothing Grey 9116GS
- .4 Additional Acceptable Manufacturers: Subject to compliance with performance requirements specified in this Section; as established by the Basis-of-Design Materials, use any of the listed manufacturers' products in accordance with Section 01 00 06.00 – General Requirements: Product Options; following manufacturer's do not require submission of a request for substitutions provided required shop drawing and product data submissions are submitted before starting any work of Section:
- [Aristech Surfaces LLC - Avonite](#)
 - [DuPont Corian](#)
 - [Samsung Staron](#)

- .5 Substitutions: Consultant may consider additional manufacturers having similar products to Acceptable Materials Manufacturers listed above during the construction period, provided they meet the performance requirements established by the named products and provided they submit requests for substitution in accordance with Section 01 00 06.00 – General Requirements: Substitutions before starting any work of this Section:
- Do not use substitute materials to establish Bid Price.
 - Substitutions that appear as a part of the project without review and acceptance by the Consultant will be rejected and replaced with one of the specified materials.

- .8 Prefabricated Sinks: Cast, nonporous, filled polymer, with through body colour meeting requirements of ANSI Z124.3, ANSI Z124.6 and NEMA LD 3, and as follows:

- .1 Mounting: Under mount
 .2 Configuration: Single
 .3 Shape: Rectangular
 .4 Size: As indicated on the plumbing fixture schedule.
 .5 Accessories:
- .1 Joint Adhesive: Manufacturer's recommended adhesive designed to create chemically bonded, inconspicuous, nonporous joints.
 .2 Panel Adhesive: Manufacturer's standard neoprene-based panel adhesive meeting ANSI A136.1.
 .3 Sealant: Mildew resistant, silicone sealant, colour, as specified in Section 07 92 00.
 .4 Sink Mounting Hardware: Manufacturer's recommended clips, inserts and fasteners for attachment of under mount sinks.

2.02 ACCESSORIES

- .8 Sealant: 1 part silicone to CAN/CGSB-19.13, non-staining, mould and mildew resistant, colour: white, refer to Section 07 92 00.
 .9 Steel Supports: As indicated in Section 05 50 00.
 .10 Gable Supports: As indicated on Drawing VLW-0412-02-PE-A7.01.
 .11 Hardware: Bolts, nuts, washers, screws, etc., hot-dip heavy zinc-coated.

2.03 CASEWORK FABRICATION

- .8 Fabricate casework in accordance with requirements of Section 10 of AWS as applicable and as modified by this Section and Drawings.
 .9 Casework for High Pressure Decorative Laminate Finish:
- .1 AWMAC Quality Grade Custom.
 .2 Exposed Exterior Parts:
- .1 Core: Particleboard
 .2 Finish: HPDL
- PL-1: Formica, Platinum 902-58
- .3 Exposed Interior Parts:
- .1 Core: Particleboard

- .2 Finish: Same as for exposed exterior parts
- .4 Semi-Exposed Parts:
 - .1 Core: Particleboard
 - .2 Finish: Liner Grade HPDL
- .5 Concealed Parts:
 - .1 Core: Same as Semi-Exposed Parts
 - .2 Finish: Backer Grade HPDL at option of fabricator for balanced finish
- .10 Section 11 AWS and as follows:
 - .1 Core: Water resistant particleboard for countertops and backsplashes at sinks and wet areas; no exceptions.
 - .2 Backsplash and Countertop Edge Style: As indicated on Drawing A7.01.
 - .3 Backsplash to Countertop Transition: As indicated on Drawing A7.01.
 - .4 Edge Treatment: Seal edge grain of core exposed at cut outs for sinks with heavy bodied, silicone based sealer; sanding sealer or back priming materials are not acceptable for this application.
- .1 Construct casework using minimum core thickness for materials listed in this section; adjust thickness of shelves to allow for uniformly distributed loading of 90 kg with a concentrated load of 23 kg and length for maximum of L/140 deflection in full use:
 - .1 Assemble casework with flush butt hairline corners and joints; make cut outs for services on site during installation
 - .2 Carefully fit, cope or mitre joints and glue with no end wood visible on finished surfaces
 - .3 Make blocking, framing, web frames from solid lumber
- .2 Glue, dowel, mortise, lock joint or dado casework; do not use staples; nailing and screws are acceptable; do not surface nail or screw through countertops:
 - .1 Set nail heads in finished surfaces; countersink screws and bolts; fill holes with plugs to match colour.
- .3 Solid surfacing fabrication:
 - .1 Fabricate units to maximum size capable of being safely transported and handled to place of final installation in accordance with shop drawing and manufacturer's written instructions using a fabricator certified by the manufacturer.
 - .2 Fabricate and machine shapes to profiles indicated on Drawings; obtain all dimensions affecting fabrication and installation from job site before starting fabrication.
 - .3 Cut, drill and shape fabrications as required to receive plumbing fittings and services, and built-in accessories, provide edge treatments, back splashes, filled contrasting colour inlays and other details as indicated on Drawings.
 - .4 Finish edges and surfaces true, level and even with inconspicuous joints between having no voids formed using manufacture's standard joint adhesive and reinforcing strips.
 - .5 Make cut outs with 3 mm radius corners to prevent stress cracking.
 - .6 Fabrication assemblies with tolerances as follows:
 - .1 Variation in component size: ± 3 mm.
 - .2 Location of openings: ± 3 mm from indicated location.
 - .7 Match numbered components assembled on site; number items to show proper location on site; number on back using material that will not show or telegraph through finished assemblies.

- .8 Provide anchorage to receive Work of other Sections scheduled and detailed to be installed.

2. EXECUTION

2.01 EXAMINATION

- .1 Visit site and note state of completion within various areas in which casework is being installed; verify that surfaces are ready to receive work of this Section and that other work is finished and painted before being built-over or covered in any way by installed casework:
 - .1 Verify that areas in which casework is scheduled are finished and ready to accept work of this Section; with walls painted, ceilings finished, overhead services completed, tested and accepted.
 - .2 Starting work will be considered as acceptance of conditions.

2.02 PREPARATION

- .1 Confirm access is sufficient for large pieces of casework, and that they can be transported easily and safely to final installation location.
- .2 Protect adjacent finished surfaces and materials from damage by work of this Section.
- .3 Back prime casework immediately after delivery to site.

2.03 INSTALLATION

- .1 Casework:
 - .1 Install casework plumb, level and true to locations indicated on Drawings and in accordance with AWS.
 - .2 Install solid surface countertop to casework units; coordinate schedule and delivery requirements to meet the construction schedule.
 - .3 Anchor to walls using fastening devices and hardware consistent with materials being fastened into and quality of finish, and as follows:
 - .1 Do not use wood plugs
 - .2 Do not use plastic plugs for ceilings or walls
 - .3 Provide wall cleats fastened to wall blocking as required
 - .4 Shim level and square in relation to adjoining surfaces
 - .5 Scribe accurately to adjacent work
 - .6 Set on steel support framing; coordinate fabrication requirements with Section 05 50 00
 - .4 Scribe neatly and accurately to smooth snug fit with adjoining surfaces and materials to align work properly; mitre corners accurately.
 - .5 Perform cutting, fitting, repairing in woodwork as required by other trades where their Work is connected to or part of this Work.
 - .6 Cut out openings for mechanical fittings and fixtures; coordinate and cooperate with mechanical work and obtain required templates, cutting locations and dimensions.
 - .7 Apply neat bead of sealant between plumbing fixtures countertops and adjoining walls and casework; seal edges of cut out core material before fixtures installed with moisture resistant compound.
 - .8 Install any finishing hardware shipped loose.
- .2 Solid Surface Installation
 - .1 Install components plumb and level, in accordance with shop drawings and manufacturers written installation requirements.

- .2 Form field joints using manufacturer's recommended adhesive, with joints inconspicuous in finished work.
- .3 Adhere under mount sinks to countertops using manufacturer's recommended adhesive and mounting hardware.
- .4 Install backsplashes and end splashes as indicated on Drawings; adhere to countertops using manufacturer's standard colour matched silicone sealant.
- .5 Coordinate plumbing connections with Division 22.

2.04 CLOSEOUT ACTIVITIES

- .1 Deficient Work: Replace, rework or refinish work that does not meet AWS requirements as directed by City at no additional cost to City.
- .2 Adjusting: Adjust hardware and operating parts during and after installation to provide smooth and proper operation of casework components.
- .3 Cleaning: Clean countertops, shelves and fixtures, and remove marks, scratches or marring on exposed and semi-exposed surfaces after work of this Section is complete and prior to Substantial Performance for the project.

END OF SECTION

1. GENERAL

1.01 SUMMARY

.1 This Section includes requirements for supply and installation of translucent sandwich panel canopy system and accessories including:

- .1 Factory prefabricated structural translucent sandwich panels
- .2 Aluminum installation system
- .3 Aluminum flashing attached to canopies

1.02 RELATED REQUIREMENTS

- .1 Section 01 33 50 – Delegated Design Submittals
- .2 Section 07 25 13 – Air and Vapour Membranes: Transition membranes between window frame opening and wall membranes.
- .3 Section 07 62 00 – Sheet Metal Flashings and Trim: Pan flashings and drip flashings.
- .4 Section 07 52 16 – Torch Applied Modified Bituminous Membrane Roofing
- .5 Section 07 92 00 – Joint Sealants

1.03 REFERENCES

- .1 Aluminum Association (AA):
 - .1 Aluminum Design Manual, 2015
- .2 Architectural Aluminum Manufacturers Association (AAMA):
 - .1 AAMA AFPA-91, Anodic Finishes/Painted Aluminum
 - .2 AAMA 611-12, Voluntary Specification for Architectural Anodized Aluminum
 - .3 AAMA 1503-98, Voluntary Test Method for Thermal Transmittance and Condensation Resistance of Windows, Doors and Glazed Wall Sections
- .3 American Society for Testing and Materials (ASTM):
 - .1 ASTM D 1002-10, Standard Test Method for Apparent Shear Strength of Single-Lap-Joint Adhesively Bonded Metal Specimens by Tension Loading (Metal-to-Metal)
 - .2 ASTM E283-04 (2012), Standard Test Method for Determining the Rate of Air Leakage through Exterior Windows, Curtain Walls, and Doors under Specified Pressure Differences across the Specimen
 - .3 ASTM E330-02 (2010), Standard Test Method for Structural Performance of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference
 - .4 ASTM E331-00 (2009), Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference
- .4 Canadian General Standards Board (CGSB):
 - .1 CAN/CGSB 41-GP-6M (November 1983), Sheets, Thermosetting Polyester Plastics, glass Fiber Reinforced
- .5 Canadian Standards Association (CSA):

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- .1 CAN/CSA G40.20/G40.21-04, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steels
- .6 Underwriters Laboratories (UL):
- .1 UL 972 – Burglary Resisting Glazing Material
- .7 Underwriters Laboratories Canada (ULC):
- .1 CAN/ULC S102-10, Method of Test for Surface Burning Characteristics of Building Materials and Assemblies
- .2 CAN/ULC S114-05, Test for Determination of Non-Combustibility in Building Materials
- .3 CAN/ULC S702-09, Thermal Insulation, Mineral Fibre, for Buildings
- .4 CAN/ULC S134-92, Standard Method of Fire Test of Exterior Wall Assemblies
- 1.04 SUBMITTALS
- .1 Provide required information in accordance with Section 01 00 06 – General Requirements:
- .2 Action Submittals: Provide the following submittals before starting any work of this Section:
- .1 Product Data: Submit product data indicating construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of product indicated, in addition to the following specific requirements:
- .1 Mechanical Fasteners: Indicate sizes, shear, and pull over loading capacity where applicable.
- .2 Corrosion Protection: Indicate thickness and type of corrosion protection coating.
- .2 Shop Drawings: Submit shop drawings prepared by or under the supervision of a qualified professional engineer detailing fabrication and assembly of glazed aluminum curtain wall systems clearly indicating all construction details including the following:
- .1 Connections and anchor requirements
- .2 Metal fabrications integral with wall system installation
- .3 Type, size and spacing of fastening devices
- .4 Design loads
- .5 Connections to adjacent air and vapour membranes
- .6 Internal drainage and sealant locations
- .7 Seal of a professional engineer registered in the Province of the Work for details requiring structural design for load bearing, or life and health safety
- .8 Other detailed requirements for installation.
- .3 Samples: Submit samples for each type of exposed finish required, in manufacturer's standard sizes for Consultant's verification of specified finishes including the following:
- .1 Submit fabricated sample of each vertical to horizontal intersection of specified systems, made from 450 mm lengths of full size components indicating details of the following:
- Joinery
 - Anchorage
 - Expansion provisions
 - Glazing
 - Flashing and drainage
- .3 Informational Submittals: Provide the following:

- .1 Qualification Statement: Submit evidence of welder qualifications specified in this Section when requested by Consultant.
- .2 Source Quality Control Submittals: Submit delegated design professional engineer's design notes and calculations when requested by Consultant.
- .3 Manufacturer's Installation Instructions: Submit manufacturer's installation instructions for transition membrane assembly when requested by Consultant.
- .4 Delegated Design Submittals: Submit letters of commitment and compliance in accordance with Section 01 33 50 – Delegated Design Submittals as follows:
 - .1 Provide Letter of Commitment in conjunction with shop drawings, signed and sealed by the professional engineer required by the Work of this Section indicating the following are designed to the intent of the Building Code:
 - Panel connections to building structure
 - Panel deflection connections to building structure
 - Deflection of members
 - Panel thickness as they relate to glass area and applied horizontal loads
 - .2 Provide Letter of Compliance, signed and sealed by the professional engineer required by the Work of this Section indicating that connections, reinforcement and deflection criteria, and glass thickness of installed system is in compliance with the intent of the Building Code and reviewed shop drawings before declaration of Substantial Performance
- .5 When requested, submit samples for each exposed finish required, in same thickness and material indicated for the work and in size indicated below. If finishes involve normal color variations, include sample sets consisting of two or more units showing the full range of variations expected.
 - .1 Sandwich panels: 14" x 28" units
 - .2 Factory finished aluminum: 5" long sections

1.05 QUALITY ASSURANCE

- .1 Manufacturer's Qualifications
 - .1 Material and products shall be manufactured by a company continuously and regularly employed in the manufacture of specified materials for a period of at least ten consecutive years and which can show evidence of those materials being satisfactorily used on at least six projects of similar size, scope and location. At least three of the projects shall have been in successful use for ten years or longer.
 - .2 Panel system must be listed by an ANSI accredited Evaluation Service, which requires quality control inspections and fire, structural and water infiltration testing of sandwich panel systems by an accredited agency.
 - .3 Quality control inspections shall be conducted at least once each year and shall include manufacturing facilities, sandwich panel components and production sandwich panels for conformance with AC177 "Translucent Fiberglass Reinforced Plastic (FRP) Faced Panel Wall, Roof and Skylight Systems" as issued by the ICC-ES.
- .2 Installer's Qualifications: Installation shall be by an experienced installer, which has been in the business of installing specified canopy systems for at least two consecutive years and can show evidence of satisfactory completion of projects of similar size, scope and type.

1.06 PERFORMANCE REQUIREMENTS

- .1 Design sandwich panel system to withstand the positive and negative pressures (wind loads) normal to the plane of the wall in accordance with the Building Code CLIMATIC requirements. Design to 30 years minimum return.
- .2 Provide a continuous interlocking rigid pvc thermal break around the perimeter of each panel forming an unbroken thermal separation of the interior and exterior environments.
- .3 Design thermal break to limit frosting and condensation on interior of panel metal surfaces to not over 5% of area when conditions are:
 - Exterior Air Temperature: -49°C
 - Interior Air Temperature: 21°C
 - Interior Relative Humidity: 35%
- .4 Provide for expansion and contraction of all parts for an exterior air temperature range from -40°C to +35°C and a building interior air temperature range from +16°C to +29°C. Movement shall not displace, twist, distort or buckle any part of the wall assembly and shall be absorbed into freely functioning expansion and contraction joints through a system of moving bearings and supports.
- .5 Air infiltration/exfiltration through the perimeter of sandwich panel system, including perimeter seal, shall not exceed 0.305 litres per second per square metre (0.01 c.f.m./sq. ft.) of glass area at a pressure difference of 75 Pa (1.56 p.s.f.).
- .6 Water infiltration shall be zero into the building under a maximum pressure of 720 Pa.
- .7 Using the climatic conditions stated above, there shall be no condensation formed on any aluminum members before any of the exposed area of the sealed unit specified for each location reaches dew-point conditions.
- .8 An air seal consistent with the rain screen principle shall be continuously installed at the inner light line and panel perimeter and connected to the structure as an integral part of the design to provide a complete impervious air and vapour retarder. Fasten air barrier to the aluminum wall using an aluminum angle as specified and detailed.
- .9 Design, fabricate and install sandwich panel system to withstand wind loads determined from the Building Code. Determination of loads shall be the responsibility of the manufacturer, however, loads used for design shall not be less than the most severe combination of effects mentioned above.
- .10 Design sandwich panel system to accommodate floor to floor deflection of 19 mm.
- .11 Maximum full load deflection, normal to the wall plane, for any member of sandwich panel system shall not exceed L/240 of its clear span or 19 mm, whichever is less. Maximum full load deflections, parallel to the wall plane shall not exceed 75% of the design clearance dimension between frame member and wall material immediately adjacent.
- .12 Permanent deformation, weld or fastener failure, component disengagement or breakage shall not occur under loading equal to 1.5 times the design load pressure (positive and negative). Permanent deformation is defined as deflection without recovery exceeding length/1000.

1.07 QUALITY ASSURANCE

- .1 If requested by Consultant, provide copies of test reports showing panel assembly complies with Article 1.6 "Performance Requirements" proceeding, as a minimum.

- .2 Fabricator shall have a minimum of 5 years successful experience in the fabrication and erection of aluminum curtain wall systems of similar sizes, shapes and finishes to the units required for this project and shall have ample facilities to produce, furnish and supply the units as required for installation without delay to the Work. Provide proof of experience satisfactory to Consultant upon request.
- .3 Retain a professional registered engineer experienced in structural design in sandwich panel system and aluminum to design units, and connections, ensure the adequacy of the structural aspects of the design, manufacture, and installation of complete assembly. This Consultant is called the "Manufacturer's Consultant" elsewhere in this Section.
- .4 Sandwich panel system must be listed by an ANSI accredited Evaluation Service that requires quality control inspections and fire, structural and water infiltration testing of sandwich panel systems by an accredited agency.

1.08 DELIVERY STORAGE AND HANDLING

- .1 Deliver, handle and store units in accordance with manufacturer's directions.
- .2 Store units at site on raised wood pallets protected from the elements and corrosive materials. Do not remove from crates or other protective covering until ready for installation.
- .3 Store pre-fabricated frame assemblies blocked off the ground to prevent warping, twisting, undue strain on assembly or physical abuse and damage.

1.09 WARRANTY

- .1 Submit manufacturer's and installer's written warranty agreeing to repair or replace panel system work, which fails in materials or workmanship within one year of the date of delivery. Failure of materials or workmanship shall include excessive deflection; deterioration of finish on metal in excess of normal weathering; and defects in accessories, translucent sandwich panels, and other components of the work.

2. PRODUCTS

2.08 ACCEPTABLE 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 in accordance with Section 01 00 06 General Requirements – Substitutions and Product Options.
 - .1 Basis-of-Design Product: Kalwall Corporation
- .2 Acceptable Materials Manufacturers: Subject to compliance with requirements specified in this Section; and as established by the Basis-of-Design Materials, use any of the listed manufacturer's products in accordance with Section 01 00 06 General Requirements – Substitutions and Product Options.
 - .1 Kingspan/CPI Daylighting, Inc.

2.09 PANEL COMPONENTS

- .1 Face Sheets: Translucent exterior face panels: Manufactured from glass fiber reinforced thermoset resins, Colour stability to ASTM D2244, impact resistant to 3.35 kNm (230 ft.-lbs.) to UL723, and flame spread rating of 25 or less when tested in accordance with ULC S102.

- .2 Translucent faces (Exterior and Interior): Manufactured from glass fiber reinforced thermoset resins, formulated specifically for architectural use.
 - .1 Thermoplastic (e.g. polycarbonate, acrylic) faces are not acceptable.
 - .2 Face sheets shall not deform, deflect or drip when subjected to fire or flame.
 - .3 Flame spread: Underwriters Laboratories (UL) listed, which requires periodic unannounced retesting, with flame spread rating no greater than 25 when tested in accordance with UL 723.
 - .4 Burn extent by ASTM D 635 shall be no greater than 1".
- .3 Exterior face sheets:
 - .1 Color stability: Full thickness of the face sheets shall not change color more than 3 CIE Units DELTA E by ASTM D 2244 after 3 years outdoor South Florida weathering at 5° facing south, determined by the average of at least three white samples with and without a protective film or coating to ensure long-term color stability. Color stability shall be unaffected by abrasion or scratching.
 - .2 Strength: Exterior face sheet shall be uniform in strength, impenetrable by hand held pencil and repel an impact minimum of 70 ft. lbs. without fracture or tear when impacted by a 3-1/4" diameter, 5 lb. free-falling ball per UL 972.
- .4 Appearance:
 - .1 Exterior face sheets: Smooth, .070 thick and Crystal in color, Type A.
 - .2 Interior face sheets: Smooth, .045 thick and Standard White in color, Type A.
 - .3 Face sheets shall not vary more than ±10% in thickness and be uniform in color.
- .5 Grid Core
 - .1 Aluminum I-beam grid core shall be of 6063-T6 or 6005-T5 alloy and temper with provisions for mechanical interlocking of muntin-mullion and perimeter. Width of I-beam shall be no less than 7/16".
- .6 Laminate Adhesive
 - .1 Heat and pressure resin type adhesive engineered for structural sandwich panel use, with minimum 25-years field use. Adhesive shall pass testing requirements specified by the International Code Council "Acceptance Criteria for Sandwich Panel Adhesives".
 - .2 Minimum tensile strength of 750 PSI when the panel assembly is tested by ASTM C 297 after two exposures to six cycles each of the aging conditions prescribed by ASTM D 1037.
 - .3 Minimum shear strength of the panel adhesive by ASTM D 1002 after exposure to four separate conditions:
 - .1 50% Relative Humidity at 68°F: 540 PSI
 - .2 182° F: 100 PSI
 - .3 Accelerated Aging by ASTM D 1037 at room temperature: 800 PSI
 - .4 Accelerated Aging by ASTM D 1037 at 182°F: 250 PSI

2.10 PANEL CONSTRUCTION

- .1 Provide sandwich panels of flat fiberglass reinforced translucent face sheets laminated to a grid core of mechanically interlocking I-beams. The adhesive bonding line shall be straight, cover the entire width of the I-beam and have a neat, sharp edge.
 - .1 Thickness: 4"
 - .2 Light transmission 37%

- .3 Solar heat gain coefficient 0.52
- .4 Panel U-factor: .53 Aluminum Grid
- .5 Grid pattern: Nominal sizes and patterns, as indicated on the Drawings.
- .2 Standard panels shall deflect no more than 1.9" at 30 PSF in 10'-0" span without a supporting frame by ASTM E 72.
- .3 Standard panels shall withstand 1200°F fire for minimum one hour without collapse or exterior flaming.
- .4 Canopy System:
 - .1 Canopy system shall pass Class A Roof Burning Brand Test by ASTM E 108.
 - .2 Canopy system shall be UL listed as a Class A Roof by UL 790, which requires periodic unannounced inspections and retesting by Underwriters Laboratories.
 - .3 Canopy System shall meet the fall through requirements of OSHA 1910.23 as demonstrated by testing in accordance with ASTM E661, thereby not requiring supplemental screens or railings.
- 2.11 BATTENS AND PERIMETER CLOSURE SYSTEM
 - .1 Closure system:
 - .1 Extruded aluminum 6063-T6 and 6063-T5 alloy and temper clamp-tite screw type closure system.
 - .2 Curved closure system may be roll formed.
 - .3 Canopy perimeter closures at curbs shall be factory sealed to panels.
 - .2 Sealing tape: Manufacturer's standard, pre-applied to closure system at the factory under controlled conditions.
 - .3 Fasteners: 300 series stainless steel screws for aluminum closures, excluding final fasteners to the building.
 - .4 Finish:
 - .1 Manufacturer's factory applied finish, which meets the performance requirements of AAMA 2604. Color to be selected from manufacturer's standards.
 - .2 Mill (optional)
 - .5 Aluminum frame: To profiles as required to performance requirements, suitable alloy 6005-T5 or 6063-T6 and proper temper for extruding and adequate structural characteristics; and suitable for finishing as specified.
 - .6 Sheet aluminum: Alloy 1100, F temper, exposed sheet finished to match frames as specified above.
 - .7 Translucent exterior face panels: Manufactured from glass fiber reinforced thermoset resins, Colour stability to ASTM D2244, impact resistant to 3.35 kNm (230 ft. – lbs.) to UL723, and flame spread rating of 25 or less when tested in accordance with ULC S102.
 - .8 Laminate Adhesive: Heat and pressure resin type adhesive engineered for structural sandwich panel use, with minimum 25-years field use. Adhesive shall pass testing requirements specified by the International Code Council "Acceptance Criteria for Sandwich Panel Adhesives". Minimum tensile strength of 750 PSI when the panel assembly is tested by ASTM C 297 after two exposures to six cycles each of the aging conditions prescribed by ASTM D 1037. Minimum shear strength of the panel adhesive by ASTM D 1002.

- .9 Fasteners: To ASTM A167, stainless steel, type 304 or cadmium plated steel selected to prevent galvanic action with the components fastened, of suitable size to sustain imposed loads.
- .10 Gaskets: Neoprene or EPDM with dimensional tolerances and durometer hardness and of suitable size and shape to meet the requirements of the specifications and their specific application. Gaskets shall be virgin material.
- .11 Supporting angles, plates, bars, rods, and other steel accessories: Mild steel CAN/CSA G40.20/G40.21, shop painted with zinc chromate primer, thickness as required to sustain imposed loads and in no case less than 4.8 mm thickness.
- .12 Sealant: Including primer, joint filler, as specified in Section 07 92 00.
- .13 Dielectric separator: Bituminous paint.
- .14 Thermal separator: Polyvinylchloride, 50 Shore A durometer hardness +5.
- .15 Sheet metal: Sheet steel to ASTM A653, galvanized.
- .16 Core Insulation: Translucent fibrous glass to CAN/ULC S702, density for specified thermal requirements.

2.12 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 Design and fabricate clips, seats and anchors for attaching wall system to building structure.

2.13 FABRICATION - TRANSLUCENT PANELS

- .1 Translucent panels shall be 70 mm thick consisting of translucent fibre glass full thickness:
 - .1 Grid pattern "Shoji"
 - .2 Translucent colour "Crystal"
 - .3 Light transmittance: 15%
 - .4 Shading coefficient 0.207
 - .5 Thermal resistance RSI 1.4 (R10).
 - .6 Solar heat Gain Coefficient: 0.18
 - .7 U-Factor: 0.14

2.14 FINISHES

- .1 Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
- .2 Clear Anodized Finish: Class I Finish: Architectural Class I, clear coating 0.018 mm or thicker in accordance with AAMA 611.

- .3 Unexposed aluminum: mill finish.

3. EXECUTION

3.08 EXAMINATION

.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 for installation are properly located and installed.
- .5 Ensure that building air and vapour retarding membranes can be sealed to wall system to maintain system integrity.

- .2 Installer shall examine substrates, supporting structure and installation conditions.

- .3 Do not proceed with panel installation until unsatisfactory conditions have been corrected.

3.09 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 Metal Protection:

- .1 Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape recommended by manufacturer for this purpose.
- .2 Where aluminum will contact concrete, masonry or pressure treated wood, protect against corrosion by painting contact surfaces with bituminous paint or method recommended by manufacturer.

3.10 INSTALLATION

- .1 Install the canopy system in accordance with the manufacturer's suggested installation recommendations and approved shop drawings.

- .1 Anchor component parts securely in place by permanent mechanical attachment system.
- .2 Accommodate thermal and mechanical movements.
- .3 Set perimeter framing in a full bed of sealant compound, or with joint fillers or gaskets to provide weather-tight construction.

- .2 Install joint sealants at perimeter joints and within the panel system in accordance with manufacturer's installation instructions.

- .3 Install in accordance with the manufacturer's written instructions and the contract documents, plumb, true, level and rigid.

- .4 Conceal all anchors and fitments. Exposed heads of fasteners not permitted. All joints in exposed work to be flush hairline butt joints.

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- .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 slots to ensure proper drainage of moisture to exterior.
 - .9 Maintain alignment with adjacent work.
 - .10 Isolate aluminum surfaces from adjacent dissimilar materials and metals with coatings of bituminous paint.
 - .11 Pack fibrous insulation in shim spaces at perimeter of assembly to maintain continuity of thermal barrier.
 - .12 Install sealants and back-up materials in strict accordance with manufacturer's written instruction.

3.11 CLEANING

- .1 Clean the canopy system interior and exterior, immediately after installation.
- .2 Refer to manufacturer's written recommendations.
- .3 At completion and continuously as Work proceeds, remove all surplus materials, debris and scrap.
- .4 At completion of Work, remove all protective surface covering film and wrappings. Clean all fiberglass, panels and frames using mild soap or other cleaning agent approved by manufacturer.

END OF SECTION

1. GENERAL**1.01 SUMMARY**

- .1 This section includes administrative and procedural guidelines and procedures for constructing an airtight Building Envelope that controls infiltration and exfiltration of air and moisture in accordance with the Building Code.
- .2 Successful installation of the Building Envelope is dependent on single source responsibility by using either a single Building Envelope Subcontractor responsible for complete envelope installation; or by the Contractor taking on single source responsibility by assigning several Building Envelope Subcontractors coordinated by the Contractor, and that can be achieved by the following:
 - .1 Coordination between methods for installation; material compatibility; transitioning or joining to adjacent materials; modifying or otherwise affecting the installed Building Envelope including scheduling and sequencing of the Work.
 - .2 Pre-construction meetings, mock-ups and sample installations to confirm, inspect, test and other related actions including reviews and inspections performed by independent agencies, and Authorities Having Jurisdiction; they do not include contract enforcement activities performed by the Consultant.

1.03 DEFINITIONS

- .1 The following definitions apply to the Common Work Results for Air Barrier and Vapour Retarder Systems specification:
- .2 Building Envelope: Building Envelope includes the airtight and moisture resistant components including joints, junctures and transitions between materials, Products, and assemblies forming the building enclosure.
- .3 Vapour Retarder: Vapour retarders form an integral part of the building enclosure and must be maintained intact and continuous on the interior (warm) side of all insulated assemblies; comprised of moisture vapour impermeable membranes that are maintained in tight physical contact to the building enclosure insulation; sealed tight to all openings and penetrations and to all other elements of the Building Envelope.
- .4 Air Barrier: Air barriers are comprised of physically strong and reliable materials designed to resist air movement into or out of the Building Envelope and resist a minimum air pressure difference of 2.0 kPa without tearing, rupturing or breaking away from its fastening; may form a part of a combined air and vapour retarder material, or may form as separate air barrier system as specified.
- .5 Manufacturers use different methods of describing the rate at which water vapour will pass through their vapour retarder materials; the three most common terms are as follows:
 - .1 Water Vapour Permeability: Time rate of water vapour transmission through unit area of flat material of unit thickness induced by unit vapour pressure difference between two specific surfaces, under specified temperature and humidity condition; arithmetic product of permeance and thickness that provides the property of a material.
 - .2 Water Vapour Permeance: Time rate of water vapour transmission through unit area of flat material or construction induced by unit vapour pressure difference between two specific surfaces, under specified temperature and humidity conditions; permeance indicates the performance of the material and is not a property of a material.
 - .3 Water Vapour Transmission Rate: Steady water vapour flow in unit time through unit area of a body, normal to specific parallel surfaces, under specific conditions of temperature and humidity at each surface.

- .4 Units of Measure: Metric units will be used to assess the performance of any given vapour retarder material, the following conversions will be used to assess manufacturers' product information:

Multiply	By	To Obtain (same test condition)
Water Vapour Transmission Rate (WVT)		
ng/h•m ²	1.43	grains/h•ft ²
grains/h•ft ²	0.697	ng/h•m ²
Permeance		
ng/Pa•s•m ²	0.0175	1 Perm (inch-pound)
1 Perm (inch-pound)	57.2	ng/Pa•s•m ²
Permeability		
ng/Pa•s•m	6.88 x 10 ⁸	1 Perm inch
1 Perm inch	1.45 x 10 ⁻⁹	ng/Pa•s•m
These units reflect commonly used terms only.		
All conversions of mm Hg to Pa will be made at a temperature of 0°C.		

1.04 REFERENCE STANDARDS

- .1 American Society for Testing and Materials (ASTM International):
- .1 ASTM E96/E96M-12, Standard Test Methods for Water Vapor Transmission of Materials
 - .2 ASTM E1105-00 (2008), 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
 - .3 ASTM E1186-03 (2009), Standard Practices for Air Leakage Site Detection in Building Envelopes and Air Barrier Systems
 - .4 ASTM E1677-11, Standard Specification for an Air Barrier (AB) Material or System for Low-Rise Framed Building Walls
 - .5 ASTM E2178-11, Standard Test Method for Air Permeance of Building Materials

1.05 ADMINISTRATIVE REQUIREMENTS

- .1 Coordination: Successful implementation of Building Envelope requires input and coordination from all project participants as follows:
- .1 Consultant: Consultant provides specifications that describe the performance requirements of the Building Envelope and quality of materials and details indicating configuration of the various Building Envelope components necessary to achieve a continuous Building Envelope.
 - .2 The City's Inspection Agency: Building Envelope Inspector provides site specific recommendations and corrections to deficient materials or workmanship, and records observations, recommendations and corrections on a timely basis.
 - .3 Building Envelope Subcontractor: Installing Subcontractors submit additional information including product data indicating actual materials used, additional drawings or documentation that may be required to confirm constructability, participate in sample and mock-up construction and implement corrective actions recommended by Building Envelope Inspector and directed by Consultant.

- .4 Contractor: Contractor prepares or adds content to their quality management program that includes construction actions that monitor installation of Building Envelope and methods to ensure that corrective actions recommended by Building Envelope Inspector and directed by Consultant are implemented.
- .2 Pre-Construction Meetings: Schedule meetings attended by Contractor, Building Envelope Subcontractors, Consultant, and the City in accordance with Section 01 00 06 – General Requirements: Project Meetings prior to installation of each Building Envelope component or phase of construction to verify construction methods for controlling air leakage into or out of conditioned spaces including the following:
 - .1 Importance of continuity of air barrier and vapour retarder system components with all joints and penetrations sealed.
 - .2 Concept that air barrier and vapour retarder system components must be structurally supported to withstand positive and negative air pressures applied to the Building Envelope.
 - .3 Requirements for air barrier and vapour retarder system components and physical connection between the following assemblies:
 - .1 Foundation and walls
 - .2 Walls to windows and doors
 - .3 Different wall systems
 - .4 Wall and roof transition
 - .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
 - .4 Requirements for best practices relating to workmanship and installation processes as follows:
 - .1 Methods for making penetrations to air barrier and vapour retarder systems vapour tight, watertight and airtight.
 - .2 Installation follow-up procedures to reduce or eliminate installation deficiencies
 - .3 Sequence of work and confirmation of compatibility of materials that lap or join dissimilar components
 - .4 Use of trained installers for critical components

1.06 QUALITY ASSURANCE

- .1 Coordinate work contributing to or affecting construction of the Building Envelope, and sequence of construction required to attain continuity of air barrier and vapour retarder system joints, junctures and transitions between materials and assemblies of materials and Products.
- .2 Use labour trained and experienced in the installation of Building Envelope Products; use materials that are compatible with each other in the final construction and that will form a continuous air barrier and vapour retarder system.
- .3 Provide quality assurance procedures, testing and verification required to install Building Envelope as follows:
 - .1 Include costs for Contractor's quality assurance program as a part of the Contract Price.
 - .2 Organize pre-construction meetings between the contributors to the Building Envelope to determine extent, responsibility and sequence of installation of airtight joints, junctures, and transitions between materials, Products and assemblies installed by the contributors to the Building Envelope.
 - .3 Perform spot checks to verify that materials, Products and assemblies installed by the contributors to the Building Envelope are ready for review by the City's inspection agency.

1.07 QUALITY CONTROL

- .1 The City will pay for inspection and testing services performed by an independent agency to verify compliance with specified requirements specified; testing services performed by the City do not relieve Contractor of responsibility for compliance with Contract Document requirements.
- .2 Inspection agency will provide qualified personnel to perform required inspections and tests; scope of service provided by the inspection agency will be limited to the following:
 - .1 Prompt notification of Consultant and Contractor of irregularities or deficiencies observed in the Work during performance of its services.
 - .2 Inspection agency is not authorized to release, revoke, alter, or enlarge requirements of the Contract Documents or approve or accept any portion of the Work; inspection agency will report findings to the City and Consultant; Consultant will require changes to the work, where report indicates deficiencies in the construction of the Building Envelope.
 - .3 Inspection agency will not be permitted to perform any duties of the Contractor.

2. PRODUCTS**2.03 PERFORMANCE REQUIREMENTS**

- .1 This Section describes coordination required between the various contributors to the successful installation of the Building Envelope including any customized fabrication and installation procedures that may be required; this section does not cover specification requirements for Products listed in Related Requirements.
- .2 Common performance requirements required to maintain continuity of the Building Envelope include the following:
 - .1 Correct installation of Products at joints and transitions to provide airtight assemblies.
 - .2 Specific quality control requirements for individual construction activities are specified in the sections of the specifications; verify that each contributor to the Building Envelope is adequately and satisfactorily performing the quality assurance documentation, tests and procedures required by each Related Section.
 - .3 Specified inspections, tests, and related actions performed by the City do not replace the Contractor's quality assurance procedures required to facilitate compliance with specified requirements.
- .3 Products used for air barrier and vapour retarder systems forming the Building Envelope shall be in accordance with the Building Code and as follows:
 - .1 Materials: Materials specified for the project have been selected for the following performance requirements; any Contractor proposed Substitutions will be assessed to the same performance requirements:
 - .1 Air Leakage Rate: 0.02 L/s•m² maximum measured at an air pressure differential of 75 Pa, in accordance with ASTM E2178.
 - .2 Permeance: 3.5 ng/Pa•s•m² maximum.
 - .2 Assemblies: Assemblies described in the specifications and drawings have been selected for the following performance requirements; any Contractor proposed Substitutions will be assessed to the same performance requirements:
 - .1 Air Leakage Rate: 0.10 L/s•m² maximum measured at an air pressure differential of 75 Pa, in accordance with ASTM E1677 where warm side Relative Humidity is between 27 and 55%.

- .2 Permeance: 25 ng/Pa•s•m² maximum where warm side Relative Humidity is between 27 and 55%.

3. EXECUTION

3.03 INSTALLATION

- .1 Conform to the requirements of this Section to maintain and protect continuity and integrity of the Building Envelope.
- .2 Install air barriers and vapour retarders in full contact with substrate in accordance with manufacturer's instructions using recommended fasteners, primers or adhesives required for a complete system.
- .3 Leave sufficient transition flaps of air barrier and vapour retarder materials to allow subsequent contributors to the Building Envelope to complete junctions; temporarily fasten and protect transition flaps from weather, wind and damage from construction so that junctions can be completed without having to repair transition flaps and so that transition can form an airtight and vapour retardant seal.
- .4 Maintain continuity of Building Envelope across expansion and control joints whether indicated and designed or not.
- .5 Refer to referenced Related Requirements for specific requirements and any site testing.

3.04 THE CITY'S SITE TESTING AND INSPECTION ACTIVITIES

- .1 The City will hire a testing and inspection agency to provide Occasional Observation and inspection during installation of the air barrier and vapour retarder systems.
- .2 Cooperate with agencies performing the City's required inspections, tests, and similar services; notify inspection agency in advance of required testing; provide auxiliary services as required by testing agency including the following:
 - .1 Access to the Work.
 - .2 Incidental labour and facilities necessary to facilitate inspections and tests.
 - .3 Adequate quantities of representative samples of materials that require testing or assist the agency in taking samples.
 - .4 Deliver samples to testing laboratories, when requested.
 - .5 Security and protection of samples and test equipment at the Project Site.
 - .6 Coordinate the sequence of activities to accommodate required inspection services with a minimum of delay.
 - .7 Coordinate activities to avoid removing and replacing construction to accommodate inspections and tests.
 - .8 Contractor is responsible for scheduling times for inspections, tests, taking samples, and similar activities.

3.05 REPAIR AND PROTECTION

- .1 Repair damaged construction and restore substrates and finishes when inspection, testing, sample-taking and similar services have been completed in accordance with Section 01 00 06 – General Requirements: Cutting and Patching; repair immediately after testing and sampling is completed to prevent damage to assemblies resulting from moisture diffusion or air leakage.
- .2 Protect construction exposed during the City's quality control activities and repaired construction from weather and sources of moisture that are deleterious to the tested assemblies.
- .3 Take all necessary precautions to prevent puncturing, tearing, weakening or damaging the Building Envelope membranes during construction; repair any damage as directed by the Consultant.

.4 Protect vapour retarder membranes from cold in final building construction using insulation.

END OF SECTION

1. GENERAL**1.01 SUMMARY**

- .1 This Section provides common design requirements relating to technical specification sections forming a part of fire and smoke rated assemblies and systems for installation by specialized Subcontractor's:
- .1 Design of Fire-Resistance Rated systems is a joint responsibility of the Consultant, the Contractor, the manufacturer and installing Subcontractor, and the Authority Having Jurisdiction.
 - .2 Drawings indicate suggested solutions to fire and smoke rated separations, assemblies and materials using Standard Details based on generic information and time assigned materials listings listed in the Building Code for components required to meet the intent of the fire and smoke rated System.
 - .3 Drawings do not portray complete assessment of all conditions associated with fire and smoke rated separations, assemblies and materials.
 - .4 Delegated design requirements of this section are included to complete the required details for the Project.
 - .5 Delegated design submittals are required so that the Consultant can accurately and completely fulfill the requirements for the submission of schedules required by the Authorities Having Jurisdiction.
- .2 This Section provides requirements for identification of fire and smoke rated assemblies common to other assemblies that reference this Section, supply and installation of identification and labelling components are the responsibility of the installing Subcontractor.
- .3 It is a requirement of this Section that work relating to construction of fire and smoke rated assemblies and components is installed under the responsibility of a single source specialty Fire Stop applicator or by the Contractor, or by several Fire Stop applicators that are closely supervised by the Contractor in accordance with requirements forming a part of the related references included in this Section.

1.02 RELATED REQUIREMENTS

- .1 Section 06 10 53 – Miscellaneous Rough Carpentry: Fire retardant treated lumber and panels.
- .2 Section 07 81 00 – Applied Fireproofing: Design of fire resistive material applied to structural members to obtain a required fire rating.
- .3 Section 07 84 00 – Firestopping: Design and labelling of openings through fire resistive assemblies, top-of-wall and building perimeter joints, mechanical and electrical penetrations, and other Fire Stop components.
- .4 Section 08 11 13 – Steel Doors and Frames: Labelling of fire-protection ratings and temperature-rise-rated (TRR) for steel doors and frames.
- .5 Section 08 31 00 – Access Doors and Panels: Labelling of fire rated access doors and frames.
- .6 Section 09 21 16 – Gypsum Board Assemblies: Labelling of fire and smoke rated assemblies and partitions.

- .7 Division 21 – Fire Suppression: Labelling of fire suppression systems; coordination of Fire Stops penetrations through other assemblies.
- .8 Division 23 – Heating, Ventilating and Air Conditioning: Coordination of fire and smoke rated dampers and detection systems; labelling of dampers and detection systems; coordination of Fire Stops penetrations through other assemblies.
- .9 Division 28 – Electronic Safety and Security: Labelling of fire detection and alarm systems.
- .10 Work of other sections having fire and smoke resistant construction or separation ratings.

1.03 PRICE AND PAYMENT PROCEDURES

- .1 Allowances: Third-party Inspections specified in this Section form a part of a cash allowance as follows:
 - .1 The City has established a requirement for third-party inspections of installed Fire Stop systems and that will be providing a report to the City at completion of the work of this Section indicating compliance with specified requirements and verification that installed materials, components and assemblies are installed in accordance with ULC Firestop Systems and Components Listings submitted for review as a part of the shop drawing process.
 - .2 Contractor and installing Subcontractors are required to cooperate with the third-party inspection agency and permit them access to Fire Stop locations and facilitate identification of materials used during installation of Fire Stop systems.
 - .3 Fire Stop inspection agency will report directly to the City and Consultant and deficiencies and noted corrective actions required by the installing Subcontractors; Consultant will inform the Contractor of any corrective actions arising from the third-party inspector's report.
 - .4 Installing Subcontractors must allow for replacement of approximately 1% of installed Fire Stop systems resulting from third-party inspector's randomized destructive testing requirements to verify that conditions observed during installation of Mock-Ups (the established standard for installation) are being met in the installed Fire Stop systems.

1.04 DEFINITIONS

- .1 The following definitions apply to the Fire and Smoke Assembly specification:
- .2 Authority Having Jurisdiction: The local Building Code authority responsible for reviewing Engineering Judgements, Fire-Resistance Rated systems and Mock-Ups (if any), and for inspecting installed Fire-Resistance Rated systems for compliance with local codes and ordinances.
- .3 Certified Fire Protection Specialist (CFPS): Person who has completed the NFPA sanctioned examination and professional accreditation, who is directly employed by the manufacturer, and who has direct experience in the preparation of Engineering Judgements.
- .4 Engineering Judgement: A written proposal submitted by the manufacturer to the Authority Having Jurisdiction arising from a variation in the assembly or system from that tested and labelled in their Fire-Resistance Rated systems, and as follows:
 - .1 Engineering Judgements are specific to this Project and details described in the written proposal and form a part of the Submittal requirements for this Section.
 - .2 Engineering Judgements must be signed by a CFPS, and form a part of the delegated design submittal required by this section and Section 01 33 50 – Delegated Design Submittals.

- .5 Manufacturer's Authorized Representative: A person who is directly employed by the manufacturer and who is capable of making onsite decisions relating to the installation of the manufacturers Products; this person is specifically noted as not being an employee of a distributor, agent or other supplier.
- .6 Fire-Protection Rating: The time in minutes or hours that a closure (doors, frames, door hardware, shutters, fire dampers and fire glass screens) will withstand the passage of flame when exposed to fire.
- .7 Fire-Resistance Rating: The time in minutes or hours that a material or assembly of materials will withstand the passage of flame and transmission of heat when exposed to fire meeting the requirements of CAN/ULC S101 or as determined by formal testing of material or assembly of materials meeting requirements of CAN/ULC S115, or an interpretation of information derived from formal testing in accordance with requirements of the Building Code and acceptable to the Authority Having Jurisdiction.
- .8 Fire Compartment: Spaces within a building that are enclosed by exterior walls or separated from other parts of the building by enclosing Fire Separations having a Fire-Resistance Rating.
- .9 Firewall: Assembly that is a Fire Separation constructed from non-combustible construction subdividing a building or separating adjoining buildings to resist the spread of fire and that has a Fire-Resistance Rating, and structural stability to remain intact under fire conditions for the required fire-rated time.
- .10 Smoke Barriers/Partitions: Barriers, partitions and other assemblies that are sealed to limit the spread of smoke and toxic gases as follows:
- .1 Assembly Type: Construction of Smoke Barriers is identical to a minimum 1-hour Fire-Resistance Rating described above that does not require ULC Fire-Resistant Assembly Listing.
- .2 Leakage Rate: Smoke Barriers must be sealed to limit the passage of smoke and toxic gases at ambient and elevated temperatures to a maximum of 25 litres/s•m² when subjected to a pressure difference of 75 Pa at 24°C and 200°C.
- .11 Recognized Testing Authority: An organization recognized by the Authority Having Jurisdiction as being capable of conducting testing and providing labelling for materials, assemblies and systems that include, but are not limited to, the following organizations:
- .1 Underwriters Laboratories of Canada (ULC)
- .2 Underwriters Laboratories Inc. (UL)
- .3 Warnock Hersey (intertek) and Electrical Testing Labs (ETL) Listed
- .4 ETL, UL and WH labelling will only be acceptable subject to the following conditions:
- .1 Fire resistance rated assemblies and materials bearing an Underwriters Laboratories Inc. (UL) or Warnock Hersey (WH) label will be acceptable for use on this project provided that the label indicates acceptance under Underwriters Laboratories of Canada (ULC) and having one of the following cUL, cUL_{US}, cWH or cWH_{US} markings.
- .2 Materials that only have UL, UL_{US}, WH or WH_{US} markings are not acceptable.
- .5 Examples of acceptable marks from Recognized Testing Authorities:



- .12 Standard Details: Details prepared by the Consultant indicating an assembly based on generic materials demonstrating configuration and proposed methods for attaining the required fire rating; Standard Details may be derived from the following criteria:
 - .1 Details may be based on specific Fire-Resistance Rated systems provided by a Recognized Testing Authority.
 - .2 Details may be based on time assigned to materials listed in the Building Code.
 - .3 Details are of a general nature only, sufficient to inform the bidders of the Consultant's design intent, and do not portray every instance or requirement that can be represented on the Project site; the supplier of materials is responsible submitting design information for Fire Stopping systems required for the Project to the Consultant prior to starting work.

1.05 REFERENCE STANDARDS

- .1 Firestop Contractors International Association (FCIA):
 - .1 FCIA Manual of Practice
- .2 Intertek Group:
 - .1 Directory of WH Listed Building Products
 - .2 Directory of ETL Listed Electrical and Electronic Products
- .3 International Fire Stop Council (IFC):
 - .1 Guidelines for Evaluating Fire Stop Systems Engineering Judgments
- .4 Underwriters Laboratories of Canada (ULC):
 - .1 Directory of Burglar and Fire Alarm Systems and Components
 - .2 Directory of Building Materials
 - .3 Directory of Fire Protection Equipment
 - .4 Directory of Fire Resistance
 - .5 Directory of Fire Stop Systems and Components
 - .6 Directory of Heating and Ventilating Equipment, Flammable Liquids and Gases Equipment, and Marine Equipment
- .5 Underwriters Laboratories Inc. (UL):
 - .1 UL Fire Resistive Assemblies and Systems, Certified for Canada (cUL).

1.06 ADMINISTRATIVE REQUIREMENTS

- .1 Delegated Design: Design fire resistive assemblies, Fire Stopping required by the Contract Documents to withstand fire ratings indicated on Drawings and in accordance with requirements of the Building Code:
 - .1 Provide manufacturers standard details where site conditions match standard assembly listings.
 - .2 Provide manufacturers Engineering Judgment, indicating acceptance by the Authority Having Jurisdiction, signed by manufacturer's CFPS designer, where assembly does not match standard assembly listing.
 - .3 Confirm proposed rated system materials and methods to applicable codes and ordinances of the Authority Having Jurisdiction.
 - .4 Additional performance requirements are listed in the referenced technical specification sections.

- .2 Coordination: Subcontractor is required to notify the Contractor where their work passes through a fire separation or removes any fire resistive materials, so that the penetration or damage is filled or repaired by an acceptable installation contractor to maintain the integrity of the fire separations:
 - .1 Contractor is required to notify the Consultant prior to penetrating any load bearing assembly that does not have a predetermined penetration location; Fire-Resistance Rated systems do not re-establish the structural integrity of load bearing partitions or assemblies, or support live loads and traffic.
 - .2 Rated System can be either “built-in” (such as; integral with concrete placement) or “post-installed”; provide built-in Rated System devices prior to concrete placement or masonry installation.
 - .3 Coordinate construction of openings and penetrating items and verify that through Fire-Resistance Rated systems are installed according to specified requirements.
 - .4 Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate penetrations through fire and smoke rated separations.
- .3 Pre-Installation Conference: Conduct conference at Project site in accordance with the requirements of Section 01 00 06 – General Requirements: Project Meetings to discuss proposed Fire-Resistance Rated systems supplied by the installing Subcontractor and manufacturer, modifications to the Consultant’s Standard Details, Engineering Judgements, placement of identification labels and coordination issues, and as follows:
 - .1 Attendees for meetings include the Consultant, Contractor, installing Subcontractor’s, Manufacturer’s Authorized Representatives, and the City’s third party inspection agency; the Authority Having Jurisdiction can be invited as a courtesy, but it is not mandatory that they attend the meeting.
- .4 Scheduling: Schedule required site visits, submission requirements and documentation procedures, review of Mock-Ups (if any) and inspection of fire and smoke rated assemblies as follows:
 - .1 Authority Having Jurisdiction: Notify Authority Having Jurisdiction in sufficient time to allow for inspection prior to Fire-Resistance Rated systems being covered up or enclosed.
 - .2 The City’s Testing Agency: Inspection and Testing: Coordinate with City’s third party inspection agency and incorporate any corrections or modifications required by inspection agency.
- .5 Sequencing: Sequence installation of fire and smoke rated components to maintain the continuity of fire separations whether or not shown on the drawings:
 - .1 Fire separations may not be pierced by electrical or similar service outlets except in accordance with Building Code.
 - .2 Do not support non-combustible construction on combustible construction.
 - .3 Fire Stop openings in non-combustible construction that terminates at the exterior wall, the underside of floor, ceiling, or roof structures, and at floors with non-combustible materials.
 - .4 Do not use combustible members, fastenings, and similar items to anchor fixtures to fire separations.
 - .5 Fire Stop openings for non-combustible pipes and ducts to prevent the passage of smoke and flame.

1.07 SUBMITTALS

- .1 Submit a summary of Fire-Resistance Rated systems proposed for use in the Project within four (4) weeks of starting work of the Contract in accordance with Section 01 00 06 – General Requirements: Submittals, and as follows:
 - .1 Provide summary of manufacturer’s details and Engineering Judgements in a format similar to that attached to the end of this Section
 - .2 Attach detailed sketches and drawings, manufacturer’s written installation instruction, and material safety and data sheets to the summary; fully cross referenced to the Drawings and the summary.
 - .3 Manufacturer’s Details:
 - .1 Submit manufacturer’s details indicating an assembly or system that matches the design intent provided by the Standard Details.
 - .2 Manufacturer’s standard details must be signed by CFPS, and include only content that is applicable to the Work of the Project.
 - .3 Provide additional details as required to address additional detail conditions not covered by the Standard Details.
 - .4 Equivalent Fire Resistance Rated Assembly (EFRR): Fire-Resistance Rated Assemblies that are submitted by a Fire Stop manufacturer using similar materials and configurations as components from a competing Fire Stop manufacturer, but that has not been tested by the submitting Fire Stop manufacturer:
 - .1 An EFRR is not qualified by exactly representative fire testing, but will be viewed as an acceptable solution provided that an engineering assessment is performed by the Fire Stop manufacturer.
 - .2 EFRRAs will be administered the same as EJs as described in this Section.
 - .5 Engineering Judgements (EJ): Documentation submitted by the Fire Stop manufacturer to the Authority Having Jurisdiction for acceptance based on conditions not forming a part of a tested assembly or system.
 - .1 Engineering Judgments will not be accepted as a Substitution where a classified system exists within the public domain; solutions from multiple Fire Stop manufacturers may be considered where products and systems from a single Fire Stop manufacturer cannot meet project specific conditions.
 - .2 Manufacturer’s details indicating a modification to an assembly or system required to meet the design intent provided by the Standard Details or to address a specific site condition not normally test for in the manufacturer’s testing program.
 - .3 Engineering Judgments must include project name and Subcontractor’s name who will install Rated System described in the Engineering Judgement.
 - .4 Engineering Judgements must be signed by a CFPS employed by the manufacturer, and who was directly responsible for preparation of the Engineering Judgement.
 - .5 Prepare Engineering Judgements in accordance with IFC Guidelines for Evaluating Fire Stop Systems Engineering Judgements.
- .2 Letters of Commitment and Compliance:
 - .1 Provide letters of Commitment and Compliance as required by Section 01 33 50 – Delegated Design Submittals.
 - .2 A principal of the installing company and the Manufacturer’s Authorized Representative (CFPS) jointly sign required letters instead of a professional engineer as required by Section 01 33 50.

- .3 Submit additional letters of Commitment and Compliance where there are more than one Manufacturer's Authorized Representative or installing Subcontractors.

1.08 QUALITY ASSURANCE

- .1 Quality Assurance requirements specific to Fire-Resistance Rated assemblies, materials and components must be read in conjunction with requirements of this Section to form a complete requirement for the Project.
- .2 Quality Assurance Program: Subcontractors are responsible for establishing a Quality Assurance program in accordance with FCIA Manual of Practice, assemble a listing of proposed Fire Stop systems and assemblies required for the project, and submit required certificates at completion of the Project that work associated with Fire and Smoke assemblies has been completed in accordance with referenced standards, and with specifications; the City's third party testing and inspection program does not diminish or replace the Subcontractor's Quality Assurance Program.
- .3 Installers: Fire-Resistance Rated systems specified for the Project will be supplied and installed by a Subcontractor specializing in the application of specific systems and that have completed training in a ULC or FM Fire Stop training and certification program, and as follows:
- .4 Manufacturer's Site Services: Manufacturer's authorized representative (not distributor or agent) will be onsite during initial installation of Fire-Resistance Rated systems to train Subcontractor's personnel in proper selection and installation procedures in accordance with manufacturer's written recommendations.

1.09 MOCK-UP

- .1 Provide Mock-Up in an accessible location at the Project site ready for review by the Authority Having Jurisdiction and the Consultant in accordance with Section 01 00 06 – General Requirements: Quality Control.
- .2 Mock-Up will be representative of the Fire-Resistance Rated systems used for the Project and be kept in a location that can be referenced during the entire construction period; Mock-Up will form the basis for acceptance of installed systems by the Authority Having Jurisdiction and the Consultant.
- .3 Refer to individual technical specification sections, which may provide additional requirements for Mock-Ups.

2. PRODUCTS

2.01 DESIGN REQUIREMENTS

- .1 Fire Test Response Characteristics: Provide Fire-Resistance Rated systems identical to those tested in assembly indicated by the Recognized Testing Authority; provide Engineering Judgements for systems that do not match the Fire-Resistance Rated systems:
 - .1 Provide a label and proof of fire resistive materials used in Fire-Resistance Rated systems issued by a Recognized Testing Authority.
 - .2 Refer to technical sections for specific requirements for sealing penetrations and joints of smoke and fire separations.

2.02 MATERIALS

- .1 Provide Fire-Resistance Rated systems composed of components that are compatible with each other, the substrates they are applied to, and the items (if any) penetrating the Rated System under conditions of service and application as demonstrated by the manufacturer based on testing and site experience.
- .2 Provide complete components for each Rated System that are needed to properly install material forming the system; use only components specified by the manufacturer and approved by the Recognized Testing Agency for the designated fire resistance Fire-Resistance Rated systems.

2.03 IDENTIFICATION MATERIALS

- .1 Adhesive Labels: Nominal 75 mm high x 125 mm wide self-adhering labels placed adjacent to fire and smoke rated penetration components, printed with the following information:
 - .1 ATTENTION: FIRE RATED PENETRATION ASSEMBLY DO NOT MODIFY
 - .2 HOUR RATING AND CLASS OF PENETRATION ASSEMBLY
 - .3 Name of Fire Stopping manufacturer;
 - .4 Names of products used;
 - .5 Manufacturers standard detail number, or Engineering Judgement identifier; ULC or cUL Number;
 - .6 Date of installation;
 - .7 Name of installing Subcontractor;
 - .8 Contact telephone number for repair or replacement of Fire Stopping materials.
 - .9 Size of Label
 - .10 Placement: Place self-adhering labels on a permanent surface adjacent to Fire Stopping installation in an inconspicuous location in fully finished areas and as follows:
 - .1 Acceptable locations include areas such as within concealed ceiling spaces, above cable trays, out of direct line-of-sight beside penetrations and similar locations.
 - .2 Confirm locations before final placement.
 - .11 Example:



- .2 Stencil Signs: Nominal 300 mm high by 400 mm wide painted and stencilled permanent signage applied to fire barriers and partitions, smoke barriers and partitions and other wall or floor assemblies containing protected openings and penetrations labelled with the following information:

ATTENTION: FIRE RATED BARRIER – PROTECT ALL OPENINGS
HOUR RATING OF ASSEMBLY

OR (as appropriate to installation)

ATTENTION: SMOKE RATED BARRIER – PROTECT ALL OPENINGS

- .1 Placement: Apply stencilled signage to wall or barrier surface at 10 metre intervals, evenly laid out across the length of the assembly at a concealed locations and as follows:
- .1 Acceptable locations include areas such as above finished ceilings, or out of direct line-of-sight in finished public spaces.
 - .2 Acceptable exposed locations include areas such as within unoccupied spaces, mechanical and electrical rooms and similar unfinished non-public spaces.
 - .3 Confirm locations before final placement.
- .2 Self-adhering labels containing similar information and sized similarly to site stencilled signage are considered as an acceptable substitution for stencilled and painted signage.
- .3 Example:



3. EXECUTION

3.01 RESPONSIBILITIES OF PARTIES INVOLVED

- .1 The Consultant is responsible for the following:
- .1 Provide Standard Details of Fire-Resistance Rated systems for the guidance of the Contractor, Subcontractors, and Authority Having Jurisdiction; Standard Details represent design intent only, and do not portray every condition that may arise in the construction process.
 - .2 Review manufacturer's submittals for conformance to design intent to comply with the Consultant's requirements for completing schedules required by the Building Code.
- .2 The Contractor is responsible for the following:
- .1 Direct Subcontractors responsible for installation of Fire-Resistance Rated systems to submit a summary of Fire-Resistance Rated systems used in the project for submission to the Authority Having Jurisdiction and the Consultant.
 - .2 Direct Subcontractors responsible for installation of Fire-Resistance Rated systems to complete any Mock-Ups required by the technical specification sections ready for review by the Authority Having Jurisdiction and the Consultant.

- .3 Direct the Subcontractor to submit Letters of Commitment and Compliance to the Consultant.
- .4 Direct the Subcontractor to notify the Authority Having Jurisdiction to inspect installed Fire-Resistance Rated systems.

.3 The Authority Having Jurisdiction will be responsible for the following:

- .1 Review manufacturer's submittals for compliance with local codes and ordinances submitted by Consultant.
- .2 Review Mock-Ups for compliance with local codes and ordinances, when they are able to attend (optional attendance).
- .3 Review of installed Fire-Resistance Rated systems for compliance with local codes and ordinances.

3.02 SITE REVIEW

- .1 Notify Consultant a minimum of seven days in advance of completion of installation of fire and smoke Fire-Resistance Rated systems and Fire Stop installations; confirm dates and times on days preceding each series of installations.
- .2 Do not cover up fire and smoke rated construction or Fire Stop systems that will become concealed behind other construction until Consultant has reviewed and Authority Having Jurisdiction's building inspector have examined each installation.

3.03 SITE QUALITY CONTROL

- .1 The City will retain a qualified third party inspection agency to conduct site review of fire and smoke rated construction to verify that fire and smoke rated assemblies, and confirm that Fire Stopping systems have been installed in accordance with governing regulations, requirements of the manufacturer and to meet acceptance criteria of the Authorities Having Jurisdiction.
- .2 Third party inspection agency will be responsible for the following:
 - .1 Review Contract Documents and verify Code requirements.
 - .2 Attend pre-installation meetings.
 - .3 Review submittals of drawings, assemblies and samples.
 - .4 Review mock-ups and provide input into mock-up requirements.
 - .5 Perform periodic site reviews and provide reports.
 - .6 Perform thickness and density testing and provide reports.
 - .7 Upon project completion provide a letter of certification indicating that code requirements have been met.
- .3 Cut tests may be made at random; the Consultant will determine the frequency of cut tests, but will not be more than 1% of total length of Fire Stopping:
 - .1 Make all necessary repairs and correct all deficiencies noted after completion of cut tests.
- .4 The City's provision of a third party inspection agency does not relieve Contractor of responsibility for supply and installation of conforming fire and smoke rated separations and assemblies.

CONCRETE FIRE PENETRATIONS – HORIZONTAL OR VERTICAL (FT RATING)			
TYPE OF PENETRATION	Combustible or Non-Combustible Penetrating Material	FT Rating	Design or Listing Number
WATER DISTRIBUTION			
SPRINKLER PIPING			
DRAIN WASTE AND VENT (DWV) PIPING			
GAS PIPING			
HVAC DUCTS (NOT REQUIRING DAMPERS)			
ELECTRICAL CABLES (DIAMETER >25 mm)			
ELECTRICAL METALLIC TUBING (EMT) OR STEEL CONDUIT			
OTHER PENETRATIONS			
PENETRATIONS THROUGH FLOOR ASSEMBLIES			
TYPE OF PENETRATION	Combustible or Non-Combustible Penetrating Material	F Rating	Design or Listing Number
WATER DISTRIBUTION			
SPRINKLER PIPING			
DRAIN WASTE AND VENT (DWV) PIPING			
GAS PIPING			
HVAC DUCTS (NOT REQUIRING DAMPERS)			
ELECTRICAL CABLES (DIAMETER >25 mm)			
ELECTRICAL METALLIC TUBING (EMT) OR STEEL CONDUIT			
OTHER PENETRATIONS			

PENETRATIONS THROUGH WALL ASSEMBLIES			
TYPE OF PENETRATION	Combustible or Non-Combustible Penetrating Material	F Rating	Design or Listing Number
WATER DISTRIBUTION			
SPRINKLER PIPING			
DRAIN WASTE AND VENT (DWV) PIPING			
GAS PIPING			
HVAC DUCTS (NOT REQUIRING DAMPERS)			
ELECTRICAL CABLES (DIAMETER >25 mm)			
ELECTRICAL METALLIC TUBING (EMT) OR STEEL CONDUIT			
OTHER PENETRATIONS			
PERIMETER SEALS, TOP-OF-WALL DETAILS AND OTHER FIRE STOPPING			
TYPE OF PENETRATION	Combustible or Non-Combustible Material	FT or F Rating	Design or Listing Number

END OF SECTION

1. GENERAL**1.01 SUMMARY**

- .1 This Section includes requirements for supply and installation of the following:
 - .1 Cavity wall insulation.
 - .2 Perimeter insulation

1.02 DEFINITIONS

- .1 The following definitions apply to the Board Insulation specification:
- .2 Long Term Thermal Resistance (LTTR): Defined as using testing methods described in either ASTM C1303 or CAN/ULC S770 to determine plastic foam insulation long term R-Value over a 15 year time period.

1.03 REFERENCE STANDARDS

- .1 American Society for Testing and Materials (ASTM):
 - .1 ASTM C1303/C1303M-15, Standard Test Method for Predicting Long-Term Thermal Resistance of Closed-Cell Foam Insulation
 - .2 ASTM D1621-16, Standard Test Method for Compressive Properties of Rigid Cellular Plastics
 - .3 ASTM D2842-12, Standard Test Methods for Water Absorption of Rigid Cellular Plastics
- .2 Underwriters Laboratories Canada (ULC):
 - .1 CAN/ULC S102-10, Method of Test for Surface Burning Characteristics of Building Materials and Assemblies
 - .2 CAN/ULC S114-05, Test for Determination of Non-Combustibility in Building Materials
 - .3 CAN/ULC S701-11, Thermal Insulation, Polystyrene, Boards and Pipe Covering
 - .4 CAN/ULC S702-14, Thermal Insulation, Mineral Fibre, for Buildings
 - .5 CAN/ULC S702.2-15, Mineral Fibre Thermal Insulation for Buildings, Part 2: Application Guidelines
 - .6 CAN/ULC S704-11, Thermal Insulation, Polyurethane and Polyisocyanurate Boards, Faced
 - .7 CAN/ULC S770-15, Determination of Long-Term Thermal Resistance of Closed-Cell Thermal Insulating Foams
 - .8 CAN/ULC S773-15, Thermal Insulation Terminology

1.04 QUALITY ASSURANCE

- .1 Regulatory Requirements: Provide insulation products that meet or contain less than the regulated limits for Ozone Depletion Potential compounds listed in the Montreal Protocol adopted by the United Nations Environmental Program.

1.05 DELIVERY, STORAGE, AND HANDLING

- .1 Storage and Handling Requirements: Protect insulation materials from physical damage and from deterioration by moisture, soiling, and other sources. Store inside and in a dry location; follow manufacturer's written instructions for handling, storing, and protecting during installation.

2. PRODUCTS**2.01 MANUFACTURERS**

- .1 Basis-of-Design Materials: Products named in this Section were used as the basis-of-design for the project; manufacturers listed as additional acceptable materials and that offer similar products may be incorporated into the work of this Section provided they meet the performance requirements established by the named products.
- .2 Additional Acceptable Materials Manufacturers: Subject to compliance with performance requirements specified in this Section; as established by the Basis-of-Design Materials, use any of the listed manufacturers' products in accordance with Section 01 00 06 – General Requirements: Substitutions and Product Options; following manufacturer's do not require submission of a request for substitutions provided required shop drawing and product data submissions are submitted before starting any work of Section:
 - .1 Beaver Plastics
 - .2 IKO
 - .3 Johns Manville
 - .4 Owens-Corning Canada
 - .5 Roxul Inc.
- .3 Substitutions: Consultant may consider additional manufacturers having similar products to Acceptable Materials Manufacturers listed above during the construction period, provided they meet the performance requirements established by the named products and provided they submit requests for substitution in accordance with Section 01 00 06 – General Requirements: Substitutions and Product Options before starting any work of this Section:
 - .1 Do not use substitute materials to establish Bid Price.
 - .2 Substitutions that appear as a part of the project without review and acceptance by the Consultant will be rejected and replaced with one of the specified materials.

2.02 MATERIALS

- .1 Cavity Insulation: Use one of the following insulation materials at Contractor's option:
 - .1 Plastic Wall Insulation: Expanded type polystyrene foam insulation, manufactured in accordance with CAN/ULC S701, Type 3, thermal resistance not less than RSI 0.81/25 mm; square edges; minimum compressive strength 140 kPa at 10% deformation in accordance with ASTM D1621, water absorption (% by volume) maximum 2% in accordance with ASTM D2842; board size 1220 mm x 2440 mm or 610 mm x 1220 mm as appropriate to application x thickness required to achieve insulation value indicated on Drawings:
 - .2 Basis-of-Design Materials: Beaver Plastics Terrafoam Platinum 3000 Type 3.
 - .1 Fibrous Mineral Wall Insulation: Unfaced, preformed rigid fibrous mineral slag board insulation manufactured 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; nominal 70 kg/m³ density; square edges, board size 406 mm x 1220 mm or 610 mm x 1220 mm as appropriate to application x thickness required to achieve insulation value indicated on Drawings:
 - .1 Basis-of-Design Materials: Rockwool CavityRock MD

.2 Fibrous Glass Wall Insulation: Unfaced, preformed rigid fibrous glass board insulation manufactured in accordance with CAN/ULC S702, Type 1, thermal resistance not less than RSI 0.77/25 mm; having a flame spread rating of 25 or less, tested in accordance with CAN/ULC S102; density 48 kg/m³; square edges, board size 406 mm x 1220 mm x thickness required to achieve insulation value indicated on Drawings:

.1 Acceptable Materials:

- Johns Manville InsulShield I/S 300
- Owens-Corning Fiberglas 703

.3 Polyisocyanurate Wall Insulation: Foil faced polyisocyanurate, preformed rigid insulation manufactured in accordance with CAN/ULC S704, Type 1, Class 2 having LTTR RSI $\geq 1.05/25$ mm; with Flame Spread/Smoke Density Classification <100/<450 in accordance with CAN/ULC S102; square edges, board size to manufacturers maximum standard x thickness required to achieve insulation value indicated on Drawings:

.1 Acceptable Materials:

- Atlas Energy Shield
- IKO Enerfoil ISO
- Johns Mansville AP Foil Faced

.3 Perimeter Grade Beam Insulation: Closed cell extruded polystyrene foam insulation manufactured in accordance with CAN/ULC S701, Type 4; thermal resistance not less than RSI 0.80/25 mm; square edges, board size 610 mm x 2440 mm x thickness required to achieve insulation value indicated on Drawings; minimum compressive strength 210 kPa at 10% deformation in accordance with ASTM D1621, water absorption (% by volume) maximum 0.7% in accordance with ASTM D2842:

.1 Acceptable Materials:

- .1 Dow Styrofoam SM
- .2 Owens-Corning Foamular C-300

2.03 ACCESSORIES

.1 Perimeter Insulation Fasteners:

.1 Mechanical Fasteners: High quality, impact resistant plastic insulation or galvanized metal insulation stay and fastener system specifically designed for installation of board insulation with self-drilling concrete screw as applicable; minimum 45 mm diameter, screw length and diameter to suit insulation thickness, corrosion protected fastener, and as follows:

.1 Acceptable Materials: Installation specific substitutions will be considered for this material:

- DekFast ES Insulation Assembly
- EJOT, ejothrm STR Assembly
- ITW Grid-Mate Flat Backed Washer
- Hilti Insulation Plate

.2 Perimeter Insulation Accessories: Coordinate supply of end closures and flashings for perimeter insulation system with Section 07 62 00 and manufacturer recommended accessories required for complete installation as follows:

- .1 Membrane Air and Vapour Barrier: Refer to Section 07 25 13 for membrane type.
 - .2 Paint: Exterior grade, latex based concrete paint as specified in Section 09 91 00 – Painting.
 - .3 Gaskets to Adjacent Substrates: Standard type suitable for use with system, permanently resilient; ultraviolet and ozone resistant; colour to match adjacent colour
 - .4 Sealants to Adjacent Substrates: Refer to Section 07 92 00, non-staining, non-shrinking and non-sagging type compatible with substrate materials; colour as selected by Consultant.
 - .5 Perimeter Insulation Fasteners: Concrete faced insulation manufacturer's standard concealed fasteners with groove mounting plate and fastening spline.
- .3 Protection Board: Pre-moulded, semi-rigid asphalt/fibre composition board, minimum 6 mm thick, formed under heat and pressure as recommended by board insulation manufacturer for below grade installations.

3. EXECUTION

3.03 EXAMINATION

- .1 Examine substrates and conditions for compliance with requirements for Sections in which substrates and related work are specified and other conditions affecting performance.
- .2 Verify that all surfaces which are to receive rigid insulation are clean, free of deleterious matter and are sufficiently level to allow the proper installation of insulation.
- .3 Verify that all flashings provided under other Sections are installed and that they divert moisture to exterior of insulated systems.

3.04 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.

3.05 INSTALLATION

- .1 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 and that has not been left exposed at any time to ice and snow.
 - .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, refer to Section 07 25 19.
 - .2 Butt edges and ends tight.
 - .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 single layer of insulation to produce thickness indicated, unless multiple layers are otherwise specifically shown or required to make up total thickness.
 - .6 Fit insulation firmly against substrate using mechanical fasteners spaced in accordance with manufacturers recommended spacing and pattern; in addition, adhere insulation to uneven substrate surfaces and provide additional fasteners to eliminate air spaces between insulation and substrate.
 - .7 Mechanically fasten insulation boards 50 mm in from edges at 300 mm centres.

- .3 Leave insulation joints unbonded over line of expansion and control joints; bond a continuous 150 mm wide strip of primary vapour membrane over expansion and control joints using compatible adhesive.
 - .4 Protect insulation from damage until it is covered; replace any broken, sunburned, crushed or dented insulation immediately prior to covering; coordinate with backfilling operations.
- .2 Cavity Wall Insulation: Fit courses of insulation between wall ties and other confining obstructions in cavity; butt edges tightly in vertical and horizontal directions and as follows:
- .1 Install cavity insulation with a tight fit to substrate materials, provide adhesive and additional fasteners where uneven substrates cause air spaces behind insulation; apply adhesive to substrate in a continuous film not less than 3 mm thick when wet and bed the insulation into adhesive before adhesive loses its tack or skins-over.
 - .2 Apply insulation fasteners using a minimum of six (6) fasteners in two rows located near the centre of the board along the narrow dimension and near the third points along the long dimension; secure boards with two clips at the centre where both dimensions are less than 600 mm.
 - .4 Install insulation clips to walls before sheet membrane vapour retarders are applied.
- .3 Perimeter Grade Beam Insulation: Install board insulation to vertical surfaces with adhesive applied in accordance with manufacturer's written instructions, and as follows:
- .4 Interior Application: Extend boards as indicated on Drawings, installed on inside face of perimeter foundation walls
 - .5 Exterior Application: Extend boards as indicated on Drawings, installed on exterior face of perimeter foundation wall
 - .6 Apply adhesive to the substrate by the "dab" method not less than 10 mm x 20 mm size at 150 mm centres; bed the insulation in the adhesive before the adhesive loses its tack or skins over.
 - .7 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.

3.04 PROTECTION

- .2 Protect installed board insulation from damage due to harmful weather exposures, physical abuse, and other causes.
- .3 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**1.01 SUMMARY**

- .1 This Section includes requirements for supply and installation of air and vapour membranes that prevent exfiltration and infiltration between interior and exterior of building through wall and roof transition construction under all conditions of air pressure differentials forming an integral part of the building enclosure installed intact and continuous on warm side of exterior insulated walls.

1.02 REFERENCE STANDARDS

- .1 American Society for Testing of Materials (ASTM International):
 - .1 ASTM D146-04 (2012)e1, Standard Test Methods for Sampling and Testing Bitumen-Saturated Felts and Woven Fabrics for Roofing and Waterproofing
 - .2 ASTM D412-06ae2, Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers – Tension
 - .3 ASTM D1970/D1970M-11, Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection
 - .4 ASTM E96/E96M-10, Standard Test Methods for Water Vapor Transmission of Materials
 - .5 ASTM E283-04 (2012), Standard Test Method for Determining the Rate of Air Leakage through Exterior Windows, Curtain Walls, and Doors under Specified Pressure Differences across the Specimen
 - .6 ASTM E2178-11, Standard Test Method for Air Permeance of Building Materials
 - .7 ASTM E2357-11, Standard Test Method for Determining Air Leakage of Air Barrier Assemblies
- .2 Canadian General Standards Board (CGSB):
 - .1 CAN/CGSB 37-GP-56M, Membrane, Modified, Bituminous, Prefabricated, and Reinforced for Roofing

1.03 ADMINISTRATIVE REQUIREMENTS

- .1 Pre-Construction Meeting: Arrange a pre-construction meeting 1 week before commencing work of this Section in accordance with Section 01 00 06 – General Requirements: Project Meetings to discuss installation requirements of specified air and vapour membrane systems, manufacturer's site review attended by Contractor for work of this Section, Consultant, manufacturer's technical representative and others affected by work of this Section.
- .2 Coordination: Coordinate interface of membranes specified in this Section with adjacent systems to ensure continuity of system and that junctions between various components are effectively sealed; verify with manufacturers and installers for installation procedures of materials incorporated into air and vapour membrane elements including membranes, transitions, coatings and sealants and continuity with roofing membrane.

1.04 SUBMITTALS

- .1 Provide required information in accordance with Section 01 00 06 – General Requirements: Submittals.
- .2 Action Submittals: Provide the following submittals before starting any work of this Section:
 - .1 Product Data: Submit manufacturer's product literature, and installation instructions required for complete and proper installation of air and vapour retarder elements including membranes, primers, fasteners, proprietary application equipment, and detailing requirements to suit specific project installation.

- .2 Samples: Submit representative sample of air and vapour membrane minimum 300 mm x 300 mm with factory applied identification clearly visible.

1.05 QUALITY ASSURANCE

- .1 Qualifications: Provide proof of qualifications when requested by Consultant:
 - .1 Manufacturer: Obtain air and vapour membrane materials through one source from a single manufacturer or using materials from a secondary source that are acceptable to the manufacturer.
 - .2 Installer: Use an installation company that is acceptable to the manufacturer, using workers who are trained and approved by the membrane manufacturer having experience with projects of similar complexity and area.

1.06 DELIVERY, STORAGE, AND HANDLING

- .1 Delivery and Acceptance Requirements: Deliver materials to job site in original unopened packages, clearly marked with manufacturer's name, material brand name and description of contents.
- .2 Storage and Handling Requirements: Protect membrane materials before, during and after installation in accordance with manufacturer's requirements for weight, temperature, heat and flame, and humidity; store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by membrane manufacturer.

1.07 SITE CONDITIONS

SPEC NOTE: Manufacturer's use the following formula to establish apparent air temperature for installation of liquid applied products and self adhering membranes when minimum actual temperatures are approaching the manufacturer's minimum temperature threshold. $T = t - (W/2)$, where:

T is apparent air temperature,

t is outside air temperature (°C) to the nearest whole degree,

W is wind speed in mph. If wind speed is in km/h, multiply by 1.6 first.

Example #1:

Manufacturer's temperature threshold: 5°C

Outside air temperature: 5°C

Wind speed: 25 MPH

Formula: $T = 5°C - (25/2)$

$T = -7.5°C$, use manufacturer's Cold Temperature membrane.

Example #2:

Manufacturer's temperature threshold: 5°C

Outside air temperature: 10°C

Wind speed: 12 km/h

Formula: $T = 10°C - [(12*1.6)/2]$

$T = +0.4°C$, use manufacturer's Cold Temperature membrane.

- .1 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.

1.08 WARRANTY

- .1 Manufacturer's Warranty: Submit manufacturer's warranty stating that air and vapour membranes and accessories are free of defects and are manufactured to meet manufacturer's published physical properties and material specifications as of the date of product delivery.

- .2 Installer's Warranty: Submit installers warranty stating that air and vapour membranes 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

2.01 MANUFACTURERS

- .1 Acceptable Materials Manufacturers: Subject to compliance with requirements specified in this Section; where multiple listings of manufacturers occur, use any of the following listed manufacturers' products in accordance with Section 01 00 06 – General Requirements: Substitutions and Product Options including the following:
 - .1 Henry Company Canada
 - .2 GCP Advanced Technologies Construction Products
 - .3 IKO Industries Ltd.
 - .4 Soprema
 - .5 Tremco
 - .6 W.R. Meadows
- .2 Substitutions: Consultant may consider additional manufacturers having similar products to Acceptable Materials Manufacturers listed above during the construction period, provided they meet the performance requirements established by the named products and provided they submit requests for substitution in accordance with Section 01 00 06 – General Requirements: Substitutions and Product Options before starting any work of this Section:
 - .1 Do not use substitute materials to establish Bid Price.
 - .2 Substitutions that appear as a part of the project without review and acceptance by the Consultant will be rejected, and replaced with one of the specified materials.

2.02 PERFORMANCE REQUIREMENTS

- .1 Provide materials and installations that meet the following material and assembly performance ratings, and as follows:
 - .1 Material Performance: Provide materials having an air permeance rating not exceeding 0.02 l/sec-m² measured at 75 Pa pressure differential in accordance with ASTM E2178; and having a vapour permeance rating not exceeding 3.5 g/sec-m² in accordance with ASTM E96.
 - .2 Assembly Performance: Install materials and accessories to provide a continuous air and vapour membrane assembly having an air leakage rate not exceeding 0.20 l/sec-m² measured at 75 Pa pressure differential in accordance with ASTM E2357; that will perform as the primary drainage plane flashed to direct condensation or water penetration to the exterior; that will accommodate movement of building materials and building expansion and contraction; and that has appropriate accessory materials to account for changes in substrate, transitions and other perimeter conditions.
 - .3 Low Temperature Performance: Modify acceptable material listings and provide manufacturer's low temperature or ultra-low temperature membrane products when installation conditions are scheduled to occur at or below installation temperature range of specified materials.

SPEC NOTE: Coordinate with drawings as to the proper wording of the air and vapour membrane. Also, coordinate drawings to include standardized drawing abbreviations where more than one system of air vapour membrane is being requested.

2.03 AIR AND VAPOUR MEMBRANE ASSEMBLY

- .1 Primers and Undercoats: Manufacturer's recommended primer or surface conditioner to improve bond between membranes to substrates having VOC content meeting or less than required for project sustainability requirements.

SPEC NOTE: Select one of the following membrane systems, or a combination of membrane systems identified by a schedule on drawings where more than one system is required. Substrate type, skill of installers and availability of materials at location of installation, and environmental conditions at time of installation is factors that need to be accounted for when making material selection. Contact your local representative for guidance in making the appropriate selection.

Torch applied membranes tend to have the best envelope performance characteristics and should be used for buildings having interior relative humidity levels greater than 40%, but can be used on other building types where installation selection criteria indicate that this material is preferred at the location of installation.

- .2 Torch Applied Membrane: Torch grade SBS modified bitumen reinforced membrane; having low temperature formulation appropriate for installation requirements; tested in accordance with ASTM E96 and ASTM E2178, and having the following nominal properties:
 - .1 Low Temperature Flexibility: Less than -20°C
 - .2 Nominal Thickness: 2.5 mm
 - .3 Acceptable Materials:
 - .1 Henry Blueskin TG
 - .2 IKO AquaBarrier TG
 - .3 Soprema Sopraseal 60 F/F

SPEC NOTE: Liquid applied membranes have good performance when encountering moist and sometimes wet substrate conditions and require less skilled workers for installation. Overall performance of liquid applied membranes is similar to that of torch applied, without the requirement for special training and certificates required for personnel handling flame equipment. This material has a wide range of acceptable performance ranges and can be used on buildings having low, medium or high interior relative humidity. The biggest advantage of liquid applied membranes is their ability to provide a seamless installation with the least amount of labour impact to the project. This system inherently maintains membrane continuity better than sheet membranes where there are multiple membrane penetrations, such as at masonry veneer ties.

- .3 Liquid Applied Membrane: Single component, liquid applied elastomeric bituminous or synthetic rubber coating, trowel or spray applied free of VOC's that could affect project sustainability requirements; having low temperature formulation appropriate for installation requirements; tested in accordance with ASTM E96 and ASTM E2178, and having the following nominal properties:
 - .1 Low Temperature Flexibility: Less than -20°C
 - .2 Nominal Thickness: 1.0 to 1.5 mm cured film thickness
 - .3 Acceptable Materials:
 - .1 Henry Air-Bloc 32
 - .2 GCP Applied Technologies Perm-A-Barrier Liquid
 - .3 Soprema Sopraseal LM 200 S
 - .4 Tremco ExoAir 120
 - .5 W.R. Meadows Air-Shield LM

Self adhering membranes have good performance when temperatures are at 5°C and rising, and can be used for buildings having interior relative humidity levels less than 40%, making this material applicable for most commercial installations and selected institutional installations. Self adhering membranes are not generally compatible with torch grade materials – confirm with manufacturers where mix-and-match systems are being considered.

- .4 Self Adhering Membrane: Self adhering SBS modified bitumen reinforced membrane; having low temperature formulation appropriate for installation requirements; tested in accordance with ASTM E96 and ASTM E2178, and having the following nominal properties:
 - .1 Low Temperature Flexibility Less than -20°C
 - .2 Nominal Thickness: 1.0 mm
 - .3 Acceptable Materials:
 - .1 Henry Blueskin SA
 - .2 GCP Applied Technologies Perm-A-Barrier Wall Membrane
 - .3 IKO AquaBarrier AVB
 - .4 Soprema Soprastick 1100T
 - .5 Tremco ExoAir 110
 - .6 W. R. Meadows Air-Shield
- .5 Through Wall Flashing Membranes: Self adhering SBS modified bitumen reinforced membrane with cross-linked polyethylene or alskins, specifically manufactured for use as through wall flashing or dampproofing course; and having the following nominal properties:
 - .1 Service Temperature Range: -40°C to +80°C
 - .2 Thickness: 1.0 mm
 - .3 Acceptable Materials:
 - .1 Henry Blueskin TWF
 - .2 GCP Applied Technologies Perm-A-Barrier Wall Flashing
 - .3 IKO AquaBarrier TWF
 - .4 Soprema Sopraseal Stick 130-S
 - .5 Tremco ExoAir TWF
 - .6 W.R. Meadows Air-Shield Thru-Wall Flashing

SL: Short parapets are sometimes detailed with a double vapour barrier (roof membrane on roof side and vapour impermeable membrane on the building face) which can lead to rapid deterioration of steel studs, plywood, and sheathing. One solution is a vapour permeable air barrier membrane and liquid water barrier on the outside building face from the roof deck to the top of parapet, such as Bakor's Blueskin VP160.

2.04 ACCESSORIES

- .1 Waterproofing Mastic: Manufacturer's recommended trowel applied waterproofing mastic containing compatible modified bitumen, fibres and mineral fillers having VOC content meeting or less than required for project sustainability requirements.
- .2 Roof-to-Wall Transition Membranes: Manufacturer's recommended reinforced self adhesive, torch grade membrane where required, compatible with roofing air and vapour membranes and wall materials specified in this Section.
- .3 Opening Transition Membranes: Manufacturer's recommended reinforced, self adhesive membrane compatible with adjacent materials, and air and vapour membranes specified in this Section.
- .4 Through Wall Membranes: Manufacturer's recommended reinforced self adhesive, torch grade membrane where required, compatible with air and vapour membrane and that will not become plastic and extrude onto finished surfaces when exposed to high wall temperatures.

3. EXECUTION**3.01 EXAMINATION**

- .1 Examine conditions of substrates and other conditions affecting this Section before starting work; notify other related trades and verify that substrates are complete and ready for installation of products specified in this Section.

3.02 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 and as follows:

SPEC NOTE: Delete components that are not used for the project from the following listing of assemblies.

- .1 Exterior Gypsum Sheathing Panels: Verify that boards are sufficiently stabilized with corners and edges fastened with appropriate screws; pre-treat board joints with reinforced self-adhesive tape or fibreglass mesh tape; fill gaps wider than 6 mm with mastic or sealant and allow sufficient time to fully cure before applying tape and liquid applied membrane.
- .3 Masonry Substrates: Apply air and vapour barrier membranes to masonry substrates having smooth flush mortar joints; fill voids and holes with lean mortar mix, non-shrinking grout or parge coat.
- .4 Adjacent Materials: Treat construction joints and install flashings as recommended by manufacturer.
- .2 Apply primer to substrates when required by manufacturer at rate recommended by manufacturer; cover primed substrates on same day, reapply primer when work cannot be completed on the same day.

3.03 INSTALLATION

- .1 Install air and vapour membranes in accordance with manufacturer's written requirements, using appropriate equipment and skilled workers and as follows:
 - .3 Holes and Tears: Repair holes and tears with compatible membrane materials; overlap affected surface area by a minimum of 100 mm and seal edges of repair with manufacturer's recommended mastic material.
 - .4 Transition Membranes: Connect air and vapour membranes to adjacent assemblies having pre-installed transition membranes at openings and other assemblies; install transition membranes where required to maintain continuity of building envelope.
 - .5 Corner Details and Protrusions: Cover inside corners and protrusions, centred and installed in direct contact with the substrate with no voids under the membrane strip; reinforce outside corners by double lapping or stripping as required by membrane manufacturer.
 - .6 Through Wall and Flexible Flashings: Install flexible membranes where required to maintain flow direction to divert water away from face of building envelope.
- .2 Separate air and vapour membranes from incompatible materials, and provide manufacturer's recommended transition materials required to maintain continuity of building envelope.
- .3 Inspect membrane installation at end of each day of work and before installation of insulation; seal upper edge of membrane with mastic at end of day's work when precipitation is anticipated or when work is expected to be delayed or interrupted by more than one day.

3.04 SITE QUALITY CONTROL

- .1 Allow access for inspection and testing of installed air and vapour membranes, and repair of deficiencies before placement of insulation materials.
- .2 Site Testing and Inspection: Inspection and testing fees will be paid by the City in accordance with Section 01 00 06 – General Requirements: Quality Control in advance of when assemblies will be ready for inspection and testing and as follows:
 - .3 Building envelope inspector will arrange for a pre-installation meeting attended by the Consultant, Contractor, manufacturer's technical personnel and other subcontractors affected by the work of this Section.
 - .4 Consultant will make a visual inspection only.
 - .5 Cooperate with building envelope inspector; repair or replace air and vapour membrane system as directed by inspector.
- .3 Manufacturer's Site Services: Arrange for air and vapour membrane manufacturer's technical personnel to review building envelope during installation as follows:
 - .3 Provide training and supervision of personnel who will install membrane systems and coordinate other subcontractors affected by work of this Section
 - .4 Provide frequent visits during the progress of the work to assure quality and competence of membrane installation in accordance with manufacturer's instructions
 - .5 Verify surface conditions prior to installation to
 - .6 Verify that workmanship requirements are being met during installation and to provide technical assistance and installation guidance as necessary to ensure a complete and continuous membrane assembly
 - .7 Verify that installation meets requirements of manufacturer's warranty after completion of membrane system
 - .8 Submit written report of site activities, directions for correction of installed membranes, detailing and any special installation requirements resulting from site conditions different than manufacturer's standard details
- .4 Non-Conforming Work: Repair or replace non-conforming work at no additional expense to the Project.

3.05 CLOSEOUT ACTIVITIES

- .1 Protection: Protect membrane as recommended by manufacturer from effects of long term exposure where membrane is open to the environment for prolonged time periods using opaque plastic sheets or tarpaulins; protect membrane from penetrations and damage by successive components of the Work; assign payment for repairs to responsible parties; make repairs in accordance with manufacturer's written instructions using original installers.
- .2 Cleaning: Remove masking materials, debris, excess materials and equipment from site at completion of the work; conduct ongoing daily cleaning as directed by the Contractor; clean stains, drips or spills of coatings, sealants, mastic or primers visible on finished surfaces.

END OF SECTION

1. GENERAL**1.01 SUMMARY**

- .1 This section includes requirements for supply and installation of a spray polyurethane foam air and vapour seal system, and other components to bridge and seal the following air leakage pathways and gaps between; but not limited to, the following:
- .1 Connections of the walls to the roof air seal.
 - .2 Connections of the walls to the foundations.
 - .3 Expansion joints.
 - .4 Openings and penetrations.
 - .5 Piping, conduit, duct and similar penetrations.
 - .6 All other air leakage pathways in the building envelope.

1.02 DEFINITIONS

- .1 The following definitions apply to the Foamed-In-Place Air and Vapour Barrier specification:
- .2 HCFC Free: Zero Global Warming, Zero Ozone Depletion (ODP) in compliance with Montreal Protocol requirement to eliminate production of HCFC 141b; products using HFC-245fa will be given preference over all other products.
- .3 LTTR (Long Term Thermal Resistance): Defined as using techniques from CAN/ULC S770 predicting foam's insulating value that has been shown to be equivalent to the average performance of a permeably faced foam insulation product over 15 years.

1.03 REFERENCE STANDARDS

- .1 American Society for Testing and Materials (ASTM):
- .1 ASTM D146-04 (2012)e1, Standard Test Methods for Sampling and Testing Bitumen-Saturated Felts and Woven Fabrics for Roofing and Waterproofing
 - .2 ASTM D412-06ae2, Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers – Tension
 - .3 ASTM D1970/D1970M-11, Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection
 - .4 ASTM E96/E96M-10, Standard Test Methods for Water Vapor Transmission of Materials
 - .5 ASTM E283-04 (2012), Standard Test Method for Determining the Rate of Air Leakage through Exterior Windows, Curtain Walls, and Doors under Specified Pressure Differences across the Specimen
 - .6 ASTM E2178-11, Standard Test Method for Air Permeance of Building Materials
 - .7 ASTM E2357-11, Standard Test Method for Determining Air Leakage of Air Barrier Assemblies
- .2 Canadian Urethane Foam Contractors Association (CUFCA):
- .1 CUFCA Quality Assurance Program, Licensed Contractor Program and Installer Certification Program
 - .2 CUFCA Site Installer Reference Guides
- .3 Canadian General Standards Board (CGSB):
- .1 CAN/CGSB 37-GP-56M, Membrane, Modified, Bituminous, Prefabricated, and Reinforced for Roofing

1.04 ADMINISTRATIVE REQUIREMENTS

- .1 Pre-Construction Meeting: Arrange a pre-construction meeting with attended by the City, Contractor, Subcontractor, manufacturer's factory trained agent and other subcontractors affected by the work of this Section as follows:
 - .1 Convene one (1) week before commencing work of this Section to discuss coordination and installation requirements of specified air and vapour seal system, transitions to adjacent membranes and requirements and location for site constructed mock-up listed below.
 - .2 Sequencing: Sequence work of this Section so that work for closures and substrates are installed before start of work for this Section.

1.05 SUBMITTALS

- .1 Provide required information in accordance with Section 01 00 06 – General Requirements: Submittals.
- .2 Action Submittals: Provide the following submittals before starting any work of this Section:
 - .1 Product Data: Submit manufacturer's product data sheets for each type of material, including manufacturer's printed instructions for evaluating, preparing, and treating substrate, temperature and other limitations of installation conditions, technical data, and tested physical and performance properties.
- .3 Informational Submittals: Provide the following submittals during the course of the work:
 - .1 Company License: Photocopy of Subcontractor's CUFCA license, current for the term of the Contract and listing of certified installers used for the project.
 - .2 Installer Certificates: Photocopies of each installers CUFCA applicator identification cards indicating certification for installation of foamed-in-place materials as thermal insulation, and as air and vapour barriers.
 - .3 Onsite Documentation and Installation Instructions: Make manufacturer's installation instructions and daily testing reports available for viewing when requested by City during installation period of materials specified in this Section.
 - .4 Material Certificates: Submit certificate of compatibility by foamed-in-place insulation manufacturer, listing all materials on the project that it connects to or that come in contact with it, and documentation confirming that materials meet requirements for an air and vapour barrier.
 - .5 Source Quality Control Submittals: Submit testing results performed by an accredited laboratory confirming material has been tested and conforms to the requirements listed Reference Standards.
 - .6 Site Quality Control Submittals: Submit SPF Quality Assurance Program (QAP) documentation and reports in accordance with requirements listed in this Section at completion of work.

1.06 QUALITY ASSURANCE

- .1 Regulatory Requirements: Provide insulations that meet requirements for non-ozone depleting materials as regulated in the Montreal Protocol adopted by the United Nations Environmental Program and that have been tested in accordance with CAN/ULC S102 and CAN/ULC S127, with protective covering installed in accordance with CAN/ULC S124.
 - .1 Manufacturer: Obtain foamed-in-place insulation materials from a single manufacturer regularly engaged in manufacturing the products specified in this Section and that manufacturer's material conforming to the requirements of CAN/ULC S705.1.

- .2 Subcontractor: Use only Subcontractor that are licensed by CUFCA as required by CAN/ULC S705.2.
 - .3 Installers: Use companies having trained and certified installers in accordance with CAN/ULC S705.2 and by the foamed-in-place insulation manufacturer.
 - .2 Certifications: Provide proof of the following during the course of the Work:
 - .1 Quality Assurance Program: Arrange for onsite daily inspections and testing, documentation and reporting in accordance with CUFCA SPF Quality Assurance Program (QAP) as mandated by CAN/ULC S705.2.
 - .2 Additional QA Agencies: Other Quality Assurance Agencies such as Morrison Hershfield or ITS may be acceptable to the City provided that information indicating equivalency to CUFCA SPF QAP is provide before starting work of this Section.
- 1.07 DELIVERY, STORAGE, AND HANDLING
- .1 Delivery and Acceptance Requirements: Deliver materials to Project site in original packages with seals unbroken, labelled with manufacturer's name, product, date of manufacture, expiration date, and directions for storage.
 - .2 Storage and Handling Requirements: Store materials in their original undamaged packages in a clean, dry, protected location and within temperature range required by air and vapour seal manufacturer, and as follows:
 - .1 Protect stored materials from direct sunlight.
 - .2 Avoid spillage; immediately notify City if spillage occurs and start clean up procedures; clean spills and leave area as it was prior to spill.
- 1.08 SITE CONDITIONS
- .1 Ambient Conditions: Apply air and vapour seal within range of ambient and substrate temperatures recommended by air and vapour seal manufacturer; do not apply air and vapour seal to frozen, damp or wet substrates.
- 1.09 WARRANTY
- .1 Special Warranty: Provide CUFCA SPF QAP accepted third party warranty covering required correction to any defects and deficiencies in materials and workmanship for a period of two (2) years with term commencing on date of Substantial Performance for the Work of the Project.
- 2. PRODUCTS**
- 2.01 MANUFACTURERS
- .1 Acceptable Materials Manufacturers: Subject to compliance with requirements specified in this Section; where multiple listings of manufacturers occur, use any of the following listed manufacturers' products in accordance with Section 01 00 06 – General Requirements: Substitutions and Product Options including the following:
 - .1 BASF The Chemical Company
 - .2 CertainTeed-Saint Gobain
 - .3 Demilec Canada
 - .4 Johns Manville
 - .5 Lapolla Canada

- .2 Substitutions: City may consider additional manufacturers having similar products to Acceptable Materials Manufacturers listed above during the construction period, provided they meet the performance requirements established by the named products and provided they submit requests for substitution in accordance with Section 01 00 06 – General Requirements: Substitutions and Product Options before starting any work of this Section:
- .1 Do not use substitute materials to establish Bid Price.
 - .2 Substitutions that appear as a part of the project without review and acceptance by the City will be rejected, and replaced with one of the specified materials.

2.02 MATERIALS

- .1 Spray Applied Polyurethane Foam: Two component, polyurethane resin and polyol, closed cell foamed-in-place insulation containing recycled materials in accordance with CAN/ULC S705.1, Type 2 and having the following minimum properties:
- .1 Vapour Permeance: Less than $60 \text{ ng/P}\cdot\text{s}\cdot\text{m}^2$ qualifying as a vapour retarder in applied thicknesses of 50 mm and greater.
 - .2 Air Leakage Rate: Maximum $0.02 \text{ L/s}\cdot\text{m}^2$ at 75 Pa.
 - .3 Long Term Thermal Resistance: Nominal RSI 1.0/25 mm in accordance with ULC S770.
 - .4 Density: Nominal $35 \text{ kg/m}^3 \pm 10\%$ by weight.
 - .5 Closed Cell Content: Minimum 95% in accordance with ASTM D2856.
 - .6 Ozone Depletion Potential: Zero.
 - .7 Global Warming Potential: Low.
 - .8 Volatile Organic Compounds: Zero.
 - .9 Acceptable Materials:
 - .1 BASF Walltite
 - .2 CertainTeed CertaSpray
 - .3 Demilec Heatlok Soya
 - .4 Icynene MD-C-200
 - .5 JM Corbond MCS SPF
 - .6 Lapolla Foam-LOK FL 2000
- .1 Air Seal Thermal Barrier (Flame Spread Protection): Vermiculite-cement based fire resistant material, wet mix spray applied fireproofing meeting requirements of ULC S124, ASTM E736, ASTM E759, ASTM E761 and ASTM E859; containing no asbestos fibre, ULC labelled and listed for assemblies and fire ratings indicated on Drawings, and as follows:
- .1 Water: Potable, clean and free from injurious amounts of deleterious substances.
 - .2 Damming Materials: In accordance with the tested assembly being installed as acceptable to Authorities Having Jurisdiction, and as recommended by manufacturer.
 - .3 Firestopping Mortar: Cementitious, single component fire resistive mortar coating; charcoal colour, tested listed and certified by ULC.
 - .4 Acceptable Materials:
 - .1 Carboline Company, A/D Fire Protection Systems, Cementitious Thermal Barrier, Type 7TB.
 - .2 Isolatak International Inc., Cafco Industries Ltd., Blaze-Shield II.
 - .3 W.R. Grace Construction Materials, Monokote Type Z-3306.
- .2 Equipment: Use equipment recommended by manufacturer for specific type of installation and in accordance with CAN/ULC S705.2.
- .3 Primer: Manufacturer's recommended primer specific to steel and aluminum surfaces subject to forming oils or grease such as steel studs, girts, roof decks, and plastic piping materials.

- .4 Accessories: Manufacturer's recommended materials required for a complete and functioning vapour resistant, air and thermal barrier.

2. EXECUTION

2.01 EXAMINATION

- .1 Examine substrates, areas, and conditions, and verify that surfaces and conditions are in accordance with manufacturer's requirements before starting work of this Section; start of work indicates acceptance of substrates.

2.02 PREPARATION

- .1 Protection of Existing Conditions: Mask and cover adjacent areas; protect other surfaces from overspray and as follows:
 - .1 Verify that any required foam stop or back up materials are in place to prevent over spray and achieve complete seal.
 - .2 Seal off existing ventilation equipment; install temporary ducting and fans to remove exhaust fumes; provide for make-up air.
 - .3 Erect barriers, isolate area and post warning signs to advise non-protected personnel to avoid the spray area.
- .2 Surface Preparation: Clean, prepare, and treat substrate in accordance with CAN/ULC S705.2, manufacturer's written instructions, and as follows:
 - .1 Provide clean, dust free, and dry substrate ready for installation of air and vapour seal.
 - .2 Clean and prime metal and plastic surfaces to remove grease and oil that have potential to impair bond of foamed-in-place materials to substrates in accordance with manufacturer's written requirements.
 - .3 Prime other substrates appropriate to the materials that foamed-in-place foam is being bonded to when recommended by manufacturer.
 - .4 Apply foamed-in-place materials in layers to achieve required bond to transition membranes and to prevent membrane damage arising from exothermic heating; allow for drying time between coats; protect self adhered membranes in accordance with manufacturer's written requirements.
 - .5 Prepare, treat, and seal vertical and horizontal surfaces at terminations and penetrations through air and vapour seal and at protrusions according to air and vapour seal manufacturer's written instructions.

2.03 INSTALLATION

- .1 Air and Vapour Seals: Apply foamed-in-place air and vapour barrier materials so that foam completely fills spaces without voids with foam continuous at corners and junctions, and as follows:
 - .1 Install transition membranes to adjacent surfaces and ensure proper adhesion of the transition membranes to the substrate, compatible with spray polyurethane foam insulation in accordance with manufacturer's written instructions.
 - .2 Install flashings, counter flashings and metal transitions in accordance with manufacturer's written instructions.
 - .3 Spray polyurethane foam air seals when surfaces and environmental conditions are within limits indicated by CAN/ULC S705.2 and manufacturer's written instructions.
 - .4 Finish foam surface free from voids and embedded foreign objects.
 - .5 Remove masking materials and over spray from adjacent areas immediately after foam surface has hardened; clean adjacent surfaces using cleaning methods that do not damage work performed by other Sections.

- .6 Trim any excess thickness that interferes with the application of cladding or covering materials installed by other Sections.
- .7 Tolerances: -6 mm, +10 mm maximum variation from required thickness.
- .8 Installation – Building Perimeter Air Seal: Fill juncture of external walls and roofs with continuous gusset shaped seal extending minimum 150 mm horizontally and vertically from line of juncture and protect with thermal barrier, and at the following additional locations:
 - .1 All joints in perimeter wide flange beam along perimeter.
 - .2 Underside of parapet diagonal bracing intersection to metal decking.
 - .3 Other locations indicated on drawings.
- .9 Installation – Hollow Metal Door Frame Air Seals: Fill hollow metal door frames 75% full with foamed-in-place air and vapour barrier prior to installation of frames, and as follows:
 - .1 Fill the remainder of the frame after installation, through the gap between the frame and the wall construction.
 - .2 Fill frame members as masonry walls are being built at lifts no greater than 1200 mm.
- .10 Installation – Exterior Aluminum Frame Air Seals: Install foamed-in-place air and vapour barrier around perimeter of exterior window and door frames to maintain continuity of the thermal barrier, after air and vapour barrier has been installed and sealed to windows.
- .11 Installation – Protrusions through Building Air and Vapour Seals: Install foamed-in-place air and vapour barrier around protrusions through exterior building envelope to achieve and maintain continuity of air/vapour seal and as follows:
 - .1 Install around hollow structural steel sections (HSS) that protrude through building envelope for a minimum distance of 1200 mm.
 - .2 Apply to interior (warm side) of structural elements to provide an insulation barrier where structural elements are continuous from interior to exterior of building envelope.
- .2 Firestopping System: Cover spray polyurethane foam with thermal barrier applied to thickness and density required to achieve fire resistance rating over spray applied polyurethane foam in accordance with requirements of the Authorities Having Jurisdiction, and as follows:
 - .1 Provide temporary forming or damming as required, and as follows:
 - .1 Use combustible type damming boards for temporary dams only; remove after air seal/firestopping materials are cured.
 - .2 Use non-combustible damming boards for temporary or permanent dams wherever damming cannot be removed after applying air seal/firestopping materials.
 - .2 Remove temporary forming and damming when materials have gained sufficient strength and after initial cure of firestop materials.
 - .3 Install mortar by pumping, trowelling or hand packing into openings to thicknesses required by ULC firestop system; tool or trowel exposed surfaces to smooth even finish.
 - .4 Completely fill and seal voids with air seal/firestop and smoke seal materials; remove excess air seal/firestop material promptly as work progresses and when installation is completed.
 - .5 Allow materials to cure; do not cover up materials until full curing has taken place and City has reviewed the installation.

2.04 SITE QUALITY CONTROL

- .1 Manufacturers Quality Assurance Program: Perform manufacturer's SPF QAP inspections and testing using recognized inspection agency and submit written reports and testing information; include costs for QAP as a part of the work of this Section.
- .2 Site Testing: Notify City when foamed-in-place insulation installations are ready for inspection prior to concealing or enclosing materials specified in this Section:
 - .1 Arrange for inspections required by CAN/ULC S705.2 and include costs for third party testing as a part of the cost for the project.
 - .2 Prepare daily reports required by CAN/ULC S705.2 and submit to City as described in this Section, and to SPF QAP as required by the Quality Assurance Program.
 - .3 Repair foamed-in-place insulation as required to ensure compliance building envelope requirements, and as directed by inspection agency.
- .3 Non-Conforming Work: Repair or replace non-conforming work and re-test to verify that installation meets specified requirements.

2.05 CLOSEOUT ACTIVITIES

- .1 Cleaning: Perform final cleaning in accordance with Section 01 00 06 – General Requirements: Final Cleaning and as follows:
 - .1 Cut back excess foamed-in-place air and vapour barrier once cured flush with surrounding surfaces.
 - .2 Recess foam where application of sealants is required.
 - .3 Clean adjacent surfaces of overspray and dusting.

END OF SECTION

1. GENERAL

1.01 RELATED REQUIREMENTS

- .1 Section 07 25 13 – Air and Vapour Membranes

2. PRODUCTS

2.01 MATERIALS

- .1 Building Paper: Asphalt impregnated kraft paper manufactured from virgin cellulose and having a 30 minute moisture resistance rating meeting the requirements of CGSB 51.32, including 35 mm long screw fasteners having 50 mm diameter plastic caps.

3. EXECUTION

3.01 INSTALLATION

- .1 Install two (2) layers of building paper air barrier sheets in direct contact with exterior side of exterior wall sheathing before windows and doors are installed; eliminate any voids behind air barrier by wrapping sheet materials over projections or recesses in wall construction.
- .2 Install starting from lowest portion of wall area working towards upper areas so that layers are shingled over preceding layers to divert water away from exterior wall sheathing materials as follows:
 - .1 Wrap corners of building with a minimum overlap of 300 mm.
 - .2 Overlap horizontal seams a minimum of 100 mm.
 - .3 Overlap vertical seams a minimum of 150 mm.
 - .4 Install second layer of building paper air barrier sheets having an offset of 50% of roll width and same corner and seam overlap widths as the first layer.
- .3 Attach air barrier to sheathing using plastic capped screws placed at a maximum vertical spacing of 450 mm o/c along each stud line.
- .4 Cut window and door rough openings as follows:
 - .1 Windows:
 - .1 Cut modified "I" pattern in the air barrier sheet.
 - .2 Cut horizontally along bottom of header.
 - .3 Cut vertically down centre of opening from top down to 2/3 of the way to the bottom.
 - .4 Cut diagonally from bottom vertical cut to left and right corners of opening.
 - .5 Fold side and bottom flaps into window opening and fasten at 150 mm o/c and trim off excess material.
 - .2 Doors:
 - .1 Cut standard "I" pattern air barrier sheet.
 - .2 Cut horizontally along bottom of door frame header and along top of sill.
 - .3 Cut vertically cut down the centre of door openings from header to sill.
 - .4 Fold side flaps inside around door openings and fasten at 150 mm o/c and trim off excess material.

- .5 Tape horizontal and vertical seam using manufacturer's recommended seaming tape; seal tears and cuts using manufacturer's recommended repair materials and methods.

END OF SECTION

1. GENERAL**1.01 SUMMARY**

- .1 Composite Roof Board/Base Sheet: Factory-laminated high performance insulating base sheet panel composed of SBS modified bitumen membrane, high-density fibreboard support panel and a polyisocyanurate insulation board.
- .2 Torch Applied Cap Sheet: Fully adhered conventional roofing system with 2 ply assembly of pre-manufactured SBS modified bituminous roofing membrane over primary and membrane underlayment, vapour retarder adhered to gypsum board sheathing on steel deck as indicated on drawings.

1.02 ADMINISTRATIVE REQUIREMENTS

- .1 Coordination: Coordinate placement of acoustical insulation or premanufactured fire stop in steel deck flutes immediately prior to roofing installation.
- .2 Pre-Construction Meetings: Include required participants and an outline agenda for meeting in accordance with Section 01 00 06 – General Requirements: Project Meetings.
 - .1 Arrange a pre-construction meeting in accordance with Section 01 00 06 – General Requirements: Project Meetings.
 - .2 Include the roofing manufacturer's representative, roofing Subcontractor's representative, the roofing inspector, Contractor, the Owner and the Consultant.
 - .3 The purpose of this meeting is to review installation conditions particular to this project and review materials specified in this section.
 - .4 The roofing inspector will complete the minutes and prepare a report for this meeting.

1.03 SUBMITTALS

- .1 Provide required information in accordance with Section 01 00 06 – General Requirements: Submittals.
- .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 air and vapour retarders specified under Section 07 25 13; submit a written declaration to the Consultant that roofing materials and components are compatible with wall air and vapour retarder membranes when requested by Consultant.
 - .2 Site Quality Control Submittal: Submit certification indicating that components used in the roofing system are supplied and warranted by a single source manufacturer.
 - .3 Submit a report, issued by a certified materials testing laboratory, attesting that the specified roofing system was tested in accordance with CSA A123.21-10.

- .4 Wind Uplift Certificate: Submit written certification prepared by roofing materials manufacturer certifying that roofing system installed meets specified wind uplift performance requirements.

1.04 QUALITY ASSURANCE

- .1 Conform to Roofing Application Standards Manual as published by Alberta Roofing Contractors' Association Ltd. (ARCA) as a reference. Only materials listed in the ARCA Manual will be acceptable for use on this project.
- .2 Execute work by an installer approved by the ARCA as a member in good standing at time of Bid submission and during execution of Work, and capable of issuing a five (5) year Certificate of Assurance.
- .3 Installer must maintain a full time experienced journeyman roofer, and at least one apprentice per crew on the Work at all times and as follows:
 - .1 The roofing Subcontractor and his sub-subcontractors must have "Approved Contractor" status by the roofing product manufacturer. Only skilled and certified trade persons, officially employed by a roofing Subcontractor operating adequate and necessary equipment, must be authorized to perform all roofing work.
 - .2 Crew members using torches must be trained under a recognized training program and certified from the manufacturer of materials being installed. Only competent, qualified tradesmen, using adequate plant and equipment, must execute the Work of this Section.

1.05 FIRE PROTECTION

- .1 Protect roof junctions at parapets, roof curbs and upstands with a fire resistant tape or barrier to prevent combustible materials within assemblies from ignition arising from the use of torches. Install prior to installation of base sheets.
- .2 Use a heat detector gun to spot any smouldering or concealed fire at the end of each work day. Establish a minimum one hour fire watch after torch application.
- .3 Do not apply torch directly to dry or unprotected wood surfaces.
- .4 Maintain a clean site and have one approved ABC fire extinguisher within 6 meters of each roofing torch. Respect all safety measures described in manufacturer's technical data sheets. Do not place torches near combustible or flammable products.

1.06 DELIVERY, STORAGE AND HANDLING

- .1 Deliver materials to the project site; handle and store in original packages and containers with manufacturer's seals and labels intact. Manufacturer's name, brand, mass, specification number and lot number must be shown on the labels.
- .2 Store materials in weatherproof shelters having floors that will protect the materials from moisture. Store materials on end. Avoid prolonged exposure of light or heat sensitive materials to sunlight.
- .3 Do not store materials on roof in concentrations that exceed design live load.
- .4 Place plywood runways over the Work to enable the movement of materials and other traffic during construction of roofing.
- .5 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.

- .6 In the event of materials damage by the elements, improper handling or other causes, such materials will be rejected and will be replaced at no extra cost to the Owner. Remove rejected materials promptly from the site.
- .7 During roofing work, exposed surfaces of finished walls must be protected with tarp to prevent damage. Assume full responsibility for damage.

1.07 SITE CONDITIONS

- .1 Minimum ambient application temperature shall not be less than -23°C. Notify Consultant and roofing inspector where installation is required below stated minimum temperature and submit manufacturer's standard cold weather installation practices prior to proceeding with work of this section.

1.08 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: 10 years, Standard, starting from Substantial Performance for the Project.
 - .2 Name of Warrantee: Warrantor shall issue a written and signed warranty identifying the owner's name as the warrantee, and stating that executed work will remain in place and be free of any defects in materials and workmanship for the stated warranty period.
- .2 Special Warranty: Provide an ARCA five (5) year Warranty Certificate.

2. PRODUCTS

2.01 MANUFACTURERS

- .1 Basis-of-Design Materials: Products named in this Section were used as the basis-of-design for the project; manufacturers listed as additional acceptable materials and that offer similar products may be incorporated into the work of this Section provided they meet the performance requirements established by the named products.
 - .1 Basis-of-Design Materials: Soprema Inc.
- .2 Additional Acceptable Materials Manufacturers: Subject to matching of colour and compliance with performance requirements specified in this Section and provided they submit requests for substitution in accordance with Section 01 00 06 – General Requirements: Substitutions and Product Options before starting any work of this Section:
 - .1 IKO Industries Ltd.
 - .2 Siplast
- .3 Substitutions: Consultant may consider additional manufacturers having similar products to Acceptable Materials Manufacturers listed above during the construction period, provided they meet the performance requirements established by the named products and provided they submit requests for substitution in accordance with Section 01 00 06 – General Requirements: Substitutions and Product Options before starting any work of this Section:
 - .1 Do not use substitute materials to establish Bid Price.
 - .2 Substitutions that appear as a part of the project without review and acceptance by the Consultant will be rejected, and replaced with one of the specified materials.

2.02 AUXILIARY LEVELLING SURFACE

- .1 Glass Mat Faced Roof Boards: Non-structural, glass mat faced mould resistant gypsum panels having water resistant core, and as follows:
 - .1 Applicable Standard: ASTM C1177/C1177M for manufacturing; ASTM D3273 for mould resistance.
 - .2 Thickness: 16 mm
 - .3 Surface Burning Characteristics: In accordance with CAN/ULC S102
 - .1 Flame Spread: 0
 - .2 Smoke Developed: 0
 - .4 Long Edges: Square
 - .5 Location: Roof substrates over steel decks and sheathing for parapets.
 - .6 Acceptable Materials:
 - .1 Georgia Pacific DensDeck
 - .2 CertainTeed GlasRoc Sheathing

2.03 ADHESIVES

- .1 Membrane Roofing Materials Adhesive: Cold adhesive-mastic composed of a bituminous binder, added to bonding agents and solvents compatible with specified roofing products.
- .2 Insulation Adhesive: Manufacturers standard adhesives specifically formulated for installation of plastic insulation to roofing materials:
 - .1 Acceptable materials:
 - .1 Insta-Foam Products Inc. Insta-Stik
 - .2 Soprema Duotack Adhesive.
- .3 Gypsum Board Adhesive: Manufacturers standard adhesives specifically formulated for installation of gypsum board to metal deck.

2.04 VAPOUR RETARDER

- .1 Vapour Retarder: Self-adhesive membrane composed of SBS modified bitumen, with a surface screen made of high-density polyethylene laminated between two layers of polyethylene films. The width of the membrane to allow the membrane to fit on the top of most structural steel deck profiles. The self-adhesive underface is protected with a silicone plastic release film.
 - .1 Acceptable Materials:
 - .1 Iko MVP (Modified Vapour Protector)
 - .2 Soprema Sopravap'R
 - .2 Vapour retarder continuity strip: SBS membrane with non-woven polyester reinforcement, glass grid and elastomeric bitumen; Sanded upper surface for exposed areas; underside self-adhesive, compatible with wall and roof air/vapour retarder membranes as recommended by accepted membrane manufacturers below.

2.05 CARPENTRY

- .1 Wood roof materials shall be as specified in Section 06 10 53. Do not use pressure treated materials where SBS membrane materials are adhered to wood fabrications.

2.06 INSULATION

- .1 Primary Flat and Sloped Insulation: Polyisocyanurate foam rigid board roof insulation, in organic glass mat facer, of largest panels practical, having square edges, minimum LTTR RSI 0.99/25 mm, total thickness as indicated on Drawings; sloped to a minimum 2% perpendicular from edge of roof to a minimum thickness of 50 mm; conforming to ULC S704, Type 3, Class 2, to a tolerance not exceeding 3 mm from nominal size in any dimension:

- .1 Acceptable Materials:
- .1 Atlas AC Foam III
 - .2 Johns Manville, E'NRG'Y 3
 - .3 Soprema, Sopra-Iso Plus

2.07 MEMBRANES

- .1 Asphaltic-Support Board and Base Sheet Membrane: Board composed of SBS modified bitumen membrane with a polyester reinforcement, factory-laminated on a semi-rigid asphaltic board. The board measures 0.91 m x 2.44 m (3 ft x 8 ft). The top surface is covered with thermofusible plastic film. The membrane side lap is part self-adhesive and part thermofusible.

- .1 Thickness: 4.8 mm (3/16 in)
- .2 In conformance with: CGSB 37.56-M (9th Draft).
- .3 Properties: MD XD
- .4 Strain energy (kJ/m) 9 7
- .5 Breaking strength (kN/m) 17 12.5
- .6 Ultimate elongation (%) 60 65
- .7 Tear resistance (N) 60
- .8 Static puncture resistance (N) 400
- .9 Dimensional stability (%) -0.4 0.3
- .10 Plastic flow (°C) ≥ 115
- .11 Cold bending at -30°C No cracking
- .12 Lap joint strength (kN/m) Pass > 4 kN/m
- .13 Basis-of-Design Material: Soprema, Soprasmart Board 180

- .2 Base Sheet Membrane for Flashings and Parapets: Membrane composed of SBS modified bitumen and glass mat reinforcement. The surface is covered with a thermofusible plastic film and the underface is covered with a release protection film. The surface shall be marked with three (3) chalk lines to ensure proper roll alignment.

- .1 Applicable Standard: CAN/CGSB 37-GP-56M
- .2 Reinforcement: Non-woven Polyester
- .3 Bitumen: Elastomeric blend of selected bitumen and SBS Polymer
- .4 Mark top face of with lines for required alignment.
- .5 Basis-of-Design Materials: Soprema, Sopraflash Flam stick

- .3 Roofing Cap Sheet Membrane for Field Surfaces: Roofing membrane composed of SBS modified bitumen with a composite reinforcement and elastomeric bitumen. The surface is protected by coloured granules, meeting heat island requirements. The underface is covered with a thermofusible plastic film.

- .1 Applicable Standard: CAN/CGSB 37-GP-56M, in conformance with: ASTM D6162.
- .2 Properties: MD
- .3 Strain energy (kJ/m) 7.8
- .4 Breaking strength (kN/m) 15
- .5 Ultimate elongation (%) 60
- .6 Tear resistance (N) 125
- .7 Static puncture resistance (N) 560

- .8 Dimensional stability (%) 0.2
- .9 Plastic flow (°C) ≥ 110
- .10 Cold bending at -30 °C No cracking
- .11 Lap joint strength (kN/m) Pass > 4 kN/m
- .12 Basis-of-Design Material: Soprema, Sopraply Traffic Cap 560

- .4 Flashing, Stripping and Upstand Membranes: Two-ply reinforced modified bitumen membrane base sheet and cap sheet; base sheet having self-adhering bottom surface and sanded top surface; cap sheet having bottom surface sanded and top surface is protected by coloured granules and having ULC Class C Rating, and as follows:

- .1 Applicable Standard: CAN/CGSB 37-GP-56M, type 1, Class C, grade 2
- .2 Reinforcement: Non-woven polyester
- .3 Elastomeric Bitumen: Mix of selected bitumen and SBS polymer
- .4 Protection: Coloured Granules – Bright White
- .5 Basis-of-Design Materials:
 - .1 Base Sheet: Soprema Sopraflash Stick
 - .2 Cap Sheet: Soprema Soprastar Flam HD GR

2.08 FASTENERS

- .1 Roofing fasteners to steel decking: Cadmium plated flat headed, self tapping screws, N°12 of Type A primer AB, in conformance with CSA B35.3.
- .2 Insulation fasteners to decking: Screws and stress plates, galvanized steel, minimum 50 mm diameter spaced one per 0.25 m², penetrating a minimum of 38 mm into top of flutes for corrosion and wind lift factors.
- .3 Roofing nails: Spiral nails with steel round-top cap 25 mm in diameter and 3 mm diameter shank, length to penetrate solid wood supports by at least 38 mm and plywood substrates by at least 19 mm.

2.09 ACCEPTABLE MEMBRANE MANUFACTURERS

- .1 Products from the following membrane manufacturers are acceptable for work of this section, use only materials from one manufacturer:
 - .1 IKO Industries Ltd.
 - .2 Soprema Waterproofing Inc.
 - .3 Siplast

2.10 PERIMETER FIRE SEAL

- .1 SBS modified bitumen, minimum 60 gm/m² glass fleece reinforced, self adhering membrane having sanded top face, cut into strips minimum 150 mm wide x nominal 1.5 mm thick.
- .2 Acceptable Materials:
 - .1 IKO Armourbond 95
 - .2 Soprema Sopraguard Tape

2.11 FLASHING AND SHEET METAL

- .1 Hot-dipped galvanized steel, prefinished of colour selected by Consultant and as specified in Section 07 62 00.

2.12 CONCRETE PAVERS

- .1 Concrete Pavers: High density hydraulic pressed pavers, size as indicated on the drawing A0.01, weight not exceeding 45 kg per unit, colours selected by Consultant from standard range having a minimum Solar Reflective Index (SRI) 78, and as indicated on drawings.
 - .1 Basis-of-Design Materials: Expocrete, Paving Slabs
- .2 Pedestals: High density polyethylene formed into an 8 X 8 grid like structure with integral spacer ribs on upper surface and shims for proper level alignment.
 - .1 Acceptable Materials:
 - .1 Pave-EL by Envirospec, Inc.
 - .2 Soprema Adjustable Paver Pedestal

2.13 PIPE SUPPORTS

- .1 Premanufactured Pipe Supports: Premanufactured pipe supports fabricated from 100% recycled rubber eligible for contribution towards project LEED requirements for recycled materials, with 2.7 mm thickness galvanized steel frame, 150 mm wide x 100 mm tall x length to suit installation; including fasteners, bridge components, and angled supports as required for a complete installation and having the following accessories:
 - .1 Pipe and Conduit Support: Galvanized pipe clamp sized to suit gas pipe in accordance with manufacturer's written instructions.
 - .2 Multi-Pipe and Conduit Support: Galvanized pipe support system size and number to suit pipes being supported in accordance with manufacturer's instructions.
 - .3 Extendable Height Support: Galvanized steel pipe extensions to suit installation in accordance with manufacturer's instructions.
 - .4 Basis-of-Design Materials: Clearline Technologies, C-Port

2.14 ACCESSORIES

- .1 Bituminous primer: Asphaltic, and compatible with SBS modified bituminous membrane.
 - .1 Acceptable Materials:
 - .1 IKO, as recommended by manufacturer
 - .2 Soprema Elastocol 500
 - .3 Siplast PA 1125 Primer
- .2 Torches: Use only torches designed for torching roofing material and acceptable to manufacturer.
- .3 Flame-Stop Membrane
 - .1 Self-adhesive membrane composed of a reinforced glass mat and SBS modified bitumen designed to prevent flames from penetrating into empty spaces and openings while installing heat-welded membranes.
 - .2 Basis-of-Design Material: Soprema, Sopramastic
- .4 Roof drain: Refer to Division 22.
- .5 Pressure sensitive tape: 50 mm wide self-adhering.
- .6 Separation Sheet: Manufacturer's recommended separation sheet matching specified inverted membrane system.

- .7 Rubber Pavers: Made from recycled rubber material, 610 mm x 610 mm x 25 mm thickness patio blocks. Colour: Black.
 - .1 Acceptable Materials:
 - .1 Eco-Flex Recycled Rubber Solutions
 - .2 RTR ECO Rubber
 - .3 Shercom Industries

3. EXECUTION

3.01 EXAMINATION AND PREPARATION

- .1 Examine surfaces and completely prepare surfaces in conformance with manufacturers written instructions.
- .2 Confirm that surfaces to which membrane is to be applied are in a condition suitable for this application.
- .3 Inspect deck conditions including slopes and wood blocking, including but not limited to: up stands and parapets, construction joints, roof drains, plumbing vents, ventilation outlets and other penetrations. Notify Contractor of conditions that do not conform to manufacturer's requirements so that required corrections can be made.
 - .1 Installation of products specified in this Section will denote acceptance of site conditions.
- .4 Do not begin work before surfaces are smooth, dry, and free of ice and debris. Use of calcium or salt is forbidden for ice or snow removal.
- .5 Do not start work of this Section until plumbing, carpentry and other related work is complete.
- .6 No materials shall be installed during rain or snowfall.
- .7 Provide fire protection during installation.

3.02 INSTALLATION – GENERAL

- .1 Install roofing elements on clean and dry surfaces, in conformance with manufacturer's instructions and recommendations.
- .2 Roofing work must be completed in a continuous fashion as surfaces are readied and weather conditions permit.
- .3 Seal seams that are not covered by a cap sheet membrane in the same day. Do not install cap sheet if any moisture is present at base sheet seams.
- .4 Whenever membranes are torch applied, a continuous and even bead of molten bitumen must be visible as the membrane is unrolled and torched.

3.03 SITE PROTECTION

- .1 Protect finished work to avoid damage during roof installation and material transportation. Install protective boardwalks over installed roofing materials to enable passage of people and products. Assume full responsibility for any damage.

3.04 EQUIPMENT FOR WORK EXECUTION

- .1 Maintain roofing equipment and tools in good working order.
- .2 Use torches recommended by roofing materials manufacturer.

3.05 GYPSUM BOARD INSTALLATION ON STEEL DECK

- .1 Screw gypsum board levelling surface into the upper rib surfaces at a minimum rate of one (1) fastener per 0.25 m², 12 screws and washers for each 1220 mm x 2440 mm board.
- .2 Increase rate to one (1) fastener per 0.20 m², 15 screws and washers for each 1220 mm x 2440 mm board, for a distance of 2440 mm around the perimeter of the roof and 45° across the corners at a distance of 3050 mm from the corner of the building.
- .3 Cut boards so edges rest on centre of upper ribs. Cut straight lines with adequate tools.
- .4 Where slopes change directions, cut boards cleanly. Avoid breaking boards to acquire deck form. Place boards perpendicular to deck ribs for continuous support at extremities.
- .5 Board joints must be staggered, in half-lengths, and perfectly butted. Joints must be sealed with heat-resistant tape in both directions to prevent any asphalt leakage into building interior.

3.06 INSTALLATION OF SELF-ADHESIVE VAPOUR BARRIER

- .1 Primer must be dry prior to installation of the vapour barrier membrane.
- .2 Beginning at the bottom of the slope, without adhering the membrane, unroll onto the substrate for alignment. Do not immediately remove the silicone release sheet.
- .3 Align the roll parallel to the corrugation of the steel deck. Make sure the membrane overlaps are supported along their entire length.
- .4 Peel back one end of the silicone release sheet and adhere this part of the membrane to the substrate. Peel back the remaining release sheet at a 45° angle to avoid wrinkles in the membrane.
- .5 Overlap adjacent membranes by 75 mm (3 in). Overlap end laps by 150 mm (6 in). Stagger end laps by at least 300 mm (12 in).
- .6 When the vapour barrier is installed directly on the steel deck, place a thin sheet of metal under the end lap of the vapour barrier.

3.07 INSTALLATION OF INSULATION

- .1 Adhere insulation by using specified adhesive in continuous strips. The adhesive spacing will be determined by the results of the wind load report based on the CSA A123.21-14 Standard.
- .2 All the boards must be in perfect connection, without any significant differences in level, and must be adhered on all their surfaces completely.
- .3 All vertical joints between level boards and sloped modules, as well as two rows of insulation boards will be staggered.
- .4 Around the drain, cut out a slight slope of 0 to 10 mm (0 to 0.4 in) in a 600 mm (24 in) radius.
- .5 Install only as much insulation as can be covered in the same day.

3.08 INSTALLATION OF PERIMETER FIRE SEAL (SELF ADHERED MEMBRANE)

- .1 Apply self adhering perimeter fire seal directly to perimeter and curb substrates prior to application of base sheet materials, to vertical joints in parapet or curb sheathing, and at vertical corners.

.2 Extend material 75 mm up face of parapet and 75 mm onto substrate, use hand roller to remove air bubbles.

.3 Install perimeter fire seal to act as temporary moisture seal until installation of flashing materials.

3.09 INSTALLATION OF BOARDS AND FACTORY-LAMINATED BASE SHEET

.1 Adhere base sheet board using adhesive applied in continuous strips. The adhesive spacing will be determined by the results of the wind load report based on the CSA A123.21-14 Standard.

.2 All boards must be in perfect connection, without any significant variances in level, and must be completely adhered to the surface.

.3 Adhere the first part of the self-adhesive side laps using a membrane roller, then heat-weld the last part (self-adhesive, heat-welded side laps).

.4 Seal end laps by welding a 330-mm (13-in) wide protection strip centered on the joint.

.5 Avoid the formation of wrinkles, swellings or fishmouths.

3.10 BASE-SHEET FLASHING INSTALLATION (SELF ADHERING MEMBRANE)

.1 Prime substrates in accordance with manufacturer's written instructions and materials. Apply base sheet flashing membranes only when primer coat is dry.

.2 Install base sheet flashing in one (1) metre widths to cover roofing substrate over 100 mm. Overlap side laps by 75 mm. Stagger side laps by at least 100 mm from base sheet overlaps on roof to avoid excessive layering.

.3 Install insulating base sheet panels, adhered with manufacturer's approved adhesives in accordance with manufacturer's written instructions and materials.

3.11 ROOFING CAP SHEET INSTALLATION TORCH APPLIED MEMBRANE

.1 Once base sheet is applied and no defects are apparent, proceed with cap sheet installation.

.2 Unroll cap sheet at drain. Carefully align first side lap (parallel to roof edge).

.3 Weld cap sheet onto base sheet with torch recommended by membrane manufacturer. During application, simultaneously melt both designated contact surfaces so a bead of bitumen is apparent as cap sheet unrolls.

.4 Avoid overheating. Take care to avoid excessive bitumen bleed-out at joints during installation.

.5 Unless overlap widths differ between cap and base sheets, make sure joints between the two layers are staggered by at least 300 mm.

.6 Overlap cap sheet side laps by 75 mm and end laps by 150 mm. Cut off corners at end laps covered by next roll. Overlap surfaces must be granule-free or degranulated.

.7 Complete welds between two membranes. Leave no zone unwelded. In cold weather, adjust welding time to obtain homogenous seam.

.8 Once cap sheet is installed, carefully check overlapped joints. Leave bleed-out at joints ungranulated until inspected and accepted by the roofing inspector. Apply granules to bleed-out area by priming with self-adhesive primer, and while still tacky shake granules onto surface and press into place.

3.12 CAP SHEET FLASHING INSTALLATION

- .1 Install cap sheet in one (1) metre widths. Overlap side laps by 75 mm. Stagger base and cap sheet overlaps on roof by at least 100 mm to avoid excessive layering. Make overlaps 150 mm wide.
- .2 Draw parallel chalk line 150 mm from up stand or parapet bases.
- .3 Sink surface granules into bed of hot bitumen with torch and round-nosed trowel from chalk line on roof to up stand or parapet base as well as over granulated vertical parts that overlapped.
- .4 Torch weld cap sheet directly onto base sheet from top to bottom to soften both membranes and obtain homogenous seal.
- .5 During installation, avoid overheating membrane and excessive bitumen bleed-out at joints.

3.13 WATERPROOFING AT ROOF DRAINS

- .1 Mechanical drains: Install mechanical drains in accordance with the requirements of Division 22.
- .2 Drains with compressible connectors:
 - .1 Install base sheet centred on drain. Cut opening of same diameter as down pipe for required water drainage.
 - .2 Install drain on base sheet in a layer of adhesive. Mechanically fastened to support.
 - .3 Torch weld base sheet roofing membrane reinforcement band 1000 mm x 1000 mm in a diagonal position to base sheet and previously primed drain flange. Apply manual pressure at drain connectors.
 - .4 Install cap sheet to edge of opening.
 - .5 Fasten dome to drain.

3.14 WATERPROOFING FOR VARIOUS DETAILS

- .1 Install waterproofing membranes in conformance with various roofing details illustrated in the manufacturer's installation manual and as submitted for review as noted above.

3.15 INSTALLATION OF CONCRETE PAVERS

- .1 Install pavers on prefabricated pads in accordance with paver pad manufacturer's written instructions.
- .2 Maintain pavers level using manufacturer's shims, where additional height is required, install additional pads. Where height adjustment exceeds 25 mm, adjust height using high density geotechnical insulation.

3.16 SHEET METAL FLASHING AND TRIM

- .1 Complete flashing work using specified materials described on plans and details, and as described in Section 07 62 00.
- .2 Nails, staples, screws, bolts, washers and other metal fasteners, will be made of compatible and rust-proof metals, of same colour as surfaces with which they are in contact.
- .3 Shaping:
 - .1 Take special care when shaping sheet metal with a permanent finish.
 - .2 Bend sheet metal using sheet metal break. When possible, use bench and appropriate tools for shaping, bending and welding work.

- .3 Fold back exposed edges by 13 mm to hide and strengthen edges.
- .4 Corners, fasteners, angles and joint covers must be of same metal, gauge and finish as metal being shaped.

.4 Installation:

- .1 Sheet metal work will conform to details, with plumb profiles free from deformities or defects that may hinder appearance.
- .2 Space angles, fasteners and seams to allow for normal expansion and contraction.
- .3 Fasteners will be concealed type, unless Consultant approves exposed fasteners in designated locations prior to installation. Metalwork must be fastened and corners and angles must be perfectly aligned.
- .4 Caulk sheet metal joints and junctions with other materials.
- .5 At junctions between roof and masonry surfaces, scrape out joints to a 25 mm depth, insert flashing, fasten and seal with specified sealer.
- .6 Install appropriate flashing, cap sheet, counter flashing, casings and other accessories to vents, pipes and other ducts to ensure perfect sealing.

3.17 CLEANING

- .1 Routinely clean project site of rubbish and other materials that may hinder roof installation, performance, or present a fire hazard.
- .2 At completion of work remove waste materials and items that could cause a roof puncture.
- .3 Clean adjacent surfaces of asphalt, bitumen and other roofing materials deleterious to appearance or function.

3.18 SITE QUALITY CONTROL

- .1 Inspection and testing of roofing application will be carried out by testing laboratory designated by Owner in cooperation with the Consultant.
- .2 Inspection fees will be paid by the Owner in accordance with Section 01 00 06 – General Requirements: Quality Control.

3.19 PROTECTION

- .1 Protect installed work and materials.

END OF SECTION

1. GENERAL**1.01 SUMMARY**

- .1 This Section includes sheet metal flashing and trim in the following categories:
 - .1 Roof drainage systems
 - .2 Exposed trim, gravel stops, and fasciae
 - .3 Metal flashing
 - .4 Prefinished Metal Cap and Flashing
- .2 Sheet metal flashings specified in this section are intended to protect membranes from accelerated deterioration arising from exposure to the elements, and to protect the building from migration of moisture into vulnerable assemblies by diverting water to the exterior or other drainage plane.
- .3 Membrane through wall and roof flashings are identified in affected related sections and specified in Section 07 25 13.

1.02 RELATED REQUIREMENTS

- .1 Section 06 10 53 – Miscellaneous Rough Carpentry: Blocking for support of flashings and copings.
- .2 Section 07 25 13 – Air and Vapour Membranes: Through wall membrane flashings and roof transition membrane flashings.
- .3 Section 07 92 00 – Joint Sealants: Elastomeric sealants.
- .4 Section 08 11 13 – Steel Doors and Frames
- .5 Section 08 41 13 – Aluminum Framed Entrances and Storefronts

1.03 REFERENCE STANDARDS

- .1 Aluminum Association (AA):
 - .1 Designation System for Aluminum Finishes, 1997
 - .2 Guidelines for Aluminum Sheet Metal Work in Building Construction, 2000
- .2 American Society for Testing and Materials (ASTM):
 - .1 ASTM B209-04, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
 - .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 A755/A755M-03, Standard Specification for Steel Sheet, Metallic Coated by the Hot-Dip Process and Prepainted by the Coil-Coating Process for Exterior Exposed Building Products
 - .4 ASTM B32-03, Specification for Solder Metal
- .3 Canadian Standards Association (CSA):
 - .1 CSA A123.3-98 (R2004), Asphalt or Tar Saturated Roofing Felt
- .4 Canadian General Standards Board (CGSB):
 - .1 CAN/CGSB 37.5-M89, Cutback Asphalt Plastic Cement
 - .2 CAN/CGSB 37.29-M89, Rubber/Asphalt Sealing Compound
 - .3 CAN/CGSB 51.32-M77, Sheathing, Membrane, Breather Type

.5 Other References:

- .1 The Alberta Roofing Contractors Association (ARCA): Manual on Good Roofing Practice and Accepted Roofing Systems

1.04 ADMINISTRATIVE REQUIREMENTS

.1 Coordination:

- .1 Coordinate work of this Section with interfacing and adjoining Work for proper sequencing of each installation and to provide positive weather resistance, durability of the work, and protection of materials and finishes.

1.05 SUBMITTALS

- .1 Provide required information in accordance with Section 01 00 06 – General Requirements: Submittals.

.2 Action Submittals: Provide the following submittals before starting any work of this Section:

- .1 Product Data: Submit product data including manufacturer's material and finish data, installation instructions, and general recommendations for each specified flashing material and fabricated product.
- .2 Samples for Initial Selection: Provide manufacturer's colour charts showing the standard range of colours for initial selection of materials.
- .3 Samples: Submit samples of sheet metal flashing, trim, and accessory items, in the specified finish, as follows:
- .1 Include 2 or more units showing the full range of variations expected, where finish involves normal colour and texture variations.
- .2 Include 300 mm square Samples of specified sheet materials indicating exposed finished surfaces.
- .3 Include 300 mm long samples of factory fabricated products exposed as finished work with specified factory finish.

1.06 QUALITY ASSURANCE

.1 Qualifications: Provide proof of qualifications when requested by City:

- .1 Installer: Engage an experienced installer having a minimum of five (5) years experience who has completed projects similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance.

2. PRODUCTS

2.01 MANUFACTURERS

- .1 Acceptable Materials Manufacturers: Subject to compliance with requirements specified in this Section; where multiple listings of manufacturers occur, use any of the following listed manufacturers' products in accordance with Section 01 00 06 – General Requirements: Substitutions and Product Options.
- .2 Substitutions: City may consider additional manufacturers having similar products to Acceptable Materials Manufacturers listed above during the construction period, provided they meet the performance requirements established by the named products and provided they submit requests for substitution in accordance with Section 01 00 06 – General Requirements: Substitutions and Product Options before starting any work of this Section:
- .1 Do not use substitute materials to establish Bid Price.

- .2 Substitutions that appear as a part of the project without review and acceptance by the City will be rejected, and replaced with one of the specified materials.

2.02 METAL FLASHING MATERIALS

- .1 Zinc Galvanized Sheet Steel Flashing: Tension levelled, Commercial Steel (CS) designation, Type A, Grade 230 in accordance with ASTM A653/A653M and as follows:
 - .1 Thickness: Minimum 0.45 mm base metal thickness, and as modified by Article 2.05 below.
 - .2 Galvanizing Designation: Z275 applied evenly to both sides.
 - .3 Metal Flashing (MF1):
 - .1 Surface Texture: Smooth.
 - .2 Finish: Prefinished colour selected from manufacturer's standard range using Valspar WeatherXL.
- .2 Formed Aluminum Flashings: Tension levelled, aluminum sheet in accordance with ASTM B209 and ANSI H35.1 alloy designation 5005-H14 and as follows:
 - .1 Thickness: Minimum 1.20 mm, and as modified by Item 2.05 below.
 - .2 Aluminum Flashing (AF1): Anodized aluminum sheet, clear Architectural Class 1 18 µm and greater finish thickness.

2.03 MISCELLANEOUS MATERIALS AND ACCESSORIES

- .1 Solder: ASTM B32, Grade Sn50, used with rosin flux for galvanized steel flashings.
- .2 Fasteners: Same metal as sheet metal flashing or other non-corrosive metal as recommended by sheet metal manufacturer. Match finish of exposed heads with material being fastened.
- .3 Dielectric separator: Bituminous paint: Isolation coating between aluminum and other metallic materials, concrete and preservative treated wood, acid and alkali resistant asphaltic paint in accordance with MPI Architectural Painting Specification Manual Approved Product listing MPI#35.
- .4 Asphalt Mastic: Solvent type asphalt mastic, nominally free of sulphur and containing no asbestos fibres, compounded for 0.40 mm dry film thickness per coat.
- .5 Mastic Sealant: CAN/CGSB 37.29 polyisobutylene; non-hardening, non-skinning, non-drying, non-migrating sealant.
- .6 Elastomeric Sealant: Generic type recommended by sheet metal manufacturer and fabricator of components being sealed and complying with requirements for joint sealants as specified in Section 07 92 00.
- .7 Epoxy Seam Sealer: Two component, non-corrosive, aluminum seam cementing compound, recommended by aluminum manufacturer for exterior and interior non-moving joints, including riveted joints.
- .8 Adhesives: Type recommended by flashing sheet metal manufacturer for waterproof and weather resistant seaming and adhesive application of flashing sheet metal.
- .9 Slip Sheet: CSA A123.3, No. 15 perforated asphalt saturated felts.
- .10 Flexible Flashing: Polyethylene faced bituminous membrane materials compatible with membrane air and vapour retarder specified in Section 07 25 13, not less than 0.5 mm thick and be compatible with all other materials being used and mastic compatible and approved for use with the flashing material.

.11 Metal Accessories: Provide sheet metal clips, straps, anchoring devices, and similar accessory units as required for installation of Work, matching or compatible with material being installed; non-corrosive; size and thickness required for performance.

.12 Roofing Cement: CAN/CGSB 37.5, asbestos free, asphalt based.

2.04 FABRICATION, GENERAL

.1 Fabricate sheet metal building flashings and trim in accordance with the recommendations of SMACNA's Architectural Sheet Metal Manual that apply to the design, dimensions, metal, and other characteristics as required.

.2 Fabricate sheet metal roofing flashings in accordance with the recommendations of the ARCA, and as follows:

.1 Make flashing of prefinished metal for cap flashings, for all flashings adjacent to roofing at roof edges and area dividers and where exposed to view from ground.

.2 Make flashing for other roof locations, of plain galvanized metal.

.3 Fabricate flashings using the following metal core thicknesses for indicated assemblies:

.1 Flat Surfaces Less Than 300 mm in Width or Height: Use 0.45 mm material except where specifically noted otherwise.

.2 Flat Surfaces 300 mm and Greater in Width or Height: Use 0.62 mm material except where specifically noted otherwise.

.3 Concealed Fastening Strips: Use 0.80 mm material.

.4 Fabricate sheet metal flashing and trim to fit substrates and result in waterproof and weather resistant performance once installed.

.5 Verify shapes and dimensions of surfaces being covered before fabricating sheet metal.

.6 Form exposed sheet metal Work that is without excessive oil canning, buckling, and tool marks and that is true to line and levels indicated, with exposed edges folded back to form hems.

.7 Seams:

.1 Fabricate non-moving seams in sheet metal with flat lock seams.

.2 Tin edges being seamed, form seams, and solder.

.8 Seams: Fabricate non-moving seams in aluminum with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.

.9 Expansion Provisions:

.1 Space movement joints at 3050 mm O/C with no joints allowed within 610 mm of corners or intersections.

.2 Form expansion joints of intermeshing hooked flanges, not less than 25 mm deep, filled with mastic sealant concealed within joints where lapped or bayonet type expansion provisions cannot be used or are not sufficiently weatherproof and waterproof.

.10 Sealed Joints: Form non-expansion, but movable, joints in metal to accommodate elastomeric sealant in accordance with SMACNA standards.

.11 Separate metal from non-compatible metal or corrosive substrates by coating concealed surfaces at locations of contact with asphalt mastic or other permanent separation as recommended by manufacturer.

.12 Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of sheet metal exposed to public view.

- .13 Fabricate cleats and attachment devices from same material as sheet metal component being anchored or from compatible, non-corrosive metal recommended by sheet metal manufacturer, and as follows:
 - .1 Size as recommended by SMACNA manual or sheet metal manufacturer for application but not less than thickness of metal being secured.

2.05 SHEET METAL FABRICATIONS

- .1 Fabricate sheet metal items in thickness or weight needed in accordance with performance requirements but not less than that listed below for each application and metal.
- .2 Downspouts: Fabricate from the following material:
 - .1 Coil Coated Galvanized Steel: 0.55 mm thick.
- .3 Roof Drain Flashing: Fabricate from the following material:
 - .1 Stainless Steel: 0.40 mm thick.
- .4 Built-in Gutters: Fabricate from the following material:
 - .1 Stainless Steel: 0.40 mm thick.
- .5 Exposed Trim, Gravel Stops, and Fasciae: Fabricate from the following material:
 - .1 Coil Coated Galvanized Steel: 0.70 mm thick.
- .6 Base Flashing: Fabricate from the following material:
 - .1 Galvanized Steel: 0.70 mm thick.
- .7 Counter Flashing: Fabricate from the following material:
 - .1 Coil Coated Galvanized Steel: 0.55 mm thick.
- .8 Flashing Receivers: Fabricate from the following material:
 - .1 Galvanized Steel: 0.55 mm thick.
- .9 Drip Edges: Fabricate from the following material:
 - .1 Coil Coated Galvanized Steel: 0.55 mm thick.
- .10 Roof Penetration Flashing: Fabricate from the following material:
 - .1 Stainless Steel: 0.50 mm thick.

2.06 ALUMINUM EXTRUSION FABRICATIONS

- .1 Aluminum Extrusion Units: Fabricate extruded aluminum running units with formed or extruded aluminum joint covers for installation behind main members where possible. Fabricate mitred and welded corner units.

3. EXECUTION

3.01 EXAMINATION

- .1 Examine substrates and conditions under which sheet metal flashing and trim are being installed and verify that Work may properly commence. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- .1 Install sheet metal flashing and trim in accordance with performance requirements, manufacturer's installation instructions, and SMACNA's Architectural Sheet Metal Manual.
- .2 Anchor units of Work securely in place by methods indicated, providing for thermal expansion of metal units; conceal fasteners where possible, and set units true to line and level as indicated.
- .3 Install Work with laps, joints, and seams that will be permanently watertight and weatherproof.
- .4 Install exposed sheet metal Work that is without excessive oil canning, buckling, and tool marks and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and to result in waterproof and weather resistant performance.
- .5 Verify shapes and dimensions of surfaces being covered before fabricating sheet metal.
- .6 Roof Edge Flashings: Secure metal flashings at roof edges at a maximum of 610 mm ^o/c.
- .7 Expansion Provisions:
 - .1 Provide for thermal expansion of exposed sheet metal Work.
 - .2 Space movement joints at maximum of 3050 mm with no joints allowed within 610 mm of corner or intersection.
 - .3 Form expansion joints of intermeshing hooked flanges, not less than 25 mm deep, filled with mastic sealant (concealed within joints) where lapped or bayonet type expansion provisions in work cannot be used or are not sufficiently weatherproof and waterproof.
- .8 Soldered Joints:
 - .1 Clean surfaces being soldered, removing oils and foreign matter.
 - .2 Pre-tin edges of sheets being soldered to a width of 38 mm, except where pre-tinned surface would show in finished Work.
 - .3 Do not solder the following metals:
 - .1 Aluminum.
 - .2 Coil coated galvanized steel sheet.
 - .4 Pre-tinning is not required for the following metals:
 - .1 Terne coated stainless steel.
 - .5 Do not use torches for soldering.
 - .6 Heat surfaces to receive solder and flow solder into joint.
 - .7 Fill joint completely.
 - .8 Completely remove flux and spatter from exposed surfaces.
- .9 Sealed Joints:
 - .1 Form non-expansion, but movable, joints in metal to accommodate elastomeric sealant in accordance with SMACNA standards.
 - .2 Fill joint with sealant and form metal to completely conceal sealant.
 - .3 Use joint adhesive for non-moving joints specified not being soldered.
- .10 Seams:
 - .1 Fabricate non-moving seams in sheet metal with flat lock seams.
 - .2 Tin edges being seamed, form seams, and solder.

- .11 Seams: Fabricate non-moving seams in aluminum with flat lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.
- .12 Separations:
 - .1 Separate metal from non-compatible metal or corrosive substrates by coating concealed surfaces, at locations of contact, with asphalt mastic or other permanent separation as recommended by manufacturer.
 - .2 Underlayment: Install a slip sheet of red rosin paper and a course of polyethylene underlayment where installing stainless steel or aluminum directly on cementitious or wood substrates.
 - .3 Bed flanges of Work in a thick coat of roofing cement where required for waterproof performance.
- .13 Counter Flashings:
 - .1 Coordinate installation of counter flashings with installation of assemblies being protected by counter flashing. Install counter flashings in reglets or receivers.
 - .2 Secure in a waterproof manner by means of snap-in installation and sealant, lead wedges and sealant, interlocking folded seam, or blind rivets and sealant.
 - .3 Lap counter flashing joints a minimum of 50 mm and bed with sealant.
- .14 Roof Drainage System:
 - .1 Install drainage items fabricated from sheet metal, with straps, adhesives, and anchors recommended by SMACNA's Manual or the Item manufacturer, to drain roof in the most efficient manner.
 - .2 Coordinate roof drain flashing installation with roof drainage system installation.
 - .3 Coordinate flashing and sheet metal items for steep sloped roofs with roofing installation.
- .15 Equipment Support Flashing:
 - .1 Coordinate equipment support flashing installation with roofing and equipment installation.
 - .2 Weld or seal flashing to equipment support member.
- .16 Roof Penetration Flashing:
 - .1 Coordinate roof penetration flashing installation with roofing and installation of items penetrating roof.
 - .2 Turn lead flashing down inside vent piping, being careful not to block vent piping with flashing.
 - .3 Seal and clamp flashing to pipes penetrating roof, other than lead flashing on vent piping.

3.03 CLEANING AND PROTECTION

- .1 Clean exposed metal surfaces, removing substances that might cause corrosion of metal or deterioration of finishes.
- .2 Provide final protection and maintain conditions that ensure sheet metal flashing and trim Work during construction is without damage or deterioration other than natural weathering at the time of Substantial Performance.

END OF SECTION

1. GENERAL**1.01 SUMMARY**

- .1 This section specifies requirements for steel commercial style gutters and downspouts including; but not limited to, the following:
 - .1 Preformed metal fascias for complete with anchorage and alignment splines.
 - .2 Preformed metal gutters for complete with thrust bars, alignment splines, transition sections and fastening.
 - .3 Bituminous mastic coating for inside surfaces of steel gutters and splash boxes.

1.02 RELATED WORK

- .2 Section 05 50 00 – Metal Fabrications: Z-bar and channel supports for metal fascias, flashings and gutters.
- .3 Section 07 21 13 – Board Insulation: Rigid insulation behind/within metal fascias.
- .5 Section 07 92 00 – Joint Sealants

1.04 REFERENCE STANDARDS

- .1 American Society for Testing of Materials (ASTM International):
 - .1 ASTM A653/A653M-17, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
 - .2 ASTM A666 – 15 – Standard Specification for Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
 - .3 ASTM B32 -08 (2014)- Standard Specification for Solder Metal.
 - .4 ASTM B209 –14 – Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
 - .5 ASTM B370-12 - Standard Specification for Copper Sheet and Strip for Building Construction
- .2 Canadian General Standards Board (CGSB):
 - .1 CAN/CGSB-37.5-M89, Cutback Asphalt Plastic Cement
- .3 Canadian Standards Association (CSA):
 - .1 CSA A23.1/A23.2-14, Concrete Materials and Methods of Concrete Construction

1.05 PERFORMANCE REQUIREMENTS

- .1 Design and install all sheet metal profiles, shapes, joints and fastenings to remain securely in place without structural failure.
- .2 Design and install sheet metal shapes, profiles, joints and fastenings to safely withstand structurally, and to remain free of visible buckling and distortion caused by:
 - .1 Thermal expansion and contraction due to local climate conditions.
 - .2 Thermal expansion and contraction due to absorption of sun heat radiation, and conduction within metal.
 - .3 Live loads (snow loads), in combination with wind force loads.
 - .4 Positive and negative wind forces.
 - .5 Live load deflection upped 1/360 of the span in the substructure.

.3 Design and install sheet metal shapes, profiles, and joints weathertight at joints, laps and fastener locations.

.4 Design to conform to applicable code for size and method of rain water discharge.

1.06 SHOP DRAWINGS

.1 Provide required information in accordance with Section 01 00 06 – General Requirements: Submittals.

.2 Clearly indicate the following:

.1 Manufacturer of prefinished coating application for metal fascias. Manufacturer of special coating application for gutters.

.2 Type and thickness of zinc-coated sheet steel.

.3 Type and mil thicknesses of prefinished colour coating system and special coating system.

.4 Typical profiles of formed sheet metal systems.

.5 Typical details of jointing of sheet metal profiles.

.6 Manufacturer and type of sealants and gaskets.

.7 Typical sectional details showing locations of fasteners.

1.07 MOCK-UPS

.1 Provide required Mock-Ups in accordance with Section 01 00 06 – General Requirements: Quality Control.

.2 Samples are to indicate method of forming joints complete with alignment splines, fastening clips, thrust bars, and typical exposed fasteners.

1.08 HANDLING AND PROTECTION

.1 Stack preformed and prefinished materials in a manner to prevent permanent deformation and marring of finished surfaces.

.2 Prevent contact with dissimilar metals during storage and protect from acids and other corrosive materials and elements.

.3 Deliver, handle and store all accessory materials to job site, in original packages and containers with manufacturer's seals and labels intact.

.4 Store materials requiring protection from the weather in weatherproof shelters having floors.

.5 Protect installed work and materials from damage.

.6 In the event of materials being damaged by the elements, improper handling, or other causes, such materials will be rejected, and shall be replaced at no increase in Contract Price. Promptly remove rejected materials from site.

1.09 WARRANTY

.1 Provide manufacturer's 5 year warranty for material finishes.

2. PRODUCTS**2.04 MATERIALS**

- .1 Prefinished sheet metal (for fascias, flashings and alignment splines for fascias): grade A commercial quality galvanized steel conforming to ASTM A653/A653M with Z275 zinc coating in accordance with ASTM A653/A653M; factory prefinished on exposed side with modified silicone polyester coating of special colour selected by Consultant; factory pre-coated on non-exposed side with lightly pigmented modified silicone polyester; of minimum 0.76 mm base metal thickness.
- .2 Sheet Metal (for gutters, alignment splines for gutters and transition sections for gutters): Grade A commercial quality galvanized steel conforming to ASTM A653/A653M with Z275 coating in accordance with ASTM A653/A653M; minimum 1.78 mm base metal thickness.
- .3 Sheet Metal (for gutter thrust bars): same quality of galvanized steel specified for gutters but in minimum 2.52 mm base metal thickness.
- .4 Sheet Metal for gutter liner: of same quality and type of galvanized sheet steel specified for fascias and flashings except without coloured coating.
- .5 Sheet Metal downspouts and Splashboxes: of same quality and type of galvanized sheet steel specified for fascias and flashings except without coloured coating.
- .6 Bituminous Coating: filled, cut-back asphalt of type recommended for roof coating; conforming to CAN/CGSB-37.8.
- .7 Sealant: type and quality specified in Section 07 92 00 – Joint Sealants. Sealants are acceptable in non-visible locations only.
- .8 Fasteners: corrosion resistant steel; self-drilling, self-tapping type; of lengths to penetrate through back-up by 13 mm; of size and strength to provide adequate securement of components; complete with soft neoprene washers where used to secure gutters and gutter lining in place; of finish to match metal surfaces in exposed locations.
- .9 Splashpads: Precast concrete splashpad from 24 MPa concrete, 310 mm wide x 75 mm deep x 610 mm long, to CAN/CSA A23.1.

2.02 FABRICATION OF FASCIAS

- .1 Fabricate fascias to profiles detailed, in maximum 2400 mm lengths.
- .2 Fascias are to have joints that are flush butt type, including joints at inside and outside corners. Back all joints, including inside and outside corners with alignment splines which have a face width of 150 mm.
- .3 Fabricate alignment splines for inside and outside corners as one piece for each location. Fabricate consultant will allow alignment splines for corners of galvanized sheet stock with shop applied enamel finish to match fascias.
- .4 Alignment splines are to follow the profile of fascias and be capable of being installed before fascias are installed. The exposed surfaces of alignment splines are to have a finish and colour to match fascias.
- .5 Form all edges slightly radiused, adequate enough to prevent damage to prefinished coatings.
- .6 Fabricate fascias complete with matching closure pieces for locations where fascias terminate at roof ends.

- .7 Fabricate shapes free of distortion, ripples, dents, buckling and other visible non-repairable surface damage.

2.03 FABRICATION OF GUTTERS

- .1 Fabricate gutters to profiles detailed, in maximum 2400 mm lengths. Joints in gutters must correspond with joints in fascias.
- .2 Fabricate all corners as one piece with joints mitred and welded watertight.
- .3 Fabricate gutters with ends closed off, with caps welded in place watertight.
- .4 Form spill-outs as detailed, welded in place watertight.
- .5 At expansion joints, cap and separate gutters end by 25 mm. Weld end caps in place watertight.
- .6 Fabricate gutter sections with flush butt joints. Back all joints with alignment splines which are to have a face width of 65 mm.
- .7 Fully weld alignment splines to one side of each gutter section so that when gutters are installed each and every joint will be backed with an alignment spline.
- .8 Lap alignment splines at 25 mm over the gutter sections to which they are welded.
- .9 Provide 25 mm wide thrust bars, spaced at maximum 600 mm on centre, and not more than 100 mm from each end of each gutter section.
- .10 Fabricate shapes free of distortion, ripples, dents, and other visible non-repairable surface damage. Grind all welds smooth and flush with adjacent surfaces.
- .11 Fabricate gutter spill-out profile 75 mm wide x 50 mm high.
- .12 Finish all gutter sections, including thrust bars, in shop before delivery to site. Clean, degrease and provide a two (2) coat thermosetting epoxy resin powder finish of colour and sheen selected by Consultant on all surfaces. Powder finish must be applied by an approved applicator.

2.04 FABRICATION OF METAL FLASHINGS

- .1 Fabricate metal flashings and lead flashings for roof changes. Form sections in maximum 2400 mm lengths.
- .2 Fabricate flashings with flat lap joints. Provide minimum 180 degree turned down hemmed edges.
- .3 Fabricate all required sections required to interlock with metal fascias as shown on the drawings.
- .4 Fabricate metal flashings with straight uniform edges, and free of distortion, ripples, and dents, buckling and other visible non-repairable surface damages.

2.05 FABRICATION OF GUTTER LINER

- .1 Fabricate metal gutter liner for gutter system between sloped translucent roofing and canopy as detailed.
- .2 Form sections in maximum sizes with all joints S-locked and sealed watertight.

2.06 FABRICATION OF DOWNSPOUTS AND SPLASHBOXES

- .1 Form sections in maximum sizes with all joints S-locked and sealed watertight.
- .2 Form downspouts minimum 75 mm x 75 mm in size, 1.6 mm thick unless otherwise detailed.

- .3 Form splash boxes from 0.45mm thick metal base, galvanized steel sheet metal.

3. EXECUTION

3.06 INSTALLATION OF EAVE EDGE FASCIAS

- .2 Install fascias well secured and rigid in place and with all sections in-line with each other. All anchorages must penetrate back up Z-bars and channels.
- .3 Install back-up alignment splines independent of fascias in a manner to allow fascias to expand and contract at joints.
- .4 Maintain 10 mm wide joints between fascia sections to allow for expansion and contraction.
- .5 Install alignment splines across expansion joints and maintaining 25 mm wide joints between fascia sections. Install to allow for movement at expansion joints.
- .6 Co-ordinate the installation of rigid insulation within/behind fascias.
- .7 Install closure pieces at locations where fascias terminate at gable ends. Install watertight.
- .8 Interlock fascias with metal flashings at roof changes. Provide watertight junctions acceptable to the Consultant.

3.07 INSTALLATION OF METAL FLASHINGS

- .2 Install metal flashings well secured in place and in a manner to allow expansion and contraction at joints. Weatherlap all joints.
- .3 All exposed fasteners must be neatly arranged in manner acceptable to Consultant. All fasteners must penetrate back up Z-bars and channels.
- .4 Metal flashings must extend minimum 75 mm over roof as shown on the Drawings.

3.08 INSTALLATION OF GUTTERS

- .2 Install gutters well secured in place and rigid, and with all sections in-line with each other. All joints must correspond with joints in metal fascias. All anchorages must penetrate back up Z-bars and channels.
- .3 Maintain 10 mm wide joints between gutter sections to allow for expansion and contraction. Seal lapped edges as work progresses. Clean all visible traces of sealant at lapped joints as work progresses.
- .4 Keep gutter sections 25 mm apart at expansion joints.
- .5 Install thrust bars at maximum 600 mm on centre, not more than 100 mm from each end of each gutter section. Co-ordinate the installation of hold-down clips for roof flashings.
- .6 Use only anchorage's which have soft neoprene washers.

3.09 INSTALLATION OF GUTTER LINER

- .2 Install gutter liner as detailed using fasteners with soft neoprene washers. Prior to installation, back-paint all metal surfaces that will be in contact with structural steel members. Use bituminous type paint material.
- .3 Flash and seal gutter-liner to downspouts. Make all connections watertight and in manner acceptable to Consultant.

3.10 INSTALLATION OF DOWNSPOUTS

- .2 Secure downspouts to structural steel columns using 0.76 mm thick galvanized steel straps at 600 mm on centre. Secure straps to steel columns using corrosion resistant screws.
- .3 Install splash boxes as indicated.

3.11 INSTALLATION OF BITUMINOUS COATING

- .2 Apply two (2) coats of asphalt bitumen on all inside surfaces of steel gutters.

END OF SECTION

1. GENERAL**1.01 SUMMARY**

- .1 Shop fabricated roof frame mounted Fall Arrest Roof Anchors.

1.02 REFERENCE STANDARDS

- .1 American Society for Testing and Materials International, (ASTM):
 - .1 ASTM A123/A123M-13, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
 - .2 ASTM A167-99(2009), Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
 - .3 ASTM A500-99, Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
- .2 Canadian Standards Association (CSA International):
 - .1 CSA B272-93 (R2000), Prefabricated Self-Sealing Roof Vent Flashings
 - .2 CSA G40.20-13/G40.21-13, 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
 - .4 CSA-W55.3-65(R1998), Resistance Welding Qualification Code for Fabricators of Structural Members Used in Buildings
 - .5 CSA W59-03, "Welded Steel Construction (Metal Arc Welding)"
 - .6 CSA W178.1-02, "Certification of Welding Inspection Organizations"
 - .7 CAN/CSA Z91-02, Health and Safety Code for Suspended Equipment Operations
- .3 Master Painters Institute (MPI):
 - .1 Architectural Painting Specification Manual
- .4 The Society for Protective Coatings (SSPC):
 - .1 SP -2, Hand-Tool Cleaning

1.03 SYSTEM DESCRIPTION

- .1 Personal Restraint Assembly: Posts, steel rope loops, and attachments to resist lateral forces 24.03 kN at any point and in all directions, without damage or permanent set.

1.04 SUBMITTALS

- .1 Provide required information in accordance with Section 01 00 06 – General Requirements: Submittals.
- .2 Submit WHMIS MSDS – Material Safety Data.

1.05 SHOP DRAWINGS

- .1 Provide required information in accordance with Section 01 00 06 – General Requirements: Submittals.
- .2 Indicate component profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories. Include erection drawings, elevations, and details where applicable.
- .3 Indicate welded connections using standard welding symbols include net weld lengths.

1.06 DELEGATED DESIGN REQUIREMENTS

- .1 Submit design data in accordance with Section 01 33 50 – Delegated Design Submittals
- .2 Submit Test Reports and substantiating engineering data and test results of previous tests by independent laboratory which purport to meet performance criteria, and other supportive data.
- .3 Design structural support framing components and site inspect the installation under direct supervision of a Professional Structural Consultant experienced in design of this Work and licensed at the place where the Project is located.
- .4 Pre-Installation Meetings: conduct pre-installation meeting to verify project requirements, manufacturer's installation instructions and manufacturer's warranty requirements.
- .5 Co-ordinate the Work with installation of roofing assembly and sheet metal work.

1.07 WELDERS' QUALIFICATIONS

- .1 Do welding inspection to CSA W178.
- .2 Resistance welding to CSA W55.3.
- .3 Fusion welding to CSA W59.
- .4 Welders Certificates: provide welders' qualifications Consultant.
- .5 Employ qualified and licensed welders possessing certificates for each procedure performed by authority having jurisdiction.
- .6 Each welder to possess identification symbol issued by authority having jurisdiction.
- .7 Certify companies for fusion welding of steel structures in accordance with CSA W47.1.
- .8 Manufacturer Qualifications: company specializing in manufacturing Products specified in this section with minimum three years documented experience.

1.08 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Waste Reduction Workplan.
- .2 Place materials defined as hazardous or toxic waste in designated containers.

1.09 SITE CONDITIONS

- .1 Verify dimensions, tolerances, and method of attachment with other work.

2. PRODUCTS**2.02 ACCEPTABLE MANUFACTURERS**

- .1 Atlas Anchor Systems (B.C.) Ltd., Telephone: (604) 435-0008
- .2 Pro-Bel Group, Telephone: (800) 461-0575
- .3 Thaler Metal Industries, Telephone: (800) 387-7217

2.03 MATERIALS

- .1 Steel Sections and Plates: CSA G40.20/G40.21.
- .2 Steel Tubing: ASTM A500, Grade B.

- .3 Steel Rings: forged steel, ring thickness determined by imposed loads.
- .4 Bolts, Nuts, and Washers for Stainless Steel: stainless steel, matte finish.
- .5 Gaskets Under Anchors: neoprene pads, compatible with roof membrane, cut to size.
- .6 Welding Materials: CSA W47.1 for materials being welded.
- .7 Shop Primer: Epoxy, anti-corrosive type, two coats.

2.04 FABRICATION

- .1 Fit and shop assemble items in largest practical sections, for delivery to site.
- .2 Fabricate items with joints tightly fitted and secured.
- .3 Continuously seal joined members by intermittent welds and plastic filler.
- .4 Grind exposed joints flush and smooth with adjacent finish surface.
- .5 Make exposed joints butt tight, flush, and hairline.
- .6 Ease exposed edges to small uniform radius.
- .7 Exposed Mechanical Fastenings: screws or bolts; consistent with design of component.
- .8 Provide and install components required for anchorage of fabrications.
- .9 Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.
- .10 Roof Anchors (Bolt Around Beam for structural steel framing):
 - .1 Type 304 stainless steel to ASTM A167 forged eye roof anchor to CSA Z91 with: urethane insulated hollow hot dipped galvanized ASTM 500C steel post (HSS) 6 mm wall thickness x 114 mm Ø x 305 mm high welded to 16 mm x 203 mm x 203 mm 44W base plate; four 16 mm Type 304 s.s. bolts and 16 mm x 203 mm x 203 mm under-beam plate, lock washers and nuts; 229 mm high flashing assembly of 1.6 mm mill finish 1100-OT alloy aluminum to CSA B272-93, with EPDM Triple Pressure Grommet Seal and EPDM Base Seal and bituminous painted deck flange.
 - .1 Acceptable material:
 - Atlas Anchor Systems Ltd. Type A Thru Bolt
 - Pro-Bel PB76-S
 - Thaler FARA-13, with SJ-34(9) New-Standard STACK JACK flashing

2.04 FABRICATION TOLERANCES

- .1 Squareness: 3 mm maximum difference in diagonal measurements.
- .2 Maximum Deviation from Plane: 1.5 mm from 1 m.

2.05 FINISHES

- .1 Prepare uncoated steel (restraint post) surfaces: SSPC-SP 2, no more than 4 hours before applying epoxy primer.
- .2 Concealed steel anchors, clean surfaces of rust, scale, grease, and foreign matter prior to finishing.

- .3 Do not prime surfaces in direct contact with concrete or where site welding is required.
- .4 Concealed Structural Components and Anchors: galvanize after fabrication to ASTM A123/A123M to minimum 600 g/sq m galvanized coating.

3. EXECUTION

3.04 EXAMINATION

- .1 Verify conditions as satisfactory to receive work of this Section.
- .2 Verify dimensions, tolerances, and method of attachment with other work.
- .3 Beginning work constitutes acceptance of existing conditions.
- .4 Verify layout of fall arrest anchors and that structural connections are suitable for work of this Section.

3.05 PREPARATION

- .1 Supervise and assist in setting of anchorage devices required for installation of work of this Section, but which do not form a part of the work of this Section.

3.06 INSTALLATION

- .1 Install items plumb and level, accurately fitted, free from distortion or defects.
- .2 Provide for erection loads, and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.
- .3 Site weld components as indicated on shop drawings. Perform site welding.
- .4 Obtain approval from Consultant prior to site cutting or making adjustments not scheduled.
- .5 After erection, apply primer in accordance with MPI Painting Manual to: welds, abrasions, and surfaces not shop primed or galvanized, except surfaces in contact with concrete.
- .6 Thread aircraft cable through eye-lets at top of post, to linear roof coverage of post restraints; pressure crimp cable ends.
- .7 Install roof support flashing in accordance with manufacturer's printed instructions.

3.07 ERECTION TOLERANCES

- .1 Maximum Variation from Plumb/Level: 6 mm.

3.08 PROTECTION OF FINISHED WORK

- .1 Protect finished Work from damage.

3.09 CLEANING

- .1 Clean manufactured units using materials and methods approved by manufacturer. Do not use cleaners or techniques which could impair performance of the roofing system.

END OF SECTION

1. GENERAL**1.01 SUMMARY**

- .1 This Section includes requirements for design, supply and installation of mineral fibre mineral fibre fireproofing, having a fire resistance rating of 1 hour applied to underside of steel decking, supporting structural steel framing as indicated on the Drawings including but not limited to, work required to patch, repair and make good after installation of adjacent materials that may cause damage to completed work of this Section.
- .2 Structural steel elements that are protected a rated gypsum board assembly do not require protection using materials specified in this Section provided that protection provided meets required fire resistance as determined from Chapter 2 of Supplement to Building Code.

1.02 RELATED REQUIREMENTS

- .1 Section 03 31 00 – Structural Concrete: Protection of concrete structures susceptible to fire damage.
- .2 Section 05 05 19 – Common Work Results for Metalwork Finishing: Coordination of surface preparation and priming requirements for structural steel surfaces.
- .3 Section 05 12 00 – Structural Steel Framing: Substrate preparation for structural steel framing requiring fire rating.
- .4 Section 05 31 00 – Steel Decking Substrate preparation for steel decking requiring fire rating.
- .5 Section 07 05 53 – Fire and Smoke Assembly Design Requirements and Identification: Coordination of fire rating systems, and design and submittal requirements.
- .6 Section 07 25 19 – Foamed-In-Place Insulation: Thermal protection for exposed plastic insulation.
- .7 Section 07 84 00 – Firestopping

1.03 REFERENCE STANDARDS

- .1 American Society for Testing of Materials (ASTM):
 - .1 ASTM E119-18ce1, Standard Test Methods for Fire Tests of Building Construction and Materials
 - .2 ASTM E605-93 (2015), Tests for Thickness and Density of Sprayed Fire-Resistive Material Applied to Structural Members
 - .3 ASTM E736-00 (2015), Standard Test Method for Cohesion/Adhesion of Sprayed Fire-Resistive Materials Applied to Structural Members
 - .4 ASTM E759-92 (2015)e1, Standard Test Method for Effect of Deflection on Sprayed Fire-Resistive Material Applied to Structural Members
 - .5 ASTM E761-92 (2015)e1, Standard Test Method for Compressive Strength of Sprayed Fire-Resistive Material Applied to Structural Members
 - .6 ASTM E859-93 (2015)e1, Standard Test Method for Air Erosion of Sprayed Fire-Resistive Materials (SFRMs) Applied to Structural Members
- .2 Underwriters Laboratories of Canada (ULC):
 - .1 CAN/ULC S101-14, Fire Endurance Tests of Building Construction and Materials
 - .2 CAN/ULC S102-10 Surface Burning Characteristics of Building Materials and Assemblies
 - .3 ULC List of Equipment and Materials

- .3 National Fire Protection Association (NFPA):
 - .1 NFPA 251-06, Standard Methods of Fire Tests of Building Construction and Materials

1.04 ADMINISTRATIVE REQUIREMENTS

- .1 Coordination: Coordinate with Section 05 05 19 so that steel surfaces meet manufacturer's minimum surface preparation requirements for bond surface, free from wax, grease or other deleterious material that could affect bond of materials specified in this Section, and as follows:
 - .1 Coordinate installation of hangers, inserts, clips and similar items to surfaces needing protection before applying mineral fibre fireproofing.
 - .2 Coordinate installation of ducts, pipes, conduits and similar items that could obstruct spraying operations before applying mineral fibre fireproofing.
 - .3 Coordinate patching of mineral fibre fireproofing after installation of materials installed subsequent to installation of mineral fibre fireproofing.
- .2 Delegated Design: Provide engineered judgements and certification for work performed by this Section in accordance with requirements of Authority Having Jurisdiction and Section 01 33 50 – Delegated Design Submittals.

1.05 SUBMITTALS

- .1 Provide required information in accordance Section 01 00 06 – General Requirements: Submittals.
- .2 Action Submittals: Provide the following submittals before starting any work of this Section:
 - .1 Product Data: Submit product data including certified copies of test reports verifying fire resistant material applied to substrate as constructed on project will meet or exceed requirements of specification.
 - .2 Installation Schedule: Submit schedule listing surfaces to which fire resistant material is applied, indicating minimum thickness required a minimum of one month prior to scheduled application of cementitious fireproofing material.
- .3 Informational Submittals: Provide the following submittals when requested by the Consultant:
 - .1 Certificates: Submit test results in accordance with CAN/ULC S101 for fire endurance and CAN/ULC S102 for surface burning characteristics.
 - .2 Delegated Design Submittals: Design intumescent coating thickness required by the Contract Documents to withstand fire ratings indicated and in accordance with requirements of the Building Code, and as follows:
 - .1 Provide manufacturers standard listing where site conditions match standard assembly listings.
 - .2 Provide manufacturers engineered judgment, indicating acceptance by the authorities having jurisdiction, signed and sealed by manufacturer's design engineer, where assembly does not match standard assembly listing.

1.06 QUALITY ASSURANCE

- .1 Regulatory Requirements: Use materials and methods required to achieve fire resistance ratings required for the Project to the satisfaction of the Authority Having Jurisdiction, by 2014 Alberta Building Code and in accordance with referenced standards.
- .2 Qualifications: Provide proof of qualifications when requested by Consultant:
 - .1 Applicator: Use applicators that are licensed or approved by manufacturer of fire resistant material.

- .2 Materials: Use materials produced under label service of an agency that has tested material, or assemblies containing material, in accordance with specified test standards.
- .3 Air Quality: Provide ventilation in areas receiving fire resistant material during and 24 hours after application to dry material; maintain non-toxic, unpolluted working area; provide temporary enclosure to prevent spray from contaminating air.
- .3 Certifications: Provide the following during the course of the Work:
 - .1 Compliance Certification: Provide certificates from manufacturer indicating tested performance requirements required by Authorities Having Jurisdiction.
 - .2 Letters of Commitment and Compliance: Provide documents prepared by the delegated design professional engineer as recommended by APEGA's Responsibilities for Engineering Services for Building Projects in accordance with Section 01 33 50 – Delegated Design Submittals.

1.07 DELIVERY, STORAGE AND HANDLING

- .1 Delivery and Acceptance Requirements: Deliver in original undamaged sealed containers with manufacturer's labels, application instructions, and labelling agency's labels intact.
- .2 Storage and Handling Requirements: Store materials in dry protected area, raised off ground and away from damp surfaces and conditions that have deleterious effect on materials; keep materials dry until ready for use; discard material that has been exposed to water before actual use; use stock before its expiration date.

1.08 SITE CONDITIONS

- .1 Ambient Conditions: Apply fireproofing materials when temperature of substrate and surrounding air is above manufacturer's minimum temperature, provide sufficient ventilation to aid curing of materials and to maintain air quality requirements.

2. PRODUCTS

2.01 MANUFACTURERS

- .1 Acceptable Materials Manufacturers: Subject to compliance with requirements specified in this Section; where multiple listings of manufacturers occur, use any of the following listed manufacturers' products in accordance with Section 01 00 06 – General Requirements: Substitutions and Product Options including the following:
 - .1 Carboline Company, A/D Fire Protection Systems Inc.
 - .2 Celufibre Industries Inc.
 - .3 Grace Construction Products
 - .4 Isolatak International Inc., Cafco Industries Limited
- .2 Substitutions: Consultant may consider additional manufacturers having similar products to Acceptable Materials Manufacturers listed above during the construction period, provided they meet the performance requirements established by the named products and provided they submit requests for substitution in accordance with Section 01 00 06 – General Requirements: Substitutions and Product Options before starting any work of this Section:
 - .1 Do not use substitute materials to establish Bid Price.
 - .2 Substitutions that appear as a part of the project without review and acceptance by the Consultant will be rejected, and replaced with one of the specified materials.

2.02 APPLIED FIREPROOFING**.1 Design Criteria:**

- .1 Adhesion: Provide materials that meet or exceed adhesion requirements in accordance with ASTM E736.
- .2 Thickness and Weight: Determine application thickness and weight of mineral fibre fireproofing based on tests of assemblies in accordance with CAN/ULC S101, ASTM E119 or NFPA 251; apply same thickness of fireproofing material to all structural components forming a part of the assembly including; but not limited to, cross bracing, support angles and hangers.
- .3 Engineered Judgements: Provide engineered judgement acceptable to Authority Having Jurisdiction where assembly being protected differs from the tested assembly used to determine thickness.

.2 Thermal Barrier for Foamed-In-Place Insulation (Flame Spread Protection): Spray applied, cement based fire resistant material, wet mix spray applied fireproofing meeting requirements of CAN/ULC S101, CAN/ULC S124, ASTM E736, ASTM E759, ASTM E761 and ASTM E859; containing no asbestos fibre, ULC labelled and listed for assemblies and fire ratings indicated on Drawings, and as follows:

- .1 Water: Potable, clean and free from injurious amounts of deleterious substances.
- .2 Damming Materials: In accordance with the tested assembly being installed as acceptable to Authorities Having Jurisdiction, and as recommended by manufacturer.
- .3 Firestopping Mortar: Cementitious, single component fire resistive mortar coating; charcoal colour, tested listed and certified by ULC.
- .4 Acceptable Materials:
 - .1 Carboline Company, A/D Fire Protection Systems, Cementitious Thermal Barrier, Type 7TB
 - .2 CCI Manufacturing Inc., HiBAR Spray Applied Fire Resistant Material
 - .3 Isolatek International Inc., Cafco Industries Ltd., Blaze-Shield II
 - .4 W.R. Grace Construction Materials, Monokote Type Z-3306

.3 Vermiculite-Cement Based Fire Resistant Material: Wet mix spray applied cement based fireproofing meeting requirements of ASTM E736, ASTM E759, ASTM E761 and ASTM E859; containing no asbestos fibre, ULC labelled and listed for assemblies and fire ratings, and as follows:

- .1 Acceptable Materials:
 - .1 Carboline, A/D Southwest Fireproofing Type 7 GP
 - .2 Isolatek, Cafco Blaze-Shield II
 - .3 Grace, Monokote Z-106

.4 Water: Clean, fresh, suitable for domestic consumption, and free from such amounts of mineral or organic substance as would affect set of fire resistant material.**.5 Primer/Adhesive:** Manufacturers recommended primer and adhesive enhancing bonding material forming a part of fire resistant system for coated or hard to bond to substrates.**3. EXECUTION****3.01 EXAMINATION**

- .1 Verification of Conditions: Verify that environmental conditions surfaces receiving mineral fibre fireproofing meet manufacturer's requirements before beginning installation products specified in this Section; installation of products will denote acceptance of site conditions.

3.02 PREPARATION**.1 Protection of Existing Conditions:**

- .1 Provide and maintain temporary enclosures to prevent spray from marring adjacent construction, close off and seal installed duct work to prevent contamination of air supply system.
- .2 Provide and maintain masking, drop cloths and polyethylene coverings to protect surfaces exposed in final construction from over spray.

.2 Surface Preparation:

- .1 Clean surfaces receiving sprayed fireproofing of oil, grease, dirt, loose paint, mill scale or any other material that could impair bond.
- .2 Prime surfaces as required by manufacturer to achieve bond of fireproofing materials to substrates.

3.03 APPLICATION

- .1 Apply mineral fibre fireproofing in accordance with manufacturer's written installation requirements and as required to obtain fire resistance ratings indicated for the Project.
- .2 Apply mineral fibre fireproofing in coats not exceeding recommended by manufacturer for fire resistance ratings indicated for the Project.
- .3 Mix each batch of material separately in accordance with manufacturer's instructions to achieve required density and thickness; do not re-temper material or use frozen, caked, or lumpy material.
- .4 Cut, patch, and repair material that does not meet requirements of this Section or which that fails to attain properties stipulated in reports of tests used to determine fire resistance rating of assembly.
- .5 Repair damage to fire resistant material caused by installation of subsequent Work.

3.04 SITE QUALITY CONTROL

- .1 Site Testing and Inspections: Site testing and inspections will be performed in accordance with requirements specified in Section 01 00 06 – General Requirements: Quality Control and as follows:
 - .1 The City may appoint third party inspection and testing agency to confirm that installation of mineral fibre fireproofing meets requirements of ASTM E605 and ASTM E736.
 - .2 One series of tests will be performed using both laboratory and site testing for each 1000 m² of floor area sprayed; patch and repair inspection locations after completion of cut tests.
 - .3 Test results will be distributed to Contractor and installing Subcontractor at completion of each floor by Consultant.
- .2 Non-Conforming Work: Repair deficiencies identified in test results; patch damage to mineral fibre fireproofing caused by other work of the Project before mineral fibre fireproofing is concealed; or if exposed, before substantial performance.

3.05 CLOSEOUT ACTIVITIES

- .1 Cleaning: Remove equipment and clean exposed wall and floor areas to remove deposits of sprayed mineral fibre fireproofing materials after completion of mineral fibre fireproofing work.

END OF SECTION

1. GENERAL

1.01 SUMMARY

- .1 This Section includes requirements for design, supply and installation, and enhanced review of static penetrations, membranes and joint firestop systems using materials or a combination of materials required to preserve the integrity and to prevent the passage of fire and smoke in assemblies having a Fire-Resistance Rating in accordance with the requirements of the Building Code.
- .2 Firestop systems are required at the following locations having a Fire-Resistance Rating:
 - .1 Penetrations through horizontal assemblies requiring protected openings including empty openings and openings that contain penetrating components.
 - .2 Penetrations through vertical assemblies including empty openings and openings that contain penetrating components.
 - .3 Membrane penetrations in wall assemblies where items penetrate only one side of the barrier.
 - .4 Joints in assemblies that allow for independent movement between assembly components.
 - .5 Perimeter of horizontal assemblies having a Fire-Resistance Rating and exterior wall assemblies.
 - .6 Joints, through penetrations and membrane penetrations in assemblies intended to limit, restrict or retard the circulation of smoke.
- .3 This Section includes requirements for Fire-Resistance Rated systems requiring Engineering Judgements in accordance with Section 07 05 53 – Fire-Resistance Rated Assembly Design and Identification, and that account for the following restrictions:
 - .1 Products that have not been tested in a system or that are not capable of obtaining an Engineering Judgement will not be acceptable for use on this Project.
 - .2 Materials having only a ULC or cUL label will not be acceptable for use on this Project, unless supporting documentation is provided indicating its use in a ULC Rated Assembly Listing for Firestop Systems and Components of an Engineering Judgement specific to the installation conditions of the project.
- .4 This Section includes requirements for installation of firestop systems under a single source of responsibility; either through direct supervision of the Contractor or a single trade responsibility performed by a specialty Subcontractor at the choice of the Contractor.

FIRESTOPPING

- .5 This Section includes requirements for installers that have completed the ULC Qualified Firestop Contractor Program, that can demonstrate knowledge for the selection and installation of firestop systems, obtain Engineering Judgements as necessary for the Project, and that have an integrated approach to controlling material selection and management of the installation process as required by this Specification and the Authority Having Jurisdiction.



- .6 This Section includes requirements for third-party verification of installed firestop system components forming a part of the work of this Section by an inspection agency that employs personnel who are qualified to perform this work in accordance a recognized training program acceptable to the Consultant and Authority Having Jurisdiction.

1.02 DEFINITIONS

- .1 Additional Definitions: Additional definitions associated with work of this Section are described in Section 07 05 53; coordinate and incorporate common work requirements specified in Section 07 05 53 with work of this Section.
- .2 Fire-Resistance Rating: The time in minutes or hours that a material or assembly of materials will withstand the passage of flame and transmission of heat when exposed to fire meeting the requirements of CAN/ULC S101 or as determined by formal testing of material or assembly of materials meeting requirements of CAN/ULC S115, or an interpretation of information derived from formal testing in accordance with requirements of the Building Code and acceptable to the Authority Having Jurisdiction.
- .3 Fire Separation: Assembly that acts as a barrier against the spread of fire, smoke and noxious gases resulting from combustion as defined by the Building Code and includes the following assemblies having a Fire-Resistance Rating requiring firestopping as follows:
- .1 Penetration-Type firestop systems located within load bearing walls and partitions.
 - .2 Penetration-Type firestop systems located within non-load bearing walls and partitions.
 - .3 Penetration-Type located within floor assemblies.
 - .4 Building Perimeter-Type located between floor assemblies and exterior wall and roof construction.
 - .5 Penetration-Type located within roof assemblies.
 - .6 Construction Joint-Type and other assemblies having a Fire-Resistance Rating indicated on Drawings or Schedules.

FIRESTOPPING

- .4 Fire Compartment: Spaces within a building that are enclosed by exterior walls or separated from other parts of the building by enclosing Fire Separations having a Fire-Resistance Rating.
- .5 Firewall: Assembly that is a Fire Separation constructed from non-combustible construction subdividing a building or separating adjoining buildings to resist the spread of fire and that has a Fire-Resistance Rating, and structural stability to remain intact under fire conditions for the required fire-rated time.
- .6 Smoke Barriers/Partitions: Barriers, partitions and other assemblies that are sealed to limit the spread of smoke and noxious gases as follows:
 - .1 Assembly Type: Construction of Smoke Barriers is identical to a minimum 1-hour Fire-Resistance Rating described above that does not require ULC Fire-Resistant Assembly Listing.
 - .2 Leakage Rate: Smoke Barriers must be sealed to limit the passage of smoke and noxious gases at ambient and elevated temperatures to a maximum of 25 litres/s•m² when subjected to a pressure difference of 75 Pa at 24°C and 200°C.
- .7 Firestop: System consisting of a material, component or combination of materials and components used to fill gaps between Fire Separations or between Fire Separations and other assemblies or used around items that wholly or partially penetrate a Fire Separation.
- .8 Membrane Penetration: An opening made through one side of an assembly having a Fire-Resistance Rating; and that is not an opening that penetrates completely through that assembly, and that a firestop system is installed to maintain the integrity of the Fire-Resistance Rating of that assembly.
- .9 Qualified Supervisor or Installer: The Contractor's supervisor or a specialty Subcontractor that can demonstrate their skill and knowledge for the design and installation of firestop systems of similar complexity and extent required for the Project, and that can certify installation was completed in accordance with ULC Listed Assemblies submitted as a component of shop drawing Submittals.
- .10 ULC Qualified Firestop Contractor: A Subcontractor that has completed the ULC Qualified Firestop Contractor Program, and that can provide proof of annual audit proving continued compliance with the program.

1.03 REFERENCE STANDARDS

- .1 American Society for Testing and Materials (ASTM International):
 - .1 ASTM E2174-14b, Standard Practice for On-Site Inspection of Installed firestops
 - .2 ASTM E2393-10a (2015), Standard Practice for On-Site Inspection of Installed Fire Resistive Joint Systems and Perimeter Fire Barriers

FIRESTOPPING

- .2 Factory Mutual (FM):
 - .1 FM 4991-13, Approval Standard of Firestop Contractors
 - .2 FM 4990-09, Approval Standard for Firestopping
- .3 International Firestop Council (IFC):
 - .1 Recommended IFC Guidelines for Evaluating Firestop Systems in Engineering Judgments
 - .2 Recommended IFC Guidelines for Evaluating Firestop Systems in Engineering Judgements: Perimeter Fire Barrier Systems
 - .3 Recommended IFC Guidelines for Evaluating Firestop Systems in Engineering Judgments on Fire Resistant Duct Enclosure Systems for Ventilation Ducts
 - .4 Recommended IFC Guidelines for Evaluating Firestop Systems in Engineering Judgments on Fire Resistant Duct Enclosure Systems for Commercial Kitchen Exhaust Ducts
- .4 Firestop Contractors International Association (FCIA):
 - .1 FCIA Manual of Practice
- .5 Underwriters Laboratories of Canada (ULC):
 - .1 ULC Firestop Systems and Components, 2015 Edition
 - .2 CAN/ULC S101-14, Fire Endurance Tests of Building Construction and Materials
 - .3 CAN/ULC S102-11, Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies
 - .4 CAN/ULC S114-05, Test for Determination of Non-Combustibility in Building Materials
 - .5 CAN/ULC S115-11, Fire Tests of Firestop Systems

1.04 ADMINISTRATIVE REQUIREMENTS

- .1 Scheduling: Submit a schedule listing surfaces and components that firestopping materials and components are being applied sufficiently in advance of installation of any through penetration and perimeter containment firestop systems to allow for full coordination of adjacent assemblies, obtaining any required Engineering Judgements or Equivalent Fire Resistance Rated Assembly, and to allow for a detailed review by the Consultant, and as follows:
 - .1 Schedule installation of cast-in-place firestop systems, components or devices to coincide with installation of concrete formwork or metal decking before placement of concrete.
 - .2 Schedule installation of drop-in type firestop systems, components or devices after placement of concrete, and to coincide with installation of piping, conduit or other penetrating components.
 - .3 Schedule installation of other firestop systems after completion of penetrating item installation, before covering or concealing of openings, joints and penetrations.

FIRESTOPPING

- .2 Coordination: Project coordination is essential to inform and educate all contributors involved with or affected by installation of firestopping systems, so that their role in protecting and maintaining the integrity of firestopping systems is understood, and as follows:
 - .1 Coordinate with other trades and verify that pipes, conduit, cable, and other items penetrating Fire-Resistance Rated assemblies are permanently installed prior to installation of firestop assemblies.
 - .2 Coordinate construction of openings and penetrating items and verify that firestop systems are installed according to specified requirements and as follows:
 - .3 Coordinate sizing of sleeves, openings, core drilled holes, or cut openings to accommodate firestop systems; diameter of sleeves or cored holes must match listed system for the device.
 - .4 Leave firestopping installations that will be concealed behind other construction open until Consultant and building inspector; if required by Authority Having Jurisdiction, have examined each installation.
- .3 Pre-Construction Meeting: Arrange a pre-construction meeting in accordance with Section 01 00 06 – General Requirements: Project Meetings, attended by Contractor, Subcontractor responsible for firestopping, firestop manufacturers’ representatives, subcontractors affected by work of this Section, and the Consultant to discuss the following requirements:
 - .1 Confirm locations, quantity and types of firestop systems for required site Mock-Ups.
 - .2 Confirm extent of standard materials and systems, and identify materials and systems that will require Engineering Judgements or Equivalent Fire Resistance Rated Assemblies
 - .3 Confirm site conditions, coordination issues and single source installation responsibility for application of firestop systems; either by a specialty firestop Subcontractor or the by the Contractor where Contractor can show proof of qualifications required by this Section.

1.05 SUBMITTALS

- .1 Provide required information in accordance with Section 01 00 06 – General Requirements: Submittals and Section 07 05 53 where Engineering Judgements or Equivalent Fire Resistance Rated Assemblies are required to complete project installation conditions.
- .2 Action Submittals: The following are required before starting any work of this Section:
 - .1 Product Data: Submit manufacturer’s product data for materials and prefabricated devices as follows:
 - .1 Include manufacturer’s installation instructions, descriptions of system composition and limitations of installation.

FIRESTOPPING

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- .2 Include confirmation that installed systems meet requirements of ULC or cUL firestop Systems and Components where installation fully matches listed assembly.
 - .3 Include copies of Equivalent Fire Resistance Rated Assembly where similar conditions as tested assemblies do not meet project installation conditions, and where installation does not require a full Engineering Judgement.
 - .4 Include copies of Equivalent Fire Resistance Rated Assembly or Engineering Judgements clearly indicating EFRRR and EJ identification numbers, project name, installing Subcontractor's name when no ULC or cUL system is available meeting project installation conditions.
- .2 Firestop System Schedule: Submit schedule prepared by installing Subcontractor indicating locations of firestop systems as follows:
- .1 Consultant's Project Number and Project Name.
 - .2 Installing Subcontractor's Name and Address.
 - .3 Listing of Manufacturers Names and Addresses for products used on the Project.
 - .4 Name of Contractor's Qualified Supervisor.
 - .5 Manufacturers' Product Reference for each type of penetrating item and joint sealant, including:
 - Listing Agency (ULC, cUL or FM) Number for each different location and assembly type.
 - Designated Rating (F, T, FT, H, W or L) appropriate to the penetrations or joint condition.
 - .6 Types of assemblies being penetrated, listing Fire-Resistance Ratings and thickness of construction.
 - .7 EFRRR and EJ numbers for non-classified firestop systems.
- .3 Informational Submittals: The following are required before starting any work of this Section:
- .1 Material Certificates: Submit written certification prepared by firestopping manufacturer stating that products supplied to the Project comply with local regulations controlling use of volatile organic compounds (VOCs) and are non-noxious to building occupants.
 - .2 Installer Qualifications: Submit copies of ULC Certificates indicating that Subcontractor has completed the requirements of the ULC Qualified Firestop Contractor Program and participates in the ULC annual audit to maintain those qualifications.

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1.06 QUALITY ASSURANCE

- .1 Regulatory Requirements: Use materials and methods of determining required thickness of application that have the full acceptance of Authority Having Jurisdiction and that are tested in accordance with ULC S115 and that form a part of a ULC or cUL listed system, Engineering Judgement or Equivalent Fire Resistance Rated Assembly.
- .2 Qualifications: Provide proof of qualifications when requested by Consultant:
 - .1 Fire-Resistance Ratings: Products used in assemblies having a Fire-Resistance Rating must be constructed, applied or installed in accordance with assemblies tested and approved by agencies acceptable to the Authority Having Jurisdiction.
 - .2 Products: Provide systems having fire test response characteristics in accordance with requirements specified in Section 07 05 53 and as follows:
 - .1 Individual products and materials containing only a testing agency mark without reference to a specific ULC or cUL listed assembly are not acceptable.
 - .2 Use only materials matching the tested and listed system; do not mix materials from of different manufacturers in the same firestop system or opening that do not form a component of the tested and listed system.
 - .3 Single source of product and materials responsibility is not required, multiple product and material sourcing is encouraged to obtain the widest selection of tested and listed systems for the project.
 - .4 Products from different manufacturers are permitted; provided they are not intermixed with other manufacturers' products, to maintain maximum opportunity for installation of tested and listed systems.
 - .5 Use a different manufacturer that has a tested and listed system before submitting an Engineering Judgment or Equivalent Fire Resistance Rated Assembly.
 - .3 Limitations of Qualifications: Installation of products and materials specified in this Section require experienced installers that are certified or otherwise licensed, and who have received installation training provided by firestopping manufacturers:
 - .1 Willingness from a supplier or manufacturer to sell fireproofing products to entities other than those qualified to perform work of this Section as specified, does not confer qualifications to the buyer of those products.
 - .2 Failure to provide proof of qualifications when requested by the Consultant will denote automatic rejection of any firestop system proposed for use.

FIRESTOPPING

- .4 Installer: Use a firestopping Subcontractor that has completed the ULC Qualified Firestop Contractor Program and that employs experienced applicators having experience with similar systems and complexity as required for the Project, using proper equipment in strict accordance with manufacturer's written installation instructions, Engineering Judgements or Equivalent Fire Resistance Rated Assembly.; Consultant will also accept Subcontractor's meeting requirements for FM 4991 Approved Firestop Contractors
- .5 Single Source Installation Responsibility: Obtain firestop systems, for each kind of penetration and construction condition required for the project from a single source of installation responsibility.

1.07 MOCK-UPS

- .1 Required Mock-Ups: Provide required Mock-Ups in accordance with Section 01 00 06 – General Requirements: Quality Control before starting work of this Section as follows:
 - .1 Install Mock-Ups for each different firestop system required for the project to verify selections and demonstrate quality of materials and installation.
 - .2 Locate Mock-Ups on site at locations appropriate to firestop system installation conditions as agreed upon between the Contractor and Consultant during the Pre-Construction Meeting.
 - .3 Consultant will review Mock-Ups for conformance to product data, Engineering Judgements and Equivalent Fire Resistance Rated Assemblies submitted for review.
 - .4 Protect acceptable Mock-Ups during construction, Mock-Ups will be used as a standard for judging completeness and acceptance of work performed by this Section.
- .2 Acceptance of Mock-Ups: Accepted Mock-Ups will form a part of final construction provided they are undisturbed at time of Substantial Performance.

1.08 DELIVERY, STORAGE, AND HANDLING

- .1 Delivery and Acceptance Requirements: Deliver and store materials in a dry protected area, in original undamaged sealed containers with the manufacturer's labels, application instructions, and labelling agency's labels intact.
- .2 Storage and Handling Requirements: Keep materials dry until ready for use and as follows:
 - .1 Keep the packages of material off the ground, under cover, and away from sweating walls and other damp surfaces. Discard material that has been exposed to water before actual use.
 - .2 Use stock before its expiration date.

FIRESTOPPING

1.09 SITE CONDITIONS

- .1 Installation Conditions: Install firestopping materials only when the areas in which they are scheduled are closed-in and protected from dampness.
- .2 Ambient Conditions: Install firestop systems when ambient or substrate temperatures are within temperature and moisture limits permitted by firestopping system manufacturers or when substrates are not wet due to rain, frost, condensation, or other causes.
- .3 Ventilation: Ventilate areas where firestop systems are being installed in accordance with manufacturer's written instructions by natural means or forced air circulation where natural means are not adequate.

2. PRODUCTS

2.01 MANUFACTURERS

- .1 Acceptable Products Manufacturers: Subject to compliance with requirements specified in this Section; where multiple listings of manufacturers occur, use any of the following listed manufacturers' products in accordance with Section 01 00 06 – General Requirements: Substitutions and Product Options including the following:
 - .1 Carboline Company, A/D Fire Protection Systems Inc.
 - .2 Passive Fire Protection Partners
 - .3 Hilti Inc.
 - .4 Roxtec
 - .5 Specified Technologies Inc.
 - .6 3M
 - .7 Tremco Ltd.
- .2 Substitutions: Consultant may consider additional manufacturers having similar products to Acceptable Products Manufacturers listed above during the construction period, provided they meet the performance requirements established by the named products and provided they submit requests for substitution in accordance with Section 01 00 06 – General Requirements: Substitution and Product Options before starting any work of this Section:
 - .1 Do not use substitute materials to establish Bid Price.
 - .2 Substitutions that appear as a part of the project without review and acceptance by the Consultant will be rejected and replaced with one of the specified materials.

2.02 SUSTAINABLE PERFORMANCE REQUIREMENTS

- .1 Indoor Air Quality: Provide products used within the building envelope (interior side of weatherproofing system) that are manufactured using low-VOC emitting formulations.

FIRESTOPPING

2.03 DESIGN REQUIREMENTS

- .1 Design Responsibility: Design firestopping required for the Project to withstand assembly fire performance requirements described on Drawings in accordance with the Building Code, and as described in Section 07 05 53, and as follows:
 - .1 Design firestop systems for empty openings and openings containing penetrating items through Fire Compartments.
 - .2 Design firestop systems that are manufactured to resist spread of fire in accordance with specified requirements, that resist passage of smoke and noxious gases, and that maintain original Fire-Resistance Rating of construction penetrated.
 - .3 Design firestopping at openings intended for ease of re-entry such as cables using elastomeric or flexible seals; do not use cementitious or rigid seals at these locations.
 - .4 Design firestopping at openings around penetrations for pipes, ductwork and other mechanical items requiring sound and vibration control using elastomeric or flexible seals; do not use cementitious or rigid seal at these locations.
 - .5 Design firestopping at fire damper locations so as not to restrict the expansion or contraction of the penetrating ductwork and does not interfere with the ability of the damper to drop into place and operate correctly.
 - .6 Design firestopping using tested assemblies to the greatest extent possible; use of Engineering Judgements and Equivalent Fire Resistance Rated Assemblies should only be submitted for review when a tested assembly is not available from any of the listed acceptable manufacturers.
 - .7 Design firestopping for the following conditions:
 - .8 Smoke Barriers: Provide materials meeting the following criteria:
 - .1 Performance Rating: L-Rated, Ambient Temperature Only.
 - .2 Assembly Rating: Not Required.
 - .3 Nominal Joint Width: As indicated.
 - .4 Movement Capabilities: Compression and extension
 - .9 Penetrations: Provide materials meeting the following criteria:
 - .1 Performance Rating: F, FT or FTW-Rated applicable to assembly being penetrated.
 - .2 Assembly Rating: Time rating for Fire-Resistance Rating and Temperature Rise Resistance Rating applicable to assembly being penetrated.
 - .3 Nominal Annular Width: As indicated.
 - .4 Movement Capabilities: Not Required.

FIRESTOPPING

- .10 Floor-to-Wall, Fire Resistive Joint System: Provide materials meeting the following criteria:
 - .1 Performance Rating: F, FT or FTW-Rated applicable to assembly being penetrated.
 - .2 Assembly Rating: Time rating for Fire-Resistance Rating and Temperature Rise Resistance Rating applicable to assembly being sealed.
 - .3 Nominal Joint Width: As indicated.
 - .4 Movement Capabilities: Compression, extension and horizontal shear.

- .11 Head-of-Wall, Fire Resistive Joint System: Provide materials meeting the following criteria:
 - .1 Performance Rating: F or FT-Rated applicable to assembly being penetrated.
 - .2 Assembly Rating: Time rating for Fire-Resistance Rating and Temperature Rise Resistance Rating applicable to assembly being sealed.
 - .3 Nominal Joint Width: As indicated.
 - .4 Movement Capabilities: Compression and extension.

- .12 Wall-to-Wall, Fire Resistive Joint System: Provide materials meeting the following criteria:
 - .1 Performance Rating: F or FT-Rated applicable to assembly being penetrated.
 - .2 Assembly Rating: Time rating for Fire-Resistance Rating and Temperature Rise Resistance Rating applicable to assembly being sealed.
 - .3 Nominal Joint Width: As indicated.
 - .4 Movement Capabilities: Compression and extension.

- .13 Curtainwall Perimeter Fire Containment System: Provide materials meeting the following criteria:
 - .1 Performance Rating: F or FW-Rated applicable to assembly being penetrated.
 - .2 Assembly Rating: 1 hour time rating for Fire-Resistance Rating and Water Resistance Rating applicable to assembly being sealed.
 - .3 Closure Rating: $\frac{3}{4}$ hour.
 - .4 Linear Opening Width: As indicated.

FIRESTOPPING

- .2 Performance Requirements: Provide manufacturer's proprietary assemblies designed to seal penetrations through and perimeters around Fire Separation or Firewall assemblies having a Fire-Resistance Rating equal to or greater than the Fire-Resistance Rating of the Fire Separation or Firewall assemblies in accordance with REFERENCE STANDARDS and the Building Code, and as follows:
- .1 Thickness and Composition of Materials: Determine thickness and composition of applied materials based on tests of assemblies identical to the assembly being protected where possible.
 - .2 Engineering Judgements: Determine system composition based on available engineering studies, or correspondence with the labelling agency indicating the effect that differences within Fire Separation where the assembly is protected but does not correspond exactly to a tested assembly; confirm acceptance of system by local Authority Having Jurisdiction in writing.
 - .3 Equivalent Fire Resistance Rated Assembly: Use the same system and material as would be required for a tested assembly with similar conditions where the assembly includes conditions that do not correspond to those included in any previously tested assembly and that do not have relevant engineering information available at the time of installation.

2.04 ASSEMBLIES

- .1 Systems: Provide firestop systems that are tested in accordance with ULC S115, comprised of asbestos free materials capable of maintaining an effective barrier against flame, smoke and noxious gases, and sized for opening sizes for which they are intended based on Fire-Resistance Ratings indicated on Drawings and as follows:
- .1 Penetrations: Provide firestopping to penetrations passing through fire-resistance rated wall and floor assemblies, and other locations indicated on Drawings:
 - .1 F-Rated Through-Penetration Firestop Systems: Provide through-penetration firestop systems that resist passage of smoke and noxious gases at ambient and elevated temperatures, with F and L ratings meeting or exceeding the fire-resistance ratings of construction being penetrated.
 - .2 T-Rated Through-Penetration Firestop Systems: Provide firestop systems with T ratings in addition to F ratings described above when temperature rise resistance is a performance requirement of construction being penetrated.
 - .3 L-Rated Through-Penetration Firestop Systems: Provide firestop systems with L ratings for assemblies requiring only ambient temperature smoke and noxious gas resistance, without additional F or T requirements.

FIRESTOPPING

- .4 W-Rated Through-Penetration Firestop Systems: Provide firestop systems with W ratings, in addition to F, T and L ratings when site conditions require water resistance as an assembly performance requirement.
- .2 Perimeter Fire Containment Systems: Provide interior perimeter fire containment systems with fire-resistance ratings in accordance with ASTM E2307.
- .3 Systems Exposed to View: Provide products that after curing do not deteriorate when exposed to traffic, moisture, and physical damage and as follows:
 - .1 Provide moisture resistant through penetration firestop systems for piping penetrations for plumbing and wet pipe sprinkler systems, and at the floor joint of fire rated gypsum board assemblies.
 - .2 Provide firestop systems capable of supporting floor loads involved either by installing floor plates or by other means for floor penetrations with annular spaces exceeding 100 mm in width and exposed to possible loading and traffic.
 - .3 Provide firestop systems not requiring removal of insulation for penetrations involving insulated piping.
 - .4 Provide products with flame spread ratings of less than 25 and smoke developed ratings of less than 50 for firestopping and joint systems exposed to view in accordance with CAN/ULC S102.
- .2 Compatibility: Provide firestop systems that are compatible with one another, with the substrates forming openings, and with the items penetrating firestop systems, under conditions of service and application, as demonstrated by firestopping system manufacturer based on testing and site experience, and as follows:
 - .1 Service Penetration Assemblies: Certified by ULC in accordance with ULC S115 and listed in ULC List of Equipment and Materials, Firestop Systems and Components.
 - .2 Service Penetration Firestopping Components: Certified by ULC in accordance with ULC S115 and listed in ULC List of Equipment and Materials, Firestop Systems and Components.
 - .3
- .3 Accessories: Provide components for each firestopping system that are needed to install fill materials and to comply with REFERENCE STANDARDS, using only components specified by firestopping system manufacturer and approved by the qualified testing and inspecting agency for firestop systems indicated. Accessories include, but are not limited to, the following items:
 - .1 Permanent forming, damming and backing materials, including the following:
 - .1 Slag or rock wool fibre insulation.
 - .2 Sealants used in combination with other forming, damming or backing materials to prevent leakage of fill materials in liquid state.

FIRESTOPPING

- .3 Fire rated form board.
- .4 Fillers for sealants.
- .2 Temporary forming materials.
- .3 Substrate primers.
- .4 Collars.
- .5 Steel sleeves.
- .6 Primers: to manufacturer's recommendation for specific material, substrate, and end use.
- .7 Water (if applicable): potable, clean and free from injurious amounts of deleterious substances.
- .8 Metal Firestop: Commercial galvanized steel, having minimum 260 g/m² zinc coating and minimum nominal metal core thickness 0.9 mm.
- .9 Moulded Flute Inserts for Steel Decks: Preformed, single piece moulded mineral fibre flute inserts sized for steel deck profiles; designed for placement at top of fire rated wall assemblies and having spray-applied intumescent fire and smoke seal as follows:
 - .1 Basis-of-Design Products: Hilti CP777 Speed Plugs with Hilti CFS-SP WB Firestop Joint Spray.
- .10 Labels: Peel-and-stick labels printed with the following information:
 - .1 ATTENTION: FIRE RATED ASSEMBLY. DO NOT MODIFY
 - .2 Name of firestopping manufacturer;
 - .3 Names of products used;
 - .4 Fire-Resistance Rating of Assembly;
 - .5 Manufacturers standard detail number, Engineering Judgement or Equivalent Fire Resistance Rated Assembly identifier; ULC or cUL Number;
 - .6 Date of installation;
 - .7 Name of installing Subcontractor;
 - .8 Contact telephone number for repair or replacement of firestopping materials.

2.05 FILL MATERIALS

- .1 Provide only fill materials that are referred to in listed assemblies of the referenced testing and inspecting agencies as fill, void, or cavity materials.
- .2 Cast-in-Place Firestopping Devices: Factory assembled devices for use in cast-in-place concrete floors and consisting of an outer metallic sleeve lined with an intumescent strip, a radial extended flange attached to one end of the sleeve for fastening to concrete formwork, and a neoprene gasket.

FIRESTOPPING

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- .3 Latex or Acrylic Sealants: Single-component latex or acrylic formulations that do not re-emulsify after cure during exposure to moisture.
 - .4 Firestopping Devices: Factory assembled collars formed from galvanized steel and lined with intumescent material sized to fit specific diameter of penetrating item.
 - .5 Cable Penetration Devices:
 - .1 Pre-manufactured intumescent blocks, as follows:
 - .1 Hilti CFS-BL Intumescent Blocks
 - .2 Roxtec Intumescent Blocks
 - .2 Pre-manufactured sleeves, consisting of an adjustable core, and as follows:
 - .1 Hilti CP 653 Speed Sleeves
 - .2 Specified Technologies EZ-Path Fire Rated Pathway
 - .3 Pre-manufactured cable management system, consisting of a system of intumescent inserts and adjustable cores, and as follows:
 - .1 Hilti Transit
 - .2 Roxtec Preformed Firestopping Systems
 - .6 Intumescent Composite Sheets: Rigid panels consisting of aluminum foil faced elastomeric sheet bonded to galvanized steel sheet.
 - .7 Intumescent Putties: Non-hardening dielectric, water resistant putties containing no solvents, inorganic fibres, or silicone compounds.
 - .8 Intumescent Spray Foam: Expanding spray-in-place intumescent foam sealant.
 - .9 Intumescent Wrap Strips: Single component intumescent elastomeric sheets with aluminum foil on one side.
 - .10 Mortars: Pre-packaged, dry mixes consisting of a blend of inorganic binders, hydraulic cement, fillers, and lightweight aggregate formulated for mixing with water at Project site to form a non-shrinking, homogeneous mortar.
 - .11 Pillows/Bags: Reusable, heat expanding pillows/bags consisting of glass fibre cloth cases filled with a combination of mineral fibre, water insoluble expansion agents and fire-retardant additives.
 - .12 Silicone Foams: Multi-component, silicone based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, non-shrinking foam.

FIRESTOPPING

- .13 Silicone Sealants: Moisture curing, single component, silicone based, neutral curing elastomeric sealants of grade indicated below:
 - .1 Grade for Horizontal Surfaces: Pourable (self-levelling) formulation for openings in floors and other horizontal surfaces.
 - .2 Grade for Vertical Surfaces: non-sag formulation for openings in vertical and other surfaces.

2.06 MIXING

- .1 Mix components and materials in accordance with firestopping system manufacturer's written instructions for accurate proportioning of materials, water (if required), type of mixing equipment, selection of mixer speeds, mixing containers, mixing time, and other items or procedures needed to produce products of uniform quality with optimum performance characteristics for application indicated.

3. EXECUTION

3.01 EXAMINATION

- .1 Examine surfaces, components, materials to receive firestopping material; report any conditions that would detrimentally affect the application of the material or the proper firestopping of the system.
 - .1 Verify service lines are in place, tested and approved where penetration sealants or caulking are required.
 - .2 Verify that proper blocking, framing (using non-combustible materials) are properly installed and prepared to receive firestopping.
 - .3 Notify Consultant in writing of any deficiencies affecting the proper performance of the firestopping, do not proceed until deficiencies are corrected.
- .2 Commence Work when conditions of surfaces and the working conditions are suitable.

3.02 PREPARATION

- .1 Prepare surfaces in contact with firestopping materials in accordance with manufacturer's instructions.
 - .1 Maintain insulation around pipes and ducts penetrating Fire Separation without interruption to vapour barrier where applicable.
 - .2 Mask where necessary to avoid spillage and over coating onto adjoining surfaces; remove stains on adjacent surfaces.

FIRESTOPPING

- .2 Provide and maintain masking, drop cloths and polyethylene coverings for such surfaces to protect them during installation operations where adjacent finished floors, walls and similar surfaces are exposed.
- .3 Provide complete enclosures and human protective devices when installing or mixing hazardous materials.
- .4 Surfaces shall be free of oil, grease, dirt, loose paint, mill scale or any other matter that could impair bond, including paint.
- .5 Prime surfaces when required by manufacturer's written instructions.
- .6 Make provisions for natural ventilation during and after application of firestopping, sealant or caulking; circulate interior air by use of temporary circulators or exhaust fans in enclosed areas or area lacking openings for natural ventilation.

3.03 APPLICATION

- .1 Apply firestopping materials in strict accordance with manufacturer's written instructions, accepted and approved tested assemblies, and details submitted for Consultant's acceptance.
- .2 Apply firestopping materials/systems to maintain the Fire Separations in the project as indicated on Drawings; apply firestop materials to partitions enclosing Fire Compartments to top, bottom and sides.
- .3 Seal holes or voids made by through penetrations, poke through termination devices, and unpenetrated openings or joints and verify continuity and integrity of Fire Separation are maintained.
- .4 Provide temporary forming as required and remove forming only after materials have gained sufficient strength and after initial curing.
- .5 Tool or trowel exposed surfaces to a neat finish.
- .6 Remove excess compound promptly as work progresses and upon completion.
- .7 Place self-sticking labels on a permanent surface adjacent to firestopping installation.

3.04 CLEANING

- .1 Clean off excess fill materials and sealants adjacent to openings and joints as work progresses; use methods and cleaning materials approved by manufacturers of firestopping products and or assemblies in which penetrations, openings, gaps and joints occur.

FIRESTOPPING

- .2 Protect firestopping during and after curing period from contact with contaminating substances; Subcontractor is responsible for making appropriate repairs, Contractor will charge appropriate trades responsible for contributing to damages.

3.05 SITE QUALITY CONTROL

- .1 Testing and Inspection: The City will engage a third-party testing and inspection agency as described in Section 07 05 53 and as follows:
 - .1 The City's testing and inspection for quality control does not replace Subcontractor's required Quality Assurance Program; Subcontractor will remain responsible for correct installation that is in conformance with listed assemblies submitted and reviewed by the Consultant.
 - .2 Firestop inspections for penetrating systems will be conducted in accordance with ASTM E2174.
 - .3 Firestop inspections for joint systems will be conducted in accordance with ASTM E2393.

3.06 SYSTEM SCHEDULE

- .1 Drawings indicate basic firestop details only and indicate performance expectations only, Subcontractor is responsible for submitting manufacturer's standard design for products supplied to the Project and include modifications to firestop systems required to meet site installation conditions, obtaining EFRRRA and EJ numbers when site conditions differ from manufacturer's standard details.
- .2 Provide firestopping systems comprised of, or combinations of the following:
 - .1 Systems with No Penetrating Items: Select one or more of the following fill materials:
 - .1 Latex or acrylic based sealant, as standard for manufacturer
 - .2 Silicone sealant
 - .3 Intumescent putty
 - .4 Intumescent foam blocks or boards
 - .5 Intumescent spray foam
 - .2 Systems for Metallic Pipes, Conduit, or Tubing: Select one or more of the following fill materials:
 - .1 Latex or acrylic based sealant, as standard for manufacturer
 - .2 Silicone sealant
 - .3 Intumescent putty
 - .4 Intumescent foam blocks or boards
 - .5 Intumescent spray foam

FIRESTOPPING

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- .3 Systems for Non-metallic Pipe, Conduit, or Tubing: Select one or more of the following fill materials:
 - .1 Intumescent firestop sealant
 - .2 Intumescent putty
 - .3 Intumescent wrap strips
 - .4 Firestopping and Smoke seals device
 - .5 Intumescent spray foam

 - .4 Re-enterable and Cable Managed Systems for Electrical, and Data and Communications Cables:
 - .1 Prefabricated Transit (Hilti)
 - .2 Preformed Intumescent Blocks (Roxtec)
 - .3 Prefabricated Cable Pathways (EZ-Path)

 - .5 Systems for Electrical, and Data and Communications Cables: Select one or more of the following fill materials:
 - .1 Prefabricated firestop Sleeve (Hilti)
 - .2 Preformed Intumescent Blocks (Roxtec)
 - .3 Prefabricated Cable Pathways (EZ-Path)
 - .4 Latex or acrylic based sealant, as standard for manufacturer
 - .5 Silicone sealant
 - .6 Intumescent putty
 - .7 Silicone foam
 - .8 Intumescent foam blocks or boards
 - .9 Intumescent spray foam

 - .6 Systems for Cable Trays: Select one or more of the following fill materials:
 - .1 Prefabricated firestop Sleeve or Gang Plates (Hilti)
 - .2 Preformed Intumescent Blocks (Roxtec)
 - .3 Prefabricated Cable Pathways (EZ-Path)
 - .4 Latex or acrylic based sealant, as standard for manufacturer
 - .5 Intumescent putty
 - .6 Silicone foam
 - .7 Pillows/bags
 - .8 Intumescent foam blocks or boards

FIRESTOPPING

- .7 Systems for Insulated Pipes: Select one or more of the following fill materials:
 - .1 Intumescent firestop sealant
 - .2 Intumescent putty
 - .3 Intumescent wrap strips
 - .4 Intumescent foam blocks or boards
 - .5 Intumescent spray foam

- .8 Systems for Miscellaneous Electrical Penetrations: Select one or more of the following fill materials:
 - .1 Latex or acrylic based sealant, as standard for manufacturer
 - .2 Intumescent putty
 - .3 Intumescent foam blocks or boards
 - .4 Intumescent spray foam

- .9 Systems for Miscellaneous Mechanical Penetrations: Select one or more of the following fill materials:
 - .1 Intumescent firestop sealant
 - .2 Intumescent foam blocks or boards
 - .3 Intumescent spray foam

- .10 Systems for Groupings of Penetrations: Select one or more of the following fill materials:
 - .1 Intumescent firestop sealant
 - .2 Intumescent wrap strips
 - .3 Firestopping and Smoke seals device
 - .4 Intumescent composite sheet
 - .5 Intumescent foam blocks or boards
 - .6 Intumescent spray foam

END OF SECTION

1. GENERAL**1.01 SUMMARY**

.1 This Section includes joint sealants for the following applications, including those specified by reference to this Section:

.1 Exterior joints for vertical surfaces and horizontal non-traffic surfaces:

- .1 Construction joints in cast-in-place concrete.
- .2 Joints between architectural cast-in-place concrete units.
- .3 Control and expansion joints in unit masonry.
- .4 Joints between metal panels.
- .5 Joints between different materials listed above.
- .6 Perimeter joints between materials listed above and frames of doors and windows.
- .7 Other joints as indicated.

.2 Exterior joints for horizontal traffic surfaces:

- .1 Isolation and contraction joints in cast-in-place concrete slabs.
- .2 Joints between different materials listed above.
- .3 Other joints as indicated.

.3 Interior joints in the following vertical surfaces and horizontal non-traffic surfaces:

- .1 Perimeter joints of exterior openings where indicated.
- .2 Tile control and expansion joints.
- .3 Perimeter joints between interior wall surfaces and frames of interior doors and windows.
- .4 Joints between walls and millwork, and walls and backsplashes.
- .5 Joints between plumbing fixtures and adjoining walls, floors, and counters.
- .6 Other joints as indicated.

.4 Interior joints in the following horizontal traffic surfaces:

- .1 Isolation joints in cast-in-place concrete slabs.
- .2 Control and expansion joints in tile flooring.
- .3 Other joints as indicated.

1.02 RELATED REQUIREMENTS

.1 Other sections of the specification requiring sealants refer to this section; coordinate requirements of referencing sections.

1.03 REFERENCE STANDARDS

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

- .1 ASTM C834-10, Standard Specification for Latex Sealants
- .2 ASTM C919-08, Standard Practice for Use of Sealants in Acoustical Applications
- .3 ASTM C920-11, Standard Specification for Elastomeric Joint Sealants
- .4 ASTM C1184-05, Standard Specification for Structural Silicone Sealants
- .5 ASTM C1193-11, Standard Guide for Use of Joint Sealants
- .6 ASTM C1248-08, Standard Test Method for Staining of Porous Substrate by Joint Sealants
- .7 ASTM C1311-10, Standard Specification for Solvent Release Sealants

- .8 ASTM C1330-02, Standard Specification for Cylindrical Sealant Backing for Use with Cold Liquid Applied Sealants
- .9 ASTM C1481-12, Standard Guide for Use of Joint Sealants with Exterior Insulation and Finish Systems (EIFS)
- .10 ASTM D2240-05, Standard Test Method for Rubber Property - Durometer Hardness
- .2 Canadian General Standards Board (CGSB):
 - .1 CGSB 19-GP-5M, Sealing Compound, Single component, Acrylic Base, Solvent Curing
 - .2 CGSB 19-GP-14M, Sealing Compound, Single component, Butyl-Polyisobutylene Polymer Base, Solvent Curing
 - .3 CAN/CGSB 19.17-M90, Single component, Acrylic Emulsion Base Sealing Compound
 - .4 CAN/CGSB 19.13-M87, Sealing Compound, Single component, Elastomeric, Chemical Curing
 - .5 CAN/CGSB 19.24-M90, Multicomponent, Chemical Curing, Sealing Compound
- 1.04 SUBMITTALS
 - .1 Provide required information in accordance with Section 01 00 06 – General Requirements: Submittals.
 - .2 Action Submittals: Provide the following submittals before starting any work of this Section:
 - .1 Product Data: Submit product data for each joint sealant product indicated.
 - .2 Samples for Initial Selection: Submit manufacturer's colour charts consisting of strips of cured sealants showing the full range of colours available for each product exposed to view for City's for initial selection.
 - .3 Informational Submittals: Provide the following submittals when requested by the City:
 - .1 Certificates: Submit product certificates for each type of joint sealant and accessory, signed by product manufacturer certifying that materials used are appropriate for applications that they were used.
- 1.05 QUALITY ASSURANCE
 - .1 Qualifications: Provide proof of qualifications when requested by City:
 - .1 Manufacturer: Obtain each type of joint sealant through one source from a single manufacturer.
 - .2 Installer: Installer shall be experienced with the use and application of materials specified in this Section, have a minimum of five (5) years experience with projects of a similar nature, and be approved or licensed for installation of elastomeric sealants by manufacturer if required for warranty conditions.
- 1.06 PROJECT CONDITIONS
 - .1 Proceed with installation of joint sealants only when the following conditions are met:
 - .1 Ambient and substrate temperature conditions are within limits permitted by joint sealant manufacturer.
 - .2 Joint substrates are dry.
 - .3 Joint widths are within tolerances of those permitted by joint sealant manufacturer for applications indicated.
 - .4 Substrates are free from contaminants capable of interfering with adhesion.

1.07 WARRANTY

- .1 Installer shall provide a warranty stating that they agree to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section for a period of two (2) years from Substantial Performance for the Project.
- .2 Manufacturer's shall provide a warranty stating that they agree to provide joint sealants to repair or replace those that do not comply with performance and other requirements specified in this Section for a period of five (5) years from Substantial Performance for the Project.
- .3 It is understood that the specified warranties exclude deterioration or failure of joint sealants arising from the following conditions:
 - .1 Movement of the structure resulting in stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression caused by structural settlement or errors attributable to design or construction.
 - .2 Disintegration of joint substrates from natural causes exceeding design specifications.
 - .3 Mechanical damage caused by individuals, tools, or other outside agents.
 - .4 Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

2. PRODUCTS**2.01 MANUFACTURERS**

- .1 Acceptable Materials Manufacturers: Subject to compliance with requirements specified in this Section; where multiple listings of manufacturers occur, use any of the following listed manufacturers' products in accordance with Section 01 00 06 – General Requirements: Substitutions and Product Options including the following:
 - .1 GE Silicones Limited
 - .2 ChemRex Inc., Sonneborn
 - .3 Chemtron Manufacturing Ltd.
 - .4 Dow Corning Canada Inc.
 - .5 Sika Chemical of Canada Ltd.
 - .6 Tremco Ltd.
- .2 Substitutions: City may consider additional manufacturers having similar products to Acceptable Materials Manufacturers listed above during the construction period, provided they meet the performance requirements established by the named products and provided they submit requests for substitution in accordance with Section 01 00 06 – General Requirements: Substitutions and Product Options before starting any work of this Section:
 - .1 Do not use substitute materials to establish Bid Price.
 - .2 Substitutions that appear as a part of the project without review and acceptance by the City will be rejected, and replaced with one of the specified materials.

2.02 MATERIALS

- .1 Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by sealant manufacturer, based on testing and site experience.
- .2 Colours of exposed joint sealants will be selected by the City from manufacturer's complete range to match adjacent finish materials.

- .3 Elastomeric Joint Sealants: Provide sealants in accordance with ASTM C920 classifications for type, grade, class, and uses related to exposure and joint substrates and as follows:
 - .1 Provide products that have been tested in accordance with ASTM C1248 where elastomeric sealants are required for non-staining to porous substrate applications.
- .4 Latex Joint Sealants: Provide sealants in accordance with ASTM C834, temperature Grade to suit related exposure and joint substrates, paintable, non-sag and non-staining for general application, and acoustic seals in exposed locations.
- .5 Acoustical Sealant for Concealed Joints: Provide sealants in accordance with CAN/CGSB 19.21-M, non-drying, non-hardening, non-skinning, non-staining, gun grade, synthetic-rubber sealant recommended for sealing interior concealed joints to reduce airborne sound transmission. Coordinate with Section 09 21 16.
- .6 Performance Requirements:
 - .1 Provide elastomeric joint sealants for exterior applications that establish and maintain watertight and airtight continuous joint seals without staining or deteriorating joint substrates.
 - .2 Provide joint sealants for interior applications that establish and maintain airtight and water resistant continuous joint seals without staining or deteriorating joint substrates.

2.03 LIQUID SEALANTS

- .1 Type S-1 Acrylic Sealant: Single component acrylic latex, Shore A Hardness 20, conforming to CAN/CGSB 19.17-M and ASTM C834:
 - .1 Acceptable Materials:
 - .1 Chemtron Latacalk
 - .2 Tremco Latex 100
 - .3 Sonneborn Sonolac
 - .2 Type S-2 Silicone Sealant, Mould and Mildew Resistant: Silicone based, Shore A Hardness 15-25, conforming to ASTM C920, Type S, Grade NS, Class25, use NT, G, and A:
 - .1 Acceptable Materials:
 - .1 GE SCS 1700
 - .2 Dow Corning 786
 - .3 Tremco Tremsil 200
 - .4 Sonneborn Omni Plus
 - .3 Type S-3 Silicone Sealant: Exterior Weatherproofing Sealant: Silicone based, single component, low modulus, neutral cure, 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 C 920, Type S, Grade NS, Class 25, use NT, M, G, A and O, colour as selected by City from Standard Range:
 - .1 Acceptable Materials:
 - .1 GE Silpruf LM SCS 2700
 - .2 Dow Corning 791
 - .3 Tremco Spectrum 1/Spectrum 3
 - .4 Sonneborn Omni Seal

- .4 Type S-4 Silicone Sealant, Butt Joint Glazing: Silicone based, single component, 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, Type S, Grade NS, Class 25, use NT, G, A, O; Colour: clear (translucent):
- .1 Acceptable Materials:
- .1 GE SCS2000
 - .2 Dow Corning 795
 - .3 Chemtron Multiseal
 - .4 Tremco Spectrum 2
- .5 Type S-5, Interior Acoustical Sealant: Mastic type, non-skinning, non-hardening, single component synthetic rubber sealant, conforming to CAN/CGSB 19.21-M:
- .1 Acceptable Materials:
- .1 Chemtron Metaseal
 - .2 Tremco Acoustic Sealant
- .6 Type S-6 Air Seal Sealant: Silicone based, single component, Shore A hardness 15 – 25, conforming to CGSB 19-GP-13M, classification C-1-40-B-N and C-1-25-B-N and ASTM C920, Type S, Grade NS, Class 25. Use NT, M, G, A and O:
- .1 Acceptable Materials:
- .1 Dow Corning 790
 - .2 GE Silpruf LM or SCS2700
 - .3 Tremco Spectrum 1
- .7 Type S-7, Two component Sealant: Chemical curing two component, non-sag, exterior wall sealant, Shore A Hardness 20-35, conforming to CAN/CGSB 19.24-M, Type 2, Class B, and ASTM C920, Type S, Grade NS, Class 25, use NT, M, and A:
- .1 Acceptable Materials:
- .1 Chemtron Thioplast 400
 - .2 Sikaflex 2c NS
 - .3 Tremco Dymeric
 - .4 Sonneborn NP 2
- .8 Type S-8, Horizontal Joint Sealant: Two component, self levelling, conforming to CAN/CGSB 19.24M, Type 1, Class A, and ASTM C920, Type M, Grade P, Class 5, use T, M, and O:
- .1 Acceptable Materials:
- .1 Sikaflex 2c SL
 - .2 Tremco THC-901
 - .3 Sonneborn SL 2

- .9 Type S-9: Not used.
- .10 Type S-10, Polyurethane Sealant: Single component, non-sag, for general construction, Shore A Hardness 15+, conforming to CAN/CGSB 19.13-M, Type 2, Classification MCG-2-25-A-N and ASTM C920, Type S, Grade NS, Class 25, Use NT, M, and A:
 - .1 Acceptable Materials:
 - .1 Chemtron Multiflex
 - .2 Sikaflex 1-a
 - .3 Sika/Sternson RC-1
 - .4 Tremco Dymonic
 - .5 Sonneborn NP 1
 - .6 Mameco/Vulkem 116

2.04 PREFORMED SEALANTS

- .1 Preformed Silicone Sealant System: Manufacturer's standard system consisting of pre-cured low modulus silicone extrusion, in sizes to fit joint widths indicated, combined with a neutral curing silicone sealant for bonding extrusions to substrates:
 - .1 Acceptable Materials:
 - .1 Dow Corning Corporation; 123 Silicone Seal
 - .2 GE Silicones; UltraSpan US1100
 - .3 Tremco; Spectrem Ez Seal

2.05 SEALANT BACKING

- .1 Provide sealant backings of material and type that are non-staining, compatible with joint substrates, sealants, primers, and other joint fillers, and are approved for applications indicated by sealant manufacturer based on site experience and laboratory testing.
- .2 Backing Rods: Meeting requirements of ASTM C1330, Type C (closed cell material with a surface skin); Type O (open cell material); or Type B (bi-cellular material with a surface skin) and as follows:
 - .1 Use backing rod materials specifically recommended by joint sealer manufacturer for type of installation and materials being used.
 - .2 Use any of the preceding types, as approved in writing by joint sealant manufacturer for joint application indicated.
 - .3 Size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.
 - .4 Non-adhering to sealant, to maintain two sided adhesion across joint.
- .3 Bond Breaker Tape: Self adhesive polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint filler materials or joint surfaces at back of joint where three sided adhesion will result in sealant failure.

2.06 ACCESSORIES

- .1 Primer: Material recommended by joint sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from pre-construction joint sealant substrate tests and site tests.
- .2 Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.

- .3 Masking Tape: Non-staining, non-absorbent material compatible with joint sealants and surfaces adjacent to joints.

3. EXECUTION

3.01 EXAMINATION

- .1 Examine joints indicated to receive joint sealants for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint sealant performance.
- .2 Proceed with installation after unsatisfactory conditions have been corrected.
 - .3 Pre-Construction Site Adhesion Testing: Site test adhesive adhesion to joint substrates before installing sealants as follows:
 - .1 Locate test joints where indicated on Drawings or, if not indicated, as directed by City.
 - .2 Conduct site tests for each application indicated below:
 - .1 Each type of elastomeric sealant and joint substrate indicated.
 - .2 Each type of non-elastomeric sealant and joint substrate.
 - .3 Notify City seven (7) days in advance of dates and times when test joints will be installed.
 - .4 Arrange for tests to take place with joint sealant manufacturer's technical representative present in accordance with ASTM C1193, and as follows:
 - .1 Test Method: X1.1 Method A, Site Applied Sealant Joint Hand Pull Tab.
 - .5 Verify adhesion to each substrate separately for joints with dissimilar substrates; extend cut along one side, verifying adhesion to opposite side; repeat procedure for opposite side.
 - .6 Report whether sealant in joint connected to pulled out portion failed to adhere to joint substrates or tore cohesively:
 - .1 Include data on pull distance used to test each type of product and joint substrate.
 - .2 Retest until satisfactory adhesion is obtained for sealants that fail adhesively.
 - .7 Evaluation of Pre-construction Site Adhesion Test Results:
 - .1 Sealants not evidencing adhesive failure from testing, in absence of other indications of non-compliance with requirements, will be considered satisfactory.
 - .2 Do not use sealants that fail to adhere to joint substrates during testing.

3.02 PREPARATION

- .1 Clean out joints immediately before installing joint sealants to comply with joint sealant manufacturer's written instructions and the following requirements:
 - .1 Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.

- .2 Clean porous joint substrate surfaces by brushing, grinding, blast cleaning, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants.
- .3 Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil free compressed air.
- .4 Remove laitance and form release agents from concrete.
- .5 Clean nonporous surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants.
- .6 Porous joint substrates include the following:
 - .1 Concrete.
 - .2 Masonry.
 - .3 Unglazed surfaces of ceramic tile.
- .7 Nonporous joint substrates include the following:
 - .1 Metal.
 - .2 Glass.
 - .3 Porcelain enamel.
 - .4 Glazed surfaces of ceramic tile.
- .2 Prime joint substrates as recommended in writing by joint sealant manufacturer, based on pre-construction joint sealant substrate tests or prior experience:
 - .1 Apply primer to comply with joint sealant manufacturer's written instructions.
 - .2 Confine primers to areas of joint sealant bond; do not allow spillage or migration onto adjoining surfaces.
- .3 Install backing rods at exterior locations when temperature is falling, to prevent possible out-gassing bubbles from cut or nicked surfaces of backing materials and potential for bubble formation in applied sealants.
- .4 Install bond breaker tapes in joints that are too shallow to allow for installation of backing rods.
- .5 Use masking tape where required to prevent contact of sealant with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears; remove tape immediately after tooling without disturbing joint seal.

3.03 INSTALLATION OF JOINT SEALANTS

- .1 Comply with joint sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.
- .2 Comply with recommendations in ASTM C1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- .3 Acoustical Sealant Application Standard: Comply with recommendations in ASTM C919 for use of joint sealants in acoustical applications as applicable to materials, applications, and conditions indicated.
- .4 Install sealant backings of type indicated to support sealants during application and at position required to produce cross sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
 - .1 Do not leave gaps between ends of sealant backings.
 - .2 Do not stretch, twist, puncture, or tear sealant backings.
 - .3 Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.

- .5 Install bond breaker tape behind sealants where sealant backings are not used between sealants and backs of moving joints.
- .6 Install sealants at the same time backings are installed, and as follows:
 - .1 Place sealants so they directly contact and fully wet joint substrates.
 - .2 Completely fill recesses in each joint configuration.
 - .3 Produce uniform, cross sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
- .7 Sealants: Immediately after sealant application and before skinning or curing begins, tool non-sag sealants to form smooth, uniform beads, to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint, and as follows:
 - .1 Remove excess sealant from surfaces adjacent to joints.
 - .2 Use tooling agents and profiles that are approved in writing by sealant manufacturer and that do not discolour sealants or adjacent surfaces in accordance with the figures listed in ASTM C1193 as follows:
 - .1 Provide concave joints in accordance with Figure 5A.
 - .2 Provide flush joint in accordance with Figure 5B.
 - .3 Provide recessed joint configuration in accordance with Figure 5C.
 - .4 Use masking tape to protect surfaces adjacent to recessed tooled joints.
- .8 Install preformed tapes in accordance with manufacturer's written instructions.
- .9 Install preformed silicone sealant system as follows:
 - .1 Apply masking tape to each side of joint, outside of area covered by sealant system.
 - .2 Apply silicone sealant to each side of joint to produce a bead of size complying with preformed silicone sealant system manufacturer's written instructions and covering a bonding area of not less than 10 mm.
 - .3 Hold edge of sealant bead 6 mm inside masking tape.
 - .4 Press silicone extrusion into sealant to wet extrusion and substrate within 10 minutes of sealant application.
 - .5 Use a roller to apply consistent pressure and ensure uniform contact between sealant and both extrusion and substrate.
 - .6 Complete installation of sealant system in horizontal joints before installing in vertical joints.
 - .7 Lap vertical joints over horizontal joints.
 - .8 Cut silicone extrusion with a razor knife at ends of joints.

3.04 CLEANING

- .1 Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

3.05 PROTECTION

- .1 Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Performance.
- .2 Cut out and remove damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work if, despite protection measures, damage or deterioration occurs.

3.06 JOINT SEALANT SCHEDULE

- .1 Where no specified type of sealant is shown or specified choose one of the sealants specified in this Section applicable to that intended application, and consistent with manufacturer's recommendations.
- .2 Use acrylic sealant Type S-1 only on the interior and only in situations where little or no movement can occur.
- .3 Use mould and mildew resistant silicone sealant Type S-2 for non-moving joints in washrooms; do not use on floors.
- .4 Use silicone general construction sealant Type S-3 or polyurethane sealant Type S-7 and S-10 for all joints, interior and exterior, where no other specific sealant type specified; do not use on horizontal traffic joints or where immersed in water.
- .5 Use silicone glazing type S-4 for sealing butt glazing joints.
- .6 Use acoustical sealant Type S-5 for interior applications only where they will be fully concealed and only where no constant or consistent air pressure difference will exist across the joint.
- .7 Use air seal sealant Type S-6 for exterior walls only where constant or consistent air pressure difference will exist across the joint.
- .8 Use two component sealant Type S-7 for exterior vertical joints where large movement is anticipated; not for continuous water immersion.
- .9 Use two component sealant type S-7 for edge joint sealant at slab edges at walls, columns, interior shaft walls and grade beams.
- .10 Use two component sealant Type S-8 for horizontal joint sealant of plaza, floors and decks, exterior areas only, subject to pedestrian and vehicular traffic.
- .11 In addition, seal the following joints:
 - .1 Seal perimeters of hollow metal door frames on both sides, and at junction between door frame and resilient or solid flooring materials.
 - .2 Seal perimeters of aluminum door frames on both sides.
 - .3 Seal junctures between interior partitions with exterior walls.
 - .4 Seal control joints in masonry veneer at the outside face.
 - .5 Seal window and door frames around the inside perimeter, so that an airtight seal is obtained, as indicated on drawings.
 - .6 Seal control, expansion joints in floors and walls and around service and fixture penetrations.

END OF SECTION

1. GENERAL**1.01 RELATED REQUIREMENTS**

- .1 Section 05 58 00 – Formed Metal Fabrication
- .2 Section 10 14 00 – Exterior Signage (Clock Tower) – Decorative Glass and Glazing: Glazing sealants and silicone structural glazing systems.

1.02 SUBMITTALS

- .1 Provide required information in accordance with Section 01 00 06 – General Requirements: Submittals.
- .2 Action Submittals: Provide the following submittals before starting any work of this Section:
 - .1 Product Data: Submit product data for each joint sealant product indicated.
- .3 Informational Submittals: Provide the following submittals when requested by the Consultant:
 - .1 Certificates: Submit product certificates for each type of joint sealant and accessory, signed by product manufacturer certifying that materials used are appropriate for applications that they were used.

1.03 QUALITY ASSURANCE

- .1 Qualifications: Provide proof of qualifications when requested by Consultant:
 - .1 Manufacturer: Obtain each type of joint sealant through one source from a single manufacturer.
 - .2 Installer: Installer shall be experienced with the use and application of materials specified in this Section, have a minimum of three (3) years experience with projects of a similar nature, and be approved or licensed for installation of elastomeric sealants by manufacturer if required for warranty conditions.

1.04 PROJECT CONDITIONS

- .1 Proceed with installation of joint sealants only when the following conditions are met:
 - .1 Ambient and substrate temperature conditions are within limits permitted by joint sealant manufacturer.
 - .2 Joint substrates are dry.
 - .3 Joint widths are within tolerances of those permitted by joint sealant manufacturer for applications indicated.
 - .4 Substrates are free from contaminants capable of interfering with adhesion.

1.05 WARRANTY

- .1 Installer shall provide a warranty stating that they agree to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section for a period of two (2) years from Substantial Performance for the Project.
- .2 Manufacturer's shall provide a warranty stating that they agree to provide joint sealants to repair or replace those that do not comply with performance and other requirements specified in this Section for a period of five (5) years from Substantial Performance for the Project.

- .3 It is understood that the specified warranties exclude deterioration or failure of joint sealants arising from the following conditions:
- .1 Movement of the structure resulting in stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression caused by structural settlement or errors attributable to design or construction.
 - .2 Disintegration of joint substrates from natural causes exceeding design specifications.
 - .3 Mechanical damage caused by individuals, tools, or other outside agents.
 - .4 Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

2. PRODUCTS

2.01 MANUFACTURERS

- .1 Acceptable Materials Manufacturers: Subject to compliance with requirements specified in this Section; where multiple listings of manufacturers occur, use any of the following listed manufacturers' products in accordance with Section 01 00 06 – General Requirements: Product Options including the following:
- .1 GE Silicones Limited
 - .2 ChemRex Inc., Sonneborn
 - .3 Chemtron Manufacturing Ltd.
 - .4 Dow Corning Canada Inc.
 - .5 Sika Chemical of Canada Ltd.
 - .6 Tremco Ltd.
- .2 Substitutions: Consultant may consider additional manufacturers having similar products to Acceptable Materials Manufacturers listed above during the construction period, provided they meet the performance requirements established by the named products and provided they submit requests for substitution in accordance with Section 01 00 06 – General Requirements: Substitution Procedures before starting any work of this Section:
- .1 Do not use substitute materials to establish Bid Price.
 - .2 Substitutions that appear as a part of the project without review and acceptance by the Consultant will be rejected, and replaced with one of the specified materials.

2.02 MATERIALS

- .1 Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by sealant manufacturer, based on testing and site experience.
- .2 Colours of exposed joint sealants will be selected by the Consultant from manufacturer's complete range to match adjacent finish materials.
- .3 Elastomeric Joint Sealants: Provide sealants in accordance with ASTM C920 classifications for type, grade, class, and uses related to exposure and joint substrates and as follows:
- .1 Provide products that have been tested in accordance with ASTM C1248 where elastomeric sealants are required for non-staining to porous substrate applications.
- .4 Latex Joint Sealants: Provide sealants in accordance with ASTM C834, temperature Grade to suit related exposure and joint substrates, paintable, non-sag and non-staining for general application.

.5 Performance Requirements:

- .1 Provide elastomeric joint sealants for exterior applications that establish and maintain watertight and airtight continuous joint seals without staining or deteriorating joint substrates.

2.03 LIQUID SEALANTS

- .1 Silicone Sealant: Exterior Weatherproofing Sealant: Silicone based, single component, low modulus, neutral cure, 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 C 920, Type S, Grade NS, Class 25, use NT, M, G, A and O, colour as selected by Consultant from Standard Range:

.1 Acceptable Materials:

- .1 GE Silpruf LM SCS 2700
.2 Dow Corning 791
.3 Tremco Spectrem 1/Spectrem 3
.4 Sonneborn Omni Seal

- .2 Silicone Sealant, Structural Glazing: Silicone based, 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 C 920, Type S, Grade P, Class 25, use T, M:

.1 Acceptable Materials:

- .1 General Electrical SSG4000
.2 Dow-Corning 995
.3 Tremco Spectrem 2

- .3 Silicone Sealant, Butt Joint Glazing: Silicone based, single component, 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, Type S, Grade NS, Class 25, use NT, G, A, O; Colour: clear (translucent):

.1 Acceptable Materials:

- .1 GE SCS2000
.2 Dow Corning 795
.3 Chemtron Multiseal
.4 Tremco Spectrem 2

2.04 SEALANT BACKING

- .1 Provide sealant backings of material and type that are non-staining, compatible with joint substrates, sealants, primers, and other joint fillers, and are approved for applications indicated by sealant manufacturer based on site experience and laboratory testing.
- .2 Backing Rods: Meeting requirements of ASTM C1330, Type C (closed cell material with a surface skin); Type O (open cell material); or Type B (bi-cellular material with a surface skin) and as follows:
- .1 Use backing rod materials specifically recommended by joint sealer manufacturer for type of installation and materials being used.
- .2 Use any of the preceding types, as approved in writing by joint sealant manufacturer for joint application indicated.
- .3 Size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.
- .4 Non-adhering to sealant, to maintain two-sided adhesion across joint.

- .3 Bond Breaker Tape: Self-adhesive polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint filler materials or joint surfaces at back of joint where three-sided adhesion will result in sealant failure.

2.05 ACCESSORIES

- .1 Primer: Material recommended by joint sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from pre-construction joint sealant substrate tests and site tests.
- .2 Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.
- .3 Masking Tape: Non-staining, non-absorbent material compatible with joint sealants and surfaces adjacent to joints.
- .4 Gasket: 3 mm thick neoprene strip, black

3. EXECUTION

3.01 EXAMINATION

- .1 Examine joints indicated to receive joint sealants for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint sealant performance.
- .2 Proceed with installation after unsatisfactory conditions have been corrected.
- .3 Pre-Construction Compatibility and Adhesion Testing: Provide site test reports indicating that joint preparation methods result in optimum adhesion of sealant to joint substrates, as follows:
 - .1 Use manufacturer's standard test method to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.
 - .2 Test not fewer than three (3) pieces of each type of material, including joint substrates, shims, joint sealant backings, secondary seals, and miscellaneous materials.
 - .3 Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
 - .4 Obtain joint sealant manufacturer's written instructions for corrective measures including use of specially formulated primers for materials failing tests.
 - .5 Testing will not be required if joint sealant manufacturer submits joint preparation data that are based on previous testing of current sealant products for adhesion to, and compatibility with, joint substrates and other materials matching those submitted.
- .4 Pre-Construction Site Adhesion Testing: Site test adhesive adhesion to joint substrates before installing sealants as follows:
 - .1 Locate test joints where indicated on Drawings or, if not indicated, as directed by Consultant.
 - .2 Conduct site tests for each application indicated below:
 - .1 Each type of elastomeric sealant and joint substrate indicated.
 - .2 Each type of non-elastomeric sealant and joint substrate indicated.
 - .3 Notify Consultant seven (7) days in advance of dates and times when test joints will be installed.
 - .4 Arrange for tests to take place with joint sealant manufacturer's technical representative present in accordance with ASTM C1193, and as follows:

- .1 Test Method: X1.1 Method A, Site Applied Sealant Joint Hand Pull Tab
- .5 Verify adhesion to each substrate separately for joints with dissimilar substrates; extend cut along one side, verifying adhesion to opposite side; repeat procedure for opposite side.
- .6 Report whether sealant in joint connected to pulled out portion failed to adhere to joint substrates or tore cohesively:
 - .1 Include data on pull distance used to test each type of product and joint substrate.
 - .2 Retest until satisfactory adhesion is obtained for sealants that fail adhesively.
- .7 Evaluation of Pre-construction Site Adhesion Test Results:
 - .1 Sealants not evidencing adhesive failure from testing, in absence of other indications of non-compliance with requirements, will be considered satisfactory.
 - .2 Do not use sealants that fail to adhere to joint substrates during testing.

3.02

PREPARATION

- .1 Clean out joints immediately before installing joint sealants to comply with joint sealant manufacturer's written instructions and the following requirements:
 - .1 Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
 - .2 Clean porous joint substrate surfaces by brushing, grinding, blast cleaning, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants.
 - .3 Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil free compressed air.
 - .4 Remove laitance and form release agents from concrete.
 - .5 Clean nonporous surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants.
 - .6 Nonporous joint substrates include the following:
 - .1 Metal.
 - .2 Glass.
- .2 Prime joint substrates as recommended in writing by joint sealant manufacturer, based on pre-construction joint sealant substrate tests or prior experience:
 - .1 Apply primer to comply with joint sealant manufacturer's written instructions.
 - .2 Confine primers to areas of joint sealant bond; do not allow spillage or migration onto adjoining surfaces.
- .3 Install backing rods at exterior locations when temperature is falling, to prevent possible out-gassing bubbles from cut or nicked surfaces of backing materials and potential for bubble formation in applied sealants.
- .4 Install bond breaker tapes in joints that are too shallow to allow for installation of backing rods.
- .5 Use masking tape where required to prevent contact of sealant with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears; remove tape immediately after tooling without disturbing joint seal.

3.03 INSTALLATION OF JOINT SEALANTS

- .1 Comply with joint sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.
- .2 Comply with recommendations in ASTM C1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- .3 Install sealant backings of type indicated to support sealants during application and at position required to produce cross sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
 - .1 Do not leave gaps between ends of sealant backings.
 - .2 Do not stretch, twist, puncture, or tear sealant backings.
 - .3 Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.
- .4 Install bond breaker tape behind sealants where sealant backings are not used between sealants and backs of moving joints.
- .5 Install sealants at the same time backings are installed, and as follows:
 - .1 Place sealants so they directly contact and fully wet joint substrates.
 - .2 Completely fill recesses in each joint configuration.
 - .3 Produce uniform, cross sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
- .6 Sealants: Immediately after sealant application and before skinning or curing begins, tool non-sag sealants to form smooth, uniform beads, to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint, and as follows:
 - .1 Remove excess sealant from surfaces adjacent to joints.
 - .2 Use tooling agents and profiles that are approved in writing by sealant manufacturer and that do not discolour sealants or adjacent surfaces in accordance with the figures listed in ASTM C1193 as follows:
 - .1 Provide concave joints in accordance with Figure 8A.
 - .2 Provide flush joint in accordance with Figure 8B.
 - .3 Provide recessed joint configuration in accordance with Figure 8C.
 - .4 Use masking tape to protect surfaces adjacent to recessed tooled joints.

3.04 SITE QUALITY CONTROL

- .1 Site test joint sealant adhesion to joint substrates as a part of the Contract and as follows:
 - .1 Extent of Testing: Test completed elastomeric sealant joints as follows:
 - .1 Perform one (1) test for each type of elastomeric sealant and joint substrate.
 - .2 Test Method: Test joint sealants according to Method A, Site Applied Sealant Joint Hand Pull Tab.
 - .3 Verify adhesion to each substrate separately for joints having dissimilar substrates; do this by extending cut along one side, verifying adhesion to opposite side, repeat procedure for opposite side.
 - .4 Inspect joints for complete fill, for absence of voids, and for joint configuration complying with specified requirements.
 - .5 Record results in a site adhesion test log, and submit to Owner as a part of Record Document submissions listed in Section 01 00 06 – General Requirements.
 - .6 Inspect tested joints and report on the following:

- .1 Whether sealants in joints connected to pulled out portion failed to adhere to joint substrates or tore cohesively:
 - Include data on pull distance used to test each type of product and joint substrate.
 - Compare these results to determine if adhesion passes sealant manufacturer's site adhesion hand pull test criteria.
 - .2 Whether sealants filled joint cavities and are free of voids.
 - .3 Whether sealant dimensions and configurations comply with specified requirements.
 - .4 Record test results in a site adhesion test log:
 - Include dates when sealants were installed, names of persons who installed sealants, test dates, test locations, whether joints were primed, adhesion results and percent elongations, sealant fill, sealant configuration, and sealant dimensions.
 - Report any failed tests to the Contractor and the Consultant, and indicate repair procedure undertaken to correct failed sealant.
 - .7 Repair sealants pulled from test area by applying new sealants following same procedures used originally to seal joints, ensuring that original sealant surfaces are clean and that new sealant contacts original sealant.
- .2 Sealants not evidencing adhesive failure from testing or non-compliance with other indicated requirements will be considered satisfactory:
- .1 Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements.
 - .2 Retest failed applications until test results prove sealants comply with indicated requirements.

3.05 CLEANING

- .1 Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

3.06 PROTECTION

- .1 Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Performance.
- .2 Cut out and remove damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work if, despite protection measures, damage or deterioration occurs.

END OF SECTION

1. GENERAL

1.01 ADMINISTRATIVE REQUIREMENTS

- .1 Coordination: Consultant recognizes that hardware may be supplied and installed by different Sections of the work and will require cooperation and coordination as a part of the project deliverables:
 - .1 Hardware groups listed in this Section and specified in Section 08 71 00 – Door Hardware are not intended to imply trade responsibility to a sole source of supply and installation.
 - .2 Coordinate supply of hardware groups listed in this Section with supply or installation of other adjacent components compatible with Contractor’s work plan and project schedule.

2. PRODUCTS

2.01 MATERIALS ABBREVIATIONS

- .1 The following Abbreviations are used to describe materials contained in the Door, Frame and Hardware Schedule:

Abbreviation	Material Description
AL	Aluminum
AN	Anodized Finish
CW	Curtain Wall
EX	Existing
F	Prepare for Future
FG	Fire Resistance Rated Glass
H	Hours
HCW	Hollow Core Wood
HM	Hollow Metal
HMI	Hollow Metal: Insulated
LL	Lead Lined
OCD	Overhead Coiling Door
OHI	Overhead Insulated Door
P	Paint Finish
PS	Pressed Steel Frame
PSI	Pressed Steel Frame: Insulated
SCW	Solid Core Wood
SF	Safety Glass
SFL	Safety Glass: Laminated
SFT	Safety Glass: Tempered
SG	Sealed Glazing Unit
SGL	Sealed Glazing Unit: Laminated
SGT	Sealed Glazing Unit: Tempered
SN	Stain Finish

Abbreviation	Material Description
SS	Stainless Steel
ST	Steel
TRR	Temperature Rise Rated
WV	Wood Veneer Finish
Door and Frame Types	Refer to Drawings for elevations and descriptions of Types referenced within the Door Schedule

3. EXECUTION

3.01 DOOR SCHEDULE

- .1 Door Schedule contains descriptions of doors, frames and hardware groups and other information associated with operations of scheduled openings.
 - .1 Confirm contents of Door Schedule indicated on Drawing VLW-0412-02-PE-A0.01 with the rest of the Drawings,
 - .2 Notify the Consultant of any inconsistencies before ordering materials.
- .2 Frame opening sizes are in nominal millimetre dimensions; clearances and undercuts must be considered when doors are ordered.
- .3 Sizes prefixed with a 2 or other number indicate multiple doors in one opening.

END OF SECTION

1. GENERAL**1.01 SUMMARY**

- .1 This Section includes requirements for supply and installation of the following:
 - .1 Steel doors
 - .2 Steel door frames
 - .3 Fire rated door and frame assemblies

1.02 DEFINITIONS

- .1 The following definitions apply to the Steel Doors and Frames specification:
- .2 **Base Metal Thickness:** Thickness dimensions are minimums as defined in referenced ASTM standards for both uncoated steel sheet and the uncoated base metal of metallic coated steel sheets.
- .3 **Opening Sizes:** Standard metric door sizes indicated in Section 08 06 10 are considered nominal dimensions, measured from frame rabbet width and height, with allowances for nominal clearances between head, jamb and door bottom in accordance with CSDMA Recommended Dimensional Standards for Commercial Steel Doors and Frames.

1.03 REFERENCE STANDARDS

- .1 American Society for Testing and Materials (ASTM):
 - .1 ASTM A653/A653M-17, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
 - .2 ASTM A879/A879M-12 (2017), Standard Specification for Steel Sheet, Zinc Coated by the Electrolytic Process for Applications Requiring Designation of the Coating Mass on Each Surface
 - .3 ASTM A924/A924M-17a, Standard Specification for General Requirements for Sheet Steel, Metallic Coated by the Hot Dip Process
- .2 Canadian General Standards Board (CGSB):
 - .1 CAN/CGSB 1.132-M90, Primer, Zinc Chromate, Low Moisture Sensitivity
 - .2 CAN/CGSB 41-GP-19Ma-78 (1984), Rigid Vinyl Extrusions for Windows and Doors
 - .3 CAN/CGSB 82.5-M88, Insulated Steel Doors
- .3 Canadian Standards Association (CSA):
 - .1 CSA W59-13, Welded Steel Construction (Metal Arc Welding)
- .4 Canadian Steel Door Manufacturers Association (CSDMA):
 - .1 Recommended Dimensional Standards for Commercial Steel Doors and Frames, 2009
 - .2 Fire Labelling Guide, 2009
- .5 National Fire Protection Association (NFPA):
 - .1 NFPA 80-2015, Fire Doors and Windows
 - .2 NFPA 252-2017, Fire Tests of Door Assemblies
- .6 Underwriters Laboratories Canada (ULC):
 - .1 CAN/ULC S104-15, Standard Method for Fire Tests of Door Assemblies

- .2 CAN/ULC S105-16, Standard Specification for Fire Door Frames Meeting the Performance Required by CAN/ULC S104
 - .3 CAN/ULC S701-11, Thermal Insulation, Polystyrene, Boards and Pipe Covering
 - .4 CAN/ULC S705.1-15, Standard for Thermal Insulation, Spray Applied Rigid Polyurethane Foam, Medium Density
 - .5 CAN/ULC S705.2-05, Standard for Thermal Insulation - Spray Applied Rigid Polyurethane Foam, Medium Density, Installer's Responsibilities - Specification
- .7 Intertek Testing Services/Warnock Hersey (WH):
- .1 Fire Rating Services, Building Materials and Equipment, Listings
- 1.04 ADMINISTRATION REQUIREMENTS
- .1 Coordination: Coordinate throat dimensions based on actual material used for wall construction assemblies; modifications arising from substitute materials may affect throat clearance required for actual construction.
- 1.05 SUBMITTALS
- .1 Provide requested information in accordance with Section 01 00 06 – General Requirements: Submittals.
 - .2 Action Submittals: Provide the following submittals before starting any work of this Section:
 - .1 Product Data: Submit Product data for each type of door and frame indicated, include door designation, type, level and model, material description, core description, construction details, label compliance, fire resistance ratings, and finishes.
 - .3 Informational Submittals: Provide the following submittals when requested by the City:
 - .1 Source Quality Control Submittals: Submit information on zinc coating treatment and primer spot treatment, including instructions for surface treatment before site painting and any restrictions or special coating requirements.
- 1.06 QUALITY ASSURANCE
- .1 Manufacturer: Obtain hollow metal doors and frames from single source of supply and from a single manufacturer, and as follows:
 - .1 Fabricate work of this Section to meet the requirements of the Canadian Steel Door and Frame Manufacturer's Association, Manufacturing Specification for Doors and Frames as a minimum, and as further modified in this section.
 - .2 Fabricator shall be a member in good standing of the Canadian Steel Door and Frame Manufacturer's Association.
 - .2 Supplier: Obtain hollow metal doors and frames from single source of supply and from a single manufacturer.
 - .3 Installer: Use installers who are experienced with the installation of hollow metal doors and frames of similar complexity and extent to that required for the Project.
 - .4 Testing Agencies: Provide doors produced under label service program of a testing agency acceptable to Authorities Having Jurisdiction, and as follows:
 - .1 Steel Fire Rated Doors and Frames: Labelled and listed by an organization accredited by Standards Council of Canada for ratings specified or indicated.

- .2 Provide fire labelled frame products for those openings requiring fire protection ratings, as scheduled:
 - .1 List by nationally recognized agency having factory inspection service and construct as detailed in Follow-up Service Procedures/Factory Inspection Manuals issued by listing agency to individual manufacturers.
 - .2 Fabricate all rated doors, frames and screens to labelling authority standard.
- .3 Affix appropriate label to each opening requiring indicating a labelling requirement listed in Section 08 06 10 as follows:
 - .1 At standard size openings: fire endurance rating.

1.07 DELIVERY, STORAGE, AND HANDLING

- .1 Delivery and Acceptance Requirements: Deliver doors and frames to project site; provide protection during transit and site storage to prevent distortion or indentation, and any additional protection required to prevent damage to finish of doors and frames and as follows:
 - .1 Inspect doors and frames on delivery for damage, and notify shipper and supplier if damage is found.
 - .2 Minor damages may be repaired provided refinished items match new work and are acceptable to the City.
 - .3 Remove and replace damaged items that cannot be repaired as directed by the City, at no additional cost to the City.
- .2 Storage and Handling Requirements: Store doors and frames at building site under cover and protected from moisture, blocked off the ground and in a manner to prevent sagging, bowing or twisting using wood blocking and as follows:
 - .1 Remove wet wrapping materials immediately upon delivery.
 - .2 Provide vented shelters to prevent humidity conditions that could damage door and frame finish.
 - .3 Provide space between stacked doors to permit air circulation.

1.08 SITE CONDITIONS

- .1 Site Measurements: Verify actual dimensions of openings by site measurements before fabrication and indicate measurements on Shop Drawings; coordinate fabrication schedule with construction progress to avoid delaying the Work.
- .2 Established Measurements: Establish dimensions and proceed with fabricating doors and frames 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.

2. PRODUCTS

2.01 MATERIALS

- .1 Steel Sheet:
 - .1 Steel Doors and Frames: Metallic coated steel sheets in accordance with ASTM A924/M924; coated to meet requirements of ASTM A653/A653M, Commercial Steel (CS), Type B, ZF120 galvanized; stretcher levelled standard of flatness where used for face sheets.

- .2 Door Cores:
- .1 Honeycomb: Structural small cell; 25 mm maximum, kraft paper honeycomb; minimum weight 36 kg/ream; minimum density 16.5 kg/m³; sanded to required thickness.
 - .2 Polystyrene: Rigid extruded, closed cell insulation, fire retardant treated meeting the requirements of ULC S701, Type 4, minimum thermal resistance RSI 0.8/25 mm thickness.
 - .3 Polyisocyanurate: Rigid foam, closed cell, faced board, meeting the requirements of ULC S705, minimum thermal resistance RSI 1.20/25 mm thickness.
- .3 Adhesives:
- .1 Core Adhesive: Heat resistant, single component, polyurethane reactive (water) hot melt, thermoset adhesive.
- .4 Touch-Up Primer: Rust inhibitive primer meeting CAN/CGSB 1.132, touch up zinc coatings using shop applied primer; grey or red coloured primer, clear primer not acceptable; provide additional primer for site touch-up to repair damaged zinc and shop applied coatings.
- .5 Accessories:
- .1 Floor anchors, channel spreaders, nominal 1.60 mm tee anchors, 1.19 mm wall stud anchors, and as follows:
 - .1 Hot dipped zinc coated for exterior locations.
 - .2 Wipe coat galvanized for interior locations.
 - .3 Drill stud anchors for wire tie to studs.
 - .4 Lag bolts, shields and bushing for existing or concrete openings.
 - .5 Provide anchors appropriate to installation conditions.
 - .2 Sealant: As specified in Section 07 92 00.
 - .3 Door Silencers (Bumpers or Mutes): Manufacturer's standard black or grey neoprene silencers; three silencers on strike jambs of single door frames; two silencers on heads of double door frames; stick on bumpers are not acceptable.

2.02 DOOR FABRICATION

- .1 Fabricate steel doors rigid, neat in appearance, and free from defects including warp and buckle; 45 mm thickness of types and sizes indicated in Section 08 06 10, and as follows:
- .1 Door faces of all steel doors shall be fabricated without visible seams, free of scale, pitting, coil brakes, buckles and waves.
 - .2 Form edges true and straight with minimum radius suitable for thickness of steel used.
 - .3 Bevel lock and hinge edges 3 mm in 50 mm; confirm requirement with builder's hardware or door swing that could dictate a different bevel.
 - .4 Top and bottom of doors shall be provided with inverted, recessed, nominal 1.60 mm steel end channels, welded to each face sheet at 150 mm o/c.
 - .5 Provide fire labelled doors for those openings requiring fire protection ratings, as indicated in Section 08 06 10.
 - .6 Doors: 45 mm with 127 mm top rail and 610 mm bottom rail with 3 mm stainless steel sheet applied both sides (kick plate); standard interlock, meeting and 127 mm jamb stiles.
 - .1 Top and bottom Channels:
 - Exterior Doors: 1.5 mm
 - Interior Fire Rated Doors: 1.9 mm

- .7 Fabricate doors with the following clearances:
 - .1 Clearance between door and frame and between meeting edges of doors swinging in pairs shall not exceed 3 mm.
 - .2 Clearance between the bottom of door and floor shall not exceed 19 mm or as required to accommodate specified hardware.
 - .3 Clearance between bottom of door and a raised non-combustible sill in accordance with NFPA 80.
 - .4 Clearance between bottom of door and nominal surface of combustible floor coverings in accordance with NFPA 80.
- .2 Insulated Doors: Flush, lock seam construction, insulated doors fabricated in accordance with CAN/CGSB 82.5, and as follows:
 - .1 Face Sheets: Minimum 1.60 mm base steel sheet thickness.
 - .2 Insulation Stiffened Core: Insulated and sound deadened with polystyrene or polyisocyanurate at choice of manufacturer core laminated under pressure to each face sheet.
 - .3 Longitudinal edges edge seams spot welded, filled with automotive body filler and sanded flush.
- .3 Non-Insulated Doors: Flush, lock seam construction, hollow steel doors fabricated in accordance with CSDMA Manufacturing Specifications for Doors and Frames, and as follows:
 - .1 Face sheets: Minimum 1.60 mm base steel sheet thickness.
 - .2 Stiffened and sound deadened with honeycomb core laminated under pressure to each face sheet.
 - .3 Longitudinal edges mechanically interlocked, edge seams spot welded, filled with automotive body filler and sanded flush.
- .4 Insulated Fire Rated Doors: Flush, lock seam construction, insulated hollow steel doors fabricated in accordance with CAN4 S104 and NFPA 80, and as follows:
 - .1 Face sheets: Minimum nominal 1.60 mm base steel sheet thickness.
 - .2 Stiffened and sound deadened with polystyrene core laminated under pressure to each face sheet.
 - .1 Longitudinal edges edge seams spot welded, filled with automotive body filler and sanded flush.
 - .2 Labelled by Underwriters Laboratories of Canada, ITS/Warnock Hersey, or other testing laboratory approved by the authority having jurisdiction.
- 1.02 PANEL FABRICATION
 - .1 Fabricate panels from the same materials, construction and finished in the same manner as doors as specified in Article 2.02 above.
- 1.03 FRAME FABRICATION
 - .1 Fabricate door frames with mitred corners of frames and weld continuously along inside of frame profile, or lap and weld concealed corner plates, making exposed faces flush, mitres tight, filled, and finished smooth, and as follows:
 - .1 Knockdown (KD) frames are not acceptable and will be rejected.
 - .2 Jamb, heads, mullions, sills and centre rails shall be straight and uniform throughout their lengths.
 - .3 Factory assembled frame product shall be square, free of defects, warps or buckles.
 - .4 Accurately cope joints at mullions, transom bars, sills or centre rails, butted and tightly fitted, with faces securely welded, matching corner joint faces.

- .5 Fabricate frames in sections for site splicing where required due to site access, or when shipping limitations dictate smaller assemblies, and as follows:
 - .1 Provide 2.74 mm splice plates for site spliced jambs, heads and sills, securely welded into one section, extending 50 mm minimum each side of splice joint.
 - .2 Provide 2.74 mm splice plates for site splices at closed sections (mullions or centre rails) securely welded to the abutting member; extend 100 mm minimum into closed sections when assembled.
 - .3 Site splice joints shall be welded, filled and ground to present a smooth uniform surface after assembly is complete.
- .6 Provide two (2) temporary steel jamb spreaders welded to the base of the jambs or mullions to maintain proper alignment during shipping and handling; remove spreaders before anchoring frame to floor.
- .7 Prepare door opening for single stud door silencers, three (3) for single door openings, and two (2) for double door openings, shipped installed; coordinate with painter for removal and reinstallation after finish painting.
- .8 Provide fire labelled frames for those openings requiring fire protection ratings, as indicated in Section 08 06 10.

.2 Frames:

- .1 Frames: 1.98 mm minimum, with 50 mm face standard frame profile, throat and frame width to suit wall construction.

1.04 HARDWARE PREPARATION

- .1 Prepare doors in coordination with hardware schedule in Section 08 71 00 and templates provided by the hardware supplier, and as follows:
 - .1 Fully Templated Mortised Hardware: Factory blank, reinforce, drill and tap doors.
 - .2 Non-Fully Templated Mortised Hardware: Factory blank and reinforce only.
 - .3 Surface Mounted Hardware: Factory reinforce only.
 - .4 Templated Holes 13 mm and Larger: Factory prepared, except mounting and through bolt holes shall be site prepared at the time of application.
 - .5 Templated Holes Less Than 13 mm Ø: Factory prepared only when required for the function of the device (for knobs, levers, cylinders, thumb or turn pieces) or when holes overlap function holes.
 - .6 Site drill and tap for surface mounted hardware or mortised hardware that is not fully templated at the time of hardware application.
- .2 Hardware Reinforcement for Doors and Frames: Carbon steel, welded in place, prime painted, to the following minimum nominal thicknesses:

Hardware Reinforcement	Door (mm)	Frame (mm)
Mortise Hinge:	3.51	3.51
Mortise or Bored Lock or Deadbolt:	1.98	1.98
Flush or Surface Bolt Front:	1.98	1.98
Surface or Concealed Closer:	2.74	2.74
Strike Reinforcements:	1.98	1.98
Hold Open Arm:	1.98	1.98
Electronic Hardware Reinforcements:	1.98	1.98
Pull Plates and Bars:	1.30	1.30
Mortar Box:	--	0.84
Surface Exit Devices:	1.98	1.98

Door Surface Hardware Reinforcements:	1.30	1.30
Frame surface hardware reinforcements:	2.74	2.74
Notes: Provide additional 4.20 mm x 32 mm x 225 mm long reinforcement spanning between hinge plate and face of door or frame, at top hinge location. Provide guard boxes to protect mortised cut-outs from spray applied insulation, fully sealed.		

.3 Electronic Door Hardware Preparation:

- .1 Provide templated, electrical passageways, hardware enclosures and junction boxes in accordance with manufacturer's standard requirements, and as required to maintain ULC Fire Labelling requirements; inter-connected with CSA approved conduit, passageways and connectors:
 - .1 Coordinate requirements of door and frame supply for provision of shallow junction boxes supplied and installed by Division 26.
 - .2 Coordinate with hardware specified in Section 08 71 00 and Section 28 13 02 for locations of conduit connections in doors and door frames; confirm security requirements before manufacturing hollow metal doors and frames.

1.05 FINISHING

- .1 Shop apply zinc rich primer to repair damaged zinc coatings arising from fabrication; cure primer fully before shipping to site; include compatible primer for site finishing and correction of surface abrasions to zinc coatings and factory applied primer.
- .2 Remove weld slag and splatter from exposed surfaces.
- .3 Fill and sand smooth tool marks, abrasions and surface blemishes to present smooth uniform surfaces.

2. EXECUTION

2.01 EXAMINATION

- .1 Examine substrates, door swing arcs, areas of installation and conditions affecting installation for compliance with requirements for manufacturer's installation tolerances and other conditions affecting performance of work of this Section.
- .2 Verify roughing-in for embedded and built-in anchor locations before installing frames.
- .3 Verify door and frame size, door swing and ratings with door opening number before installing frames.
- .4 Installation of hollow metal doors and frames will denote acceptance of site conditions.

2.02 INSTALLATION

- .1 Install steel doors, frames, and accessories in accordance with CSDMA Installation Guide, manufacturer's data, and as specified in this Section.
- .2 Door Frames:
 - .1 Remove temporary spreaders before installing door frames, leaving exposed surfaces smooth and undamaged.

- .2 Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set; limit of acceptable frame distortion 2 mm out of plumb measured on face of frame, maximum twist corner to corner of 3 mm; align horizontal lines in final assembly.
 - .3 Brace frames rigidly in position until adjacent construction is complete; install wooden spreaders at third points of frame rebate to maintain frame width, install centre brace to support head of frames 1200 mm and wider in accordance with CSDMA Installation Guide; do not use temporary metal spreaders for bracing of frames.
 - .4 Place frames before construction of enclosing walls and ceilings allowing for deflection of adjacent construction to ensure that structural loads are not transmitted to frames, and as follows:
 - .1 Check and correct opening width and height, squareness, alignment, twist and plumb as frames are installed in accordance with CSDMA Recommended Dimensional Standards for Commercial Steel Doors and Frames.
 - .2 Metal Stud Partitions: Provide a minimum of three wall anchors per jamb for frames up to 2150 mm high and 1 additional anchor for each 600 mm over 2150 mm high; install adjacent to hinge location on hinge jamb and at corresponding heights on strike jamb; attach wall anchors to studs with screws.
 - .3 Remove wooden braces after frames are securely fastened or attached to adjacent construction.
 - .5 Install studded door silencers.
 - .6 Fill steel frames for insulated doors with foamed-in-place insulation before installation of sealants and back-up materials; coordinate with Section 07 25 19.
 - .7 Install fire rated frames in accordance with NFPA 80.
- .3 Frame Tolerances: Install frames to tolerances listed in CSDMA Installation Guide, and as follows:
- .1 Squareness: Maximum 1.6 mm measured across opening between hinge jamb and strike jamb.
 - .2 Plumbness: Maximum 1.6 mm measured from bottom of frame to head level.
 - .3 Alignment: Maximum 1.6 mm measured offset between face of hinge jamb and strike jamb relative to wall construction.
 - .4 Twist: Maximum 1.6 mm measured from leading edge of outside frame rabbet to leading edge of inside frame rabbet.
- .4 Doors:
- .1 Fit hollow metal doors accurately in frames within clearances required for proper operation; shim as necessary for proper operation.
 - .2 Install hardware in accordance with manufacturers' templates and instructions.
 - .3 Adjust operable parts for correct clearances and function.
 - .4 Install fire rated doors within clearances specified in NFPA 80.

2.03 ADJUSTING AND CLEANING

- .1 Immediately after installation, sand smooth any rusted or damaged areas of prime coat and apply touch up of air drying primer compatible with factory applied primer, and as follows:
 - .1 Clean exposed surfaces with soap and water to remove foreign matter before site touch-up.
 - .2 Finish exposed site welds to a smooth uniform surface and touch-up with site applied rust inhibitive primer.
 - .3 Site apply touch-up primer on exposed surfaces where zinc coating or factory applied primer has been damaged during installation or handling.

- .2 Keep steel surfaces free of grout, tar or other bonding materials or sealers; clean grout or other bonding material from surfaces immediately following installation.

END OF SECTION

1. GENERAL**1.01 SUMMARY**

.1 This Section includes requirements for supply and installation of the following:

- .1 Non-rated wall access doors and frames
- .2 Fire rated wall access doors and frames
- .3 Non-rated Ceiling access doors and frames
- .4 Fire rated ceiling access doors and frames

1.02 REFERENCE STANDARDS

.1 American Society for Testing and Materials (ASTM International):

- .1 ASTM A568/A568M-13ae1, Standard Specification for Steel, Sheet, Carbon, Structural, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, General Requirements for
- .2 ASTM A591/A591M-98, Standard Specification for Steel Sheet, Electrolytic Zinc-Coated, for Light Coating Weight (Mass) Applications
- .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 A780-09, Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
- .5 ASTM A1008/A1008M-13, Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable
- .6 ASTM B221-13, Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
- .7 ASTM C36/C36M-03, Standard Specification for Gypsum Wallboard

.2 National Fire Protection Agency (NFPA):

- .1 NFPA 80, Standard for Fire Doors and Fire Windows

.3 International Organization for Standardization (ISO):

- .1 ISO 14021:1999, Environmental labels and declarations -- Self-declared environmental claims (Type II environmental labelling)

.4 Underwriters Laboratories of Canada (ULC):

- .1 CAN/ULC S104-15, Standard Method for Fire Tests of Door Assemblies

.5 Underwriters' Laboratories (UL), Standards for Safety acceptable to the Standards Council of Canada (SCC)

1.03 ADMINISTRATION REQUIREMENTS

.1 Pre-Construction Meeting: Arrange a pre-construction meeting in accordance with Section 01 00 06 – General Requirements: Project Meetings, and as follows:

- .1 Attendance will be required by the Contractor, major Mechanical and Electrical Subcontractors, and other subcontractors affected by work of this Section; purpose of meeting will be to discuss placement and type of access doors and panels and obtain Consultant's acceptance of locations before completing any permanent work of this Project.

- .2 Coordination: Determine specific locations and sizes for access doors needed to gain access to concealed equipment, and indicate on schedule specified in 1.04.2.3 below, and as follows:
 - .1 Coordinate locations of all access panels in gypsum board ceilings with Consultant for size and location prior to installation, making every effort to locate outside of gypsum board ceilings.
 - .2 Coordinate acceptable locations and sizes with Architectural Reflected Ceiling Plans; no access panels are allowed in public corridors or feature ceilings.
 - .3 Coordinate closely with mechanical and electrical sections for size and locations of access panels in walls and ceilings; provide access doors and panels required for project.

1.04 SUBMITTALS

- .1 Provide required information in accordance with Section 01 00 06 – General Requirements: Submittals.
- .2 Action Submittals: Provide the following submittals before starting any work of this Section:
 - .1 Product Data: Provide product data for each type of door and frame indicated, including construction details relative to materials, individual components and profiles, finishes, and fire ratings (if required) for access doors and frames.
 - .2 Shop Drawings: Provide coordination drawings and reflected ceiling plans drawn to scale and coordinating penetrations and ceiling-mounted items with concealed framing, suspension systems, piping, ductwork, and other construction. Show the following:
 - .1 Method of attaching door frames to surrounding construction.
 - .2 Ceiling mounted items including access doors and frames, lighting fixtures, diffusers, grilles, speakers, sprinklers, and special trim.
 - .3 Samples: Provide complete door and frame schedule, including types, general locations, sizes, construction details, latching or locking provisions, and other data pertinent to installation.

1.05 QUALITY ASSURANCE

- .1 Regulatory Requirements: Provide fire rated access doors and frames in accordance with NFPA 80 or ULC S104, and labelled and listed by UL, ULC or ITS/Warnock Hersey, or another testing and inspecting agency acceptable to Authority Having Jurisdiction.

2. PRODUCTS

2.01 NON-RATED ARCHITECTURAL ACCESS PANELS

- .1 Flush doors and trimless frames, fabricated as follows:
 - .1 Aluminum Extrusions: ASTM B221, Alloy 6063-T6.
 - .2 Door: Extruded aluminum frame with gypsum board inlay and structural nylon corner elements:
 - .1 Gypsum Board: to ASTM C36, 13 mm and 16 mm thickness to match adjacent construction.
 - .2 Size: Square sized to suit access requirements if not indicated on Drawings.
 - .3 Latch: Tamper-resistant torx drive.
 - .4 Hinge: Concealed, two point pin hinge, non-corroding, allowing door to open 120° and allowing door to be removed.
 - .5 Edge Bead: Recessed extruded aluminum frame edge bead providing surface that can be finished to adjacent gypsum board.

- .6 Accessories: Fibreglass reinforced nylon, zinc plated screws, stainless steel springs and retaining wire to manufacturer's standard.
- .7 Finish: Aluminum frames, gypsum board, nylon and aluminum cam latch to receive the same finish and paint as the surrounding surface.
- .8 Basis-of-Design Materials:
 - .1 Access Panel Solutions, BaucoPlus-II Architectural Access Panel.

2.02 FIRE RATED ACCESS PANELS IN GYPSUM BOARD

- .1 Flush, fire rated access doors and trimless frames, fabricated from zinc coated steel sheet, and as follows:
 - .1 Cold-Rolled Steel Sheets: ASTM A1008/A1008M, Commercial Steel (CS), or ASTM A1008/A1008M, Drawing Steel (DS), Type B; stretcher-levelled standard of flatness; with minimum thickness indicated representing specified nominal thickness according to ASTM A568/A568M.
 - .2 Galvanizing: Electrolytic zinc-coated steel sheet, complying with ASTM A591/A591M, Class C coating or ASTM A653/A653M Z180 (G60) mill phosphatized zinc coating, at fabricator's option.
 - .3 Door: Flush panel, minimum thickness of 0.95 mm.
 - .4 Latch: Self-latching bolt operated by tamper-resistant torx drive with interior release.
 - .5 Hinge: Concealed, two point pin hinge, non-corroding, allowing door to open 120° and allowing door to be removed.
 - .6 Automatic Closer: Spring type.
- .2 Edge Beads: Edge trim formed from 0.80 mm nominal thickness zinc coated steel sheet formed to receive joint compound and in size to suit thickness of gypsum board.
- .3 Door Frame: Minimum 1.6 mm thick sheet metal with gypsum board bead.
 - .1 Acceptable Materials: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - .1 Acudor Products, Inc., FB-5050-DW
 - .2 Nystrom Inc., UW Series

2.03 FIRE RATED ACCESS PANELS IN MASONRY OR CONCRETE

- .1 Flush, fire rated access doors and trimless frames, fabricated from zinc coated steel sheet, and as follows:
 - .1 Cold-Rolled Steel Sheets: ASTM A1008/A1008M, Commercial Steel (CS), or ASTM A1008/A1008M, Drawing Steel (DS), Type B; stretcher-levelled standard of flatness; with minimum thickness indicated representing specified nominal thickness according to ASTM A568/A568M.
 - .2 Galvanizing: Electrolytic zinc-coated steel sheet, complying with ASTM A591/A591M, Class C coating or ASTM A653/A653M Z180 (G60) mill phosphatized zinc coating, at fabricator's option.
 - .3 Door: Flush panel, minimum thickness of 0.95 mm.
 - .4 Latch: Self-latching bolt operated by tamper-resistant torx drive with interior release.
 - .5 Hinge: Concealed, two point pin hinge, non-corroding, allowing door to open 120° and allowing door to be removed.
 - .6 Automatic Closer: Spring type.
 - .7 Edge Trim: All purpose exposed flange formed from 1.98 mm nominal thickness zinc coated steel sheet.
 - .8 Door Frame: Minimum 1.6 mm thick sheet metal with gypsum board bead.

.9 Acceptable Materials:

- .1 Acudor Products, Inc., FB-5050
- .2 Nystrom Inc., UT Series
- .3 Milcor Limited., UNIFRAD Universal Fire Rated Access Door

2.04 FABRICATION

- .1 Provide access door assemblies manufactured as integral units ready for installation.
- .2 Provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness for metal surfaces exposed to view in the completed Work.
- .3 Grind exposed welds smooth and flush with adjacent surfaces. Furnish attachment devices and fasteners of type required to secure access panels to types of supports indicated.
- .4 Latching Mechanisms: Supply number required to hold doors in flush, smooth plane when closed based on size of door or panel opening.
- .5 Apply manufacturer's standard protective coating on aluminum that will come in contact with concrete after fabrication.

2.05 FINISHES

- .1 Comply with NAAMM's Metal Finishes Manual for Architectural and Metal Products for recommendations for applying and designating finishes.
- .2 Finish metal fabrications after assembly.
- .3 Aluminum Finishes:
 - .1 Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
 - .2 As-Fabricated Finish: AA-M10 Mechanical Finish: as fabricated, unspecified (mill finish).
- .4 Steel Finishes:
 - .1 Surface Preparation: Clean surfaces with non-petroleum solvent so surfaces are free of oil and other contaminants. For galvanized surfaces, apply, after cleaning, a conversion coating suited to the organic coating to be applied over it. For zinc coated surfaces, clean welds, mechanical connections, and abraded areas, and apply galvanizing repair paint specified below to comply with ASTM A780.
 - .2 Factory Priming for Site Painted Finish: Apply shop primer immediately after cleaning and pre-treating, as follows:
 - .1 Shop Primer for Ferrous Metal: Fast-curing, lead- and chromate free, universal modified alkyd primer selected for good resistance to normal atmospheric corrosion, compatibility with finish paint systems and capability to provide a sound foundation for site-applied topcoats despite prolonged exposure.
 - .2 Shop Primer for Zinc Coated Steel: Organic zinc-rich primer complying with SSPC-Paint 20 and compatible with topcoat.
 - .3 Galvanizing Repair Paint: High zinc dust content paint for regalvanizing welds in steel, complying with SSPC-Paint 20.

3. EXECUTION

3.01 PREPARATION

- .1 Advise installers of other work about specific requirements relating to access door installation, including sizes of openings to receive access door and frame, as well as locations of supports, inserts, and anchoring devices.

3.02 INSTALLATION

- .1 Installation shall be completed by Section 09 21 16 – Gypsum Board Assemblies.
- .2 Comply with manufacturer's written instructions for installing access doors and frames.
- .3 Set frames accurately in position and attach securely to supports with plane of face panels aligned with adjacent finish surfaces.
- .4 Install access doors with trimless frames flush with adjacent finish surfaces or recessed to receive finish material.
- .5 Remove and replace doors and frames that are warped, bowed, or otherwise damaged.

3.03 ADJUSTING

- .1 Adjust doors and hardware after installation for proper operation.

END OF SECTION

1. GENERAL

1.01 SUMMARY

- .1 This Section includes requirements of supply and installation for interior and exterior aluminum framed storefronts, entrance framing and swing doors.

1.02 RELATED REQUIREMENTS

- .1 Section 07 92 00 – Joint Sealants: Sealants installed with aluminum framed entrance and storefront systems.
- .2 Section 08 06 10 – Door Schedule
- .3 Section 08 42 29 – Sliding Automatic Entrances: Automatic entrance doors.
- .4 Section 08 71 00 – Door Hardware: Hardware groups and Hardware installation requirements and quality standards.
- .5 Section 08 81 00 – Glass Glazing: Glass requirements.

1.03 DEFINITIONS

- .1 The following definitions apply to the Aluminum Framed Entrances and Storefronts:
- .2 Equal Dimensions: Calculated dimensions for entrance system assemblies indicating equal modules aligning with in-place structural elements followed by even division of the space between structural elements; this means that entrance system materials are evenly spaced between adjacent structural members, not necessarily evenly spaced across the entire wall assembly.

1.04 REFERENCE STANDARDS

- .1 American Architectural Manufacturer's Association (AAMA):
 - .1 AAMA 501-15, Methods of Test for Exterior Walls
 - .2 AAMA 611-14, Voluntary Specification for Architectural Anodized Aluminum
- .2 American National Standards Institute (ANSI):
 - .1 BHMA A156.4-2013, Door Closers
 - .2 BHMA A156.8-2015, Door Controls - Overhead Stops and Holders
- .3 American Society for Testing and Materials (ASTM):
 - .1 ASTM A666-15, Standard Specification for Annealed or Cold Worked Austenitic Stainless Steel Sheet, Strip, Plate and Flat Bar
 - .2 ASTM B36/B36M-13, Standard Specification for Brass Plate, Sheet, Strip and Rolled Bar
 - .3 ASTM B209/209M-14, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
 - .4 ASTM B221-14, Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
 - .5 ASTM B429/A429M-10e1, Standard Specification for Aluminum-Alloy Extruded Structural Pipe and Tube
 - .6 ASTM C920-18, Standard Specification for Elastomeric Joint Sealants
- .4 Canadian Standards Association (CSA):
 - .1 CSA G40.20-13/G40.21-13, General Requirements for Rolled or Welded Structural Quality Steel Structural Quality Steel

- .2 CSA W47.1-09, Certification of Companies for Fusion Welding of Steel
- .3 CSA W47.2-11, Certification of Companies for Fusion Welding of Aluminum
- .4 CSA W59-03, Welded Steel Construction (Metal Arc Welding), Metric
- .5 CSA W59.2-1991 (R2003), Welded Aluminum Construction

.5 Canadian Welding Bureau (CWB Group Industry Services):

- .1 CWB 112E, 93-1, Welding Symbols Study Guide
- .2 CWB 113E, 94-1, Weld Quality and Examination Methods Study Guide

.6 The Society for Protective Coatings (SSPC)/National Association of Corrosion Engineers (NACE International):

- .1 Surface Preparation Guidelines:
 - .1 SSPC-SP COM Surface Preparation Commentary for Steel and Concrete Substrates
 - .2 SSPC-PS Guide 12.00, Guide to Zinc-Rich Coating Systems

1.05 ADMINISTRATIVE REQUIREMENTS

- .1 Pre-Construction Meeting: Conduct a pre-construction meeting in accordance with Section 01 00 06 – General Requirements: Project Meetings, on site to review methods and procedures related to glazed aluminum curtain wall systems including but not limited to the following:
 - .1 Review and finalize construction schedule and verify availability of materials, installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 - .2 Review location and alignment of vertical and horizontal elements as they relate to the aesthetic criteria indicated on the Drawings, and the technical requirements indicated on the shop drawings.

1.06 SUBMITTALS

- .1 Provide required information in accordance with Section 01 00 06 – General Requirements: Submittals.
- .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: Submit shop drawings detailing fabrication and assembly for aluminum framed entrance systems including plans, elevations, sections, details, and attachments to other work and the following:
 - .1 Details of provisions for system expansion and contraction and for draining moisture occurring within the system to the exterior.
 - .2 Hardware schedule and operating hardware types, functions, quantities, and locations.
 - .3 Connections to adjacent air and vapour membranes.
 - .4 Isometric drawing indicating joinery, anchorage, flashing and drainage provisions.
 - .3 Samples: Submit samples of each type of exposed finish required in manufacturer's standard sizes for verification of colours selected for the Project.
 - .4 Informational Submittals: Provide the following during the course of the work:

- .1 Source Quality Control Submittals: Submit pre-construction sealant test reports for structural sealant glazed systems, compatibility and adhesion test reports from sealant manufacturer indicating that materials forming joint substrates and joint sealant backings have been tested for compatibility and adhesion with sealants, including sealant manufacturer's interpretation of test results for sealant performance and recommendations for primers and substrate preparation needed to obtain adhesion.
- .2 Structural Silicone Adhered Glazing Certificates: Submit an engineered and certified installation report before starting construction for review by Consultant; include a general overview of the installation process, complete design and installation guidelines from the manufacturer's printed literature.

1.07 PROJECT CLOSEOUT SUBMISSIONS

- .1 Operation and Maintenance Data: Submit manufacturer's written instructions for cleaning of aluminum finishes and maintenance of operational hardware; include name of original installer and contact information in accordance with Section 01 00 06 – General Requirements: Closeout Submissions.

1.08 QUALITY ASSURANCE

- .1 Qualifications: Provide proof of qualifications when requested by the City:
 - .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.

1.09 SITE CONDITIONS

- .1 Site Measurements: Verify actual locations of structural supports for aluminum framed entrance and storefront systems by site measurements before fabrication and indicate measurements on Shop Drawings.
- .2 Established Dimensions: Establish dimensions and proceed with fabricating aluminum framed entrance and storefront systems where site measurements cannot be made without delaying the Work; coordinate construction to ensure that actual dimensions correspond to established dimensions.

1.10 WARRANTY

- .1 Manufacturer Warranty: Provide warranty, signed and issued in the name of City, 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; 2 years.
 - .2 Joint Sealants, Caulking: Failure to maintain seal; 2 years.
 - .3 Aluminum Brake Shapes: Oil canning and delaminations; 2 years.
 - .4 Failure of Operating Components to Function Normally; 2 years.
 - .5 Finishes: Failure to specified finishes not attributable to normal weathering; 5 years.

2. PRODUCTS

2.01 MANUFACTURERS

- .1 Basis-of-Design Materials: Products named in this Section were used as the basis-of-design for the project; manufacturers listed as additional acceptable materials and that offer similar products may be incorporated into the work of this Section provided they meet the performance requirements established by the named products.

- .2 Additional Acceptable Materials Manufacturers: Subject to compliance with performance requirements specified in this Section; as established by the Basis-of-Design Materials, use any of the listed manufacturers' products in accordance with Section 01 00 06 – General Requirements: Substitutions and Product Options; following manufacturer's do not require submission of a request for substitutions provided required shop drawing and product data submissions are submitted before starting any work of Section:
 - .1 A & D Prevost Inc.
 - .2 Alumicor Limited
 - .3 Kawneer Canada Ltd.
- .3 Substitutions: City may consider additional manufacturers having similar products to Acceptable Materials Manufacturers listed above during the construction period, provided they meet the performance requirements established by the named products and provided they submit requests for substitution in accordance with Section 01 00 06 – General Requirements: Substitutions and Product Options before starting any work of this Section:
 - .1 Do not use substitute materials to establish Bid Price.
 - .2 Substitutions that appear as a part of the project without review and acceptance by the City will be rejected, and replaced with one of the specified materials.
- .4 Substitution Limitations: Information on Drawings and in Specifications establishes requirements for aesthetic effects and performance characteristics of the aluminum framed entrance systems required for the Project as follows:
 - .1 Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction.
 - .2 Performance characteristics are indicated by criteria subject to verification by one or more methods including pre-construction testing, site testing, and in-service performance.

2.02 DESIGN CRITERIA

- .1 Provide aluminum framed entrance systems, including anchorage, capable of withstanding, without failure, the effects of the following:
 - .1 Structural loads.
 - .2 Thermal movements.
 - .3 Movements of supporting structure including, but not limited to, story drift and deflection from uniformly distributed and concentrated live loads.
 - .4 Dimensional tolerances of building frame and other adjacent construction.
- .2 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.

.3 Structural Sealant:

- .1 Capable of withstanding tensile and shear stresses imposed by aluminum framed entrance and storefront systems without failing adhesively or cohesively.
- .2 Provide sealant that fails cohesively before sealant releases from substrate when tested for adhesive compatibility with each substrate and joint condition required:
 - .1 Adhesive failure will be considered as when sealant pulls away from substrate cleanly, leaving no sealant material behind.
 - .2 Cohesive failure will be considered as when sealant breaks or tears within itself but does not separate from each substrate because sealant-to-substrate bond strength exceeds sealant's internal strength.
- .3 Structural Sealant Joints: Designed to produce tensile or shear stress in structural-sealant joints of less than 140 kPa.

2.03 MATERIALS

- .1 Aluminum: Materials recommended by manufacturer for type of use and finish indicated, and as follows:
 - .1 Sheet and Plate: In accordance with ASTM B209/B209M, and ANSI H35.1 AA1100-H14, or AA5005-H32 or H34, anodizing quality.
 - .2 Extruded Bars, Rods, Profiles, and Tubes: In accordance with ASTM B221, and ANSI H35.1 AA6063-T5 or T6, anodizing quality.
 - .3 Extruded Structural Pipe and Tubes: In accordance with ASTM B429, and ANSI H35.1 AA6061-T6 or AA6063-T6, anodizing quality.
 - .4 Structural Profiles: In accordance with ASTM B308/B308M, anodizing quality.
 - .5 Welding Rods and Bare Electrodes: CSA W59.2.
- .2 Steel Reinforcement: Coat steel with manufacturer's standard corrosion resistant primer applied immediately after surface preparation and pre-treatment, and as follows:
 - .1 Rolled Sheet or Strip: CSA G40.20/G40.21.
 - .2 Structural Shapes, Plates and Bars: CSA G40.20/G40.21.
- .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 City.
 - .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 Anchors: Three way adjustable anchors that accommodate fabrication and installation tolerances in material and finish compatible with adjoining materials and recommended by manufacturer.
- .6 Anti-Rotation Channels: Manufacturer's recommended extruded aluminum or reinforced nylon anti rotation channel, or load bearing high density insulation designed to retain air seal membrane through pressure to the face of the tubular back section and prevent rotation of pressure cap.

- .7 Concealed Flashing: Manufacturer's standard corrosion resistant, non-staining, non-bleeding flashing materials that are compatible with adjacent materials.
- .8 Transition Membranes: Full length self adhering SBS modified bitumen reinforced membrane; having low temperature formulation appropriate for installation requirements and compatible with materials specified in Section 07 25 13.
- .9 Glazing Gaskets: Manufacturer's standard sealed corner, pressure glazing system consisting of black, resilient elastomeric glazing gaskets, setting blocks, and shims or spacers as recommended by manufacturer for joint type.

2.04 ENTRANCE FRAMES

- .1 Manufacturer's extruded aluminum glazed doors for manual swing operation, reinforced as required to withstand traffic conditions, and as follows:
 - .1 Construction: Wide stile, non-thermally broken frame sections.
 - .2 Dimensions: Nominal 50 mm deep with 90 mm wide vertical rails; 90 mm wide top rail; and 170 mm bottom rail.
 - .3 Glazing Method: Bevelled stops for single glazing, with non-removable glazing stops on outside of door.
 - .4 Basis-of-Design Material: Kawneer 350 Series.
- .2 Manufacturer's standard extruded aluminum framing members of thickness required and reinforced as required to support imposed loads, and as follows:
 - .1 Construction: Non-thermally broken, stick framed
 - .2 Dimensions: Nominal 45 mm face x 115 mm deep total frame profile.
 - .3 Basis-of-Design Material: Kawneer Trifab VG 450 Series.

2.05 STOREFRONT FRAMES

- .1 Manufacturer's standard extruded aluminum framing members of thickness required and reinforce to support imposed loads.
 - .1 Frame Type 1:
 - .1 Construction: Thermally broken, pressure plate glazed.
 - .2 Dimensions: Nominal 65 mm face x 133 mm deep back frame profile, with glazing throat to accommodate 25 mm sealed glazing unit.
 - .3 Cover Depth: Nominal 65 mm wide x 25 mm deep
 - .4 Glazing Method: Glazed from exterior
 - .5 Installation Method: Single span, punched opening
 - .6 Operable Units: None

2.06 DOOR HARDWARE

- .1 Manufacturer's heavy duty hardware units in sizes and types as required to meet entrance use as indicated on Drawings, with the following opening force limitations:
 - .1 Egress Doors: Maximum 135 N to set door in motion and not more than 70 N to open door to minimum required width.
 - .2 Accessible Interior Doors: Maximum 20 N to operate door through entire range of movement.
 - .3 Latches and Exit Devices: Not more than 70 N required to release latch.

- .2 Provide door hardware in accordance with Section 08 71 00 and requirements of this Section; using products that are recommended and supplied by entrance system manufacturer; in accordance with referenced standards, meeting requirements for description, quality, type, and function listed in hardware schedule.
- .3 Hinges: As indicated in Section 08 71 00.
- .4 Locking Devices: Manufacturer's standard locking mechanism that do not require use of key, tool, or special knowledge for operation, and as follows:
 - .1 Mortise Cylinders and Turns: As specified in Section 08 71 00.
 - .2 Panic Exit Devices: In accordance with BHMA A156.3, Grade 1, listed and labelled by a testing and inspecting agency acceptable to Authorities Having Jurisdiction for panic protection, type and function as listed in Section 08 71 00.
 - .3 Keying:
 - .1 Use ETS approved keying System
 - .2 Permanently inscribe each key with a visual key control number and include notation "DO NOT DUPLICATE".
- .5 Trims:
 - .1 Strikes: Provide strike with black plastic dust box for each latch or lock bolt; fabricated for aluminum framing.
 - .2 Operating Trim: In accordance with BHMA A156.6.
 - .3 Closers: In accordance with BHMA A156.4, Grade 1, sized as required by door size, exposure to weather, and anticipated frequency of use; adjustable to meet site conditions and requirements for opening force; having accessories required for complete installation.
 - .4 Concealed Overhead Holders: In accordance with BHMA A156.8, Grade 1.
 - .5 Surface Mounted Holders: In accordance with BHMA A156.16, Grade 1.
 - .6 Door Stops: In accordance with BHMA A156.16, Grade 1, floor mounted as appropriate for door location indicated with integral rubber bumper.
 - .7 Weather Stripping: Manufacturer's standard replaceable components, and as follows:
 - .1 Compression Type: Moulded neoprene meeting ASTM D2000 or moulded PVC meeting ASTM D 2287.
 - .2 Sliding Type: Wool, polypropylene, or nylon woven pile with nylon fabric or aluminum-strip backing meeting AAMA 701.
 - .8 Weather Sweeps: Manufacturer's standard exterior door bottom sweep with concealed fasteners on mounting strip.
 - .9 Silencers: In accordance with BHMA A156.16, Grade 1.
 - .10 Thresholds: Raised thresholds bevelled with a slope of not more than 1:2, with maximum height of 13 mm; in accordance with BHMA A156.21.
 - .11 Finger Guards: Manufacturer's standard collapsible neoprene or PVC gasket anchored to frame hinge jamb at center pivoted doors.
- .6 Glazing Sealants: As recommended by manufacturer for joint type and as follows:
 - .1 Weather Seal Sealant:
 - .1 ASTM C920 for Type S, Grade NS, Class 25, Uses NT, G, A, and O; neutral-curing silicone formulation compatible with structural sealant and other system components with which it comes in contact; and recommended by structural and weather seal sealant and curtain wall manufacturers for this use.
 - .2 Joint Movement Capability: Accommodate 50% increase or decrease in joint width at time of application when measured according to ASTM C719.

- .3 Colour: Matching structural sealant.
- .4 Acceptable Materials:
 - General Electrical SSG4000
 - Dow-Corning 995
 - Tremco Spectrum 2
- .2 Structural Sealant: Provide materials that have been tested in accordance with ASTM C1135 and as follows:
 - .1 Formulation: Meeting ASTM C1184, neutral-curing silicone formulation compatible with system components with which it comes in contact, specifically formulated and tested for use as structural sealant, and approved by structural sealant manufacturer for use in curtain-wall systems indicated.
 - .2 Colour: As selected by Consultant from manufacturer's full range of colors.
 - .3 Type: Manufacturer's standard single or two-component.
 - .4 Minimum Tensile Strength: 345 kPa.
 - .5 Modulus of Elasticity: As required by structural sealant glazed curtain wall system design to meet performance requirements; designed and certified by manufacturer's engineer.
- .7 Automatic Door Operator: As indicated in Section 08 71 13.

2.07 ALUMINUM FINISHES

- .1 Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
- .2 High Performance Organic Finish:
 - .1 3 Coat PVDF Coating: AA-C12 Chemical Finish, cleaned with inhibited chemicals; C40 Chemical Finish, conversion coating; R1x Organic Coating, manufacturer's standard 3 coat, thermo-cured system consisting of specially formulated inhibitive primer, fluoropolymer colour coat, and clear fluoropolymer topcoat, with both colour coat and clear topcoat containing not less than 70% PVDF resin by weight; prepare, pre-treat, and apply coating to exposed metal surfaces in accordance with AAMA 2605 and with coating and resin manufacturers' written instructions.
 - .2 Colour: PPG Kuala White UC74215.
 - .3 Basis-of-Design Products: PPG Duranar

2.08 ACCESSORIES

- .1 Perimeter Air Seal and Insulation: Spray foam as specified in Section 07 25 19.
- .2 Exterior Perimeter Sealants: Non-sagging, polyurethane or silicone sealant compatible with glazing materials and adjacent construction as specified in Section 07 92 00, with foam rod backing materials.
- .3 Interior Perimeter Sealants: Non-sagging acrylic sealant compatible with glazing materials and adjacent construction as specified in Section 07 92 00, with foam rod backing materials.

- .4 Bituminous Paint: Cold applied asphalt mastic paint containing no asbestos, formulated for minimum 0.762 mm thickness per coat.

2.09 FABRICATION

- .1 Form aluminum brake shapes before applying shop applied finishes.
- .2 Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish; remove weld spatter and welding oxides from exposed surfaces by de-scaling or grinding.
- .3 Fabricate framing member components having the following characteristics when fully assembled:
 - .1 Sharp and straight profiles, free of defects or deformations with accurately fitted joints and ends coped or mitred.
 - .2 Drainage to allow water entering joints, condensation occurring within framing members, and moisture migrating within the system to flow to the exterior.
 - .3 Physical and thermal isolation of glass and glazing from framing members.
 - .4 Accommodations for thermal and mechanical movements of glass and glazing, and framing to maintain required glazing edge clearances.
 - .5 Provisions for site replacement of glazing.
 - .6 Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.
- .4 Fabricate storefront framing components using shear block system, screw spline system or head-and-sill receptor system with shear blocks at intermediate horizontal members to accommodate storefront loading requirements.
- .5 Reinforce door frames as required to support loads imposed by door operation and for installing hardware, and as follows:
 - .1 Provide compression weather stripping at fixed stops at exterior doors.
 - .2 Provide silencers at stops to prevent metal-to-metal contact at interior doors; install three silencers on strike jamb of single door frames and two silencers on head of frames for pairs of doors.
- .6 Reinforce entrance frames as required for installing hardware, and as follows:
 - .1 Provide sliding weather stripping retained in adjustable strip mortised into door edge at pairs of exterior doors.
 - .2 Provide weather sweeps applied to door bottoms at exterior doors.
- .7 Factory install hardware to the greatest extent possible; cut, drill, and tap for factory installed hardware before applying finishes.
- .8 Clearly mark components to identify their locations in Project in accordance with shop drawings after fabrication.

3. EXECUTION

3.01 EXAMINATION

- .1 Examine areas for compliance with requirements for installation tolerances and other conditions affecting performance of work.
- .2 Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- .1 Install storefront and entrance framing in accordance with manufacturer's written instructions using materials free from damage and having tightly fitting joints to produce hairline joints free of burrs and distortion, rigidly secured to prevent movement within joints.
- .2 Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration; seal joints watertight except where required to allow for drainage of water from within framing system.
- .3 Protect aluminum against contact with concrete and dissimilar metals by painting contact surfaces with primer, by applying sealant or tape, or installing nonconductive spacers as recommended by manufacturer for this purpose.
- .4 Install components to drain water passing joints, condensation occurring within framing members, and moisture migrating within the system to exterior.
- .5 Set continuous sill members and flashing in full sealant bed to produce weather tight installation.
- .6 Install components plumb and true in alignment with established lines and grades, without warp or rack.
- .7 Install perimeter air seals in accordance with Section 07 25 19 and City's requirements for a continuous air seal.
- .8 Install perimeter joint sealants in accordance with Section 07 92 00 to produce weather tight installation.
- .9 Install glass in accordance with Section 08 81 00.
- .10 Entrances:
 - .1 Install entrance framing to produce smooth operation and tight fit at contact points.
 - .2 Install exterior entrance framing to produce tight fit at weather stripping and weather tight closure.

3.03 ERECTION TOLERANCES

- .1 Install aluminum framed entrance and storefront systems in accordance with the following maximum tolerances:
 - .1 Location and Plane: Limit variation from true location and plane to 3 mm in 3660 mm; 6 mm over total length.
 - .2 Alignment:
 - .1 Limit offset from true alignment to 1.5 mm where surfaces abut in line.
 - .2 Limit offset from true alignment to 0.8 mm where surfaces meet at corners.
 - .3 Diagonal Measurements: Limit difference between diagonal measurements to 3 mm.

3.04 ADJUSTING

- .1 Adjust operating hardware for smooth operation in accordance with hardware manufacturers' written instructions.
- .2 Adjust closers designated as accessible for people with disabilities to provide a 3 second closer sweep period for doors to move from a 70° open position to 75 mm from latch measured to the leading door edge.

3.05 PROTECTION

- .1 Protect aluminum finishes and glazing during erection against disfiguration, contamination or damage by abuse or harmful materials.
- .2 Install protective cover where exposure to damage is critical.
- .3 Mark each light with large cross or other symbol to make glass obvious and noticeable to other trades after glass is installed, using substance that will not stain, mark or "shadow" glass either by itself or by reaction with sunlight, moisture or the environment; masking tape is not considered as a suitable material; replace glass units marked with masking tape.

END OF SECTION

1. GENERAL

1.01 SUMMARY

- .1 This section includes requirements for supply and installation of automatic entrance door systems comprising the following:
- .1 Exterior Sliding doors and frames enclosures
 - .2 Glass and glazing
 - .3 Door hardware
 - .4 Operator equipment
 - .5 Control system
 - .6 Perimeter sealant
- .2 This section includes for products installed by this section but not provided under this section including; but not limited to, the following:
- .1 Installation of finish hardware, supplied by Section 08 71 00.
 - .2 Installation of glass and glazing materials, supplied by Section 08 81 00.
- .3 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.

1.02 REFERENCE STANDARDS

- .1 Architectural Aluminum Manufacturers Association (AAMA):
- .1 AAMA AFPA-91, Anodic Finishes/Painted Aluminum
 - .2 AAMA 611-14, Voluntary Specification for Architectural Anodized Aluminum
 - .3 AAMA 701.2-11, Voluntary Specifications for Pile Weather Strip
 - .4 AAMA CW-RS-1-12, The Rain Screen Principle and Pressure Equalized Wall Design
 - .5 AAMA RPC-00, Rain Penetration Control: Applying Current Knowledge
- .2 American Society for Testing and Materials (ASTM):
- .1 ASTM A653/A653M-17, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
 - .2 ASTM A167-99 (2009), Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet and Strip
 - .3 ASTM B209M-14, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
 - .4 ASTM B221-14, Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
 - .5 ASTM B429M-10e1, Standard Specification for Aluminum-Alloy Extruded Structural Pipe and Tube
 - .6 ASTM D2000-12 (2017), Standard Classification System for Rubber Products in Automotive Applications
 - .7 ASTM D2287-12 (2001), Specification for Non-Rigid Vinyl Chloride Polymer and Copolymer Molding and Extrusion Compounds
 - .8 ASTM E283-04 (2012), Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen
 - .9 ASTM E330-14, Standard Test Method for Structural Performance of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference
 - .10 ASTM E331-00 (2016), Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference

.11 ASTM E547-00 (2016), Test Method for Water Penetration of Exterior Windows, Curtain Walls, and Doors by Cyclic Static Air Pressure Differential

.3 Canadian Standards Association (CSA):

- .1 CSA G40.20-13/G40.21-13 (R2018), General Requirements for Rolled or Welded Structural Quality Steel
- .2 CSA W47.1-09 (R2014), Certification of Companies for Fusion Welding of Steel
- .3 CSA W47.2-11 (2015), Certification of Companies for Fusion Welding of Aluminum
- .4 CSA W59-13, Welded Steel Construction (Metal Arc Welding), Metric
- .5 CSA W59.2-1991 (R2018), Welded Aluminum Construction

.4 Canadian General Standards Board (CGSB):

- .1 CAN/CGSB-69.18-M90; Butts and Hinges
- .2 CAN/CGSB-69.19-93, Exit Devices
- .3 CAN/CGSB-69.20-M90, Door Controls (Closers)
- .4 CAN/CGSB-69.21-M90, Auxiliary Locks and Associated Products
- .5 CAN/CGSB-69.26-96, Power Operated Pedestrian Doors

.5 Underwriters' Laboratories of Canada (ULC):

- .1 CAN/ULC-S533-15, Standard for Egress Door Securing and Releasing Devices

1.03 ADMINISTRATIVE REQUIREMENTS

.1 Pre-Installation Meeting: Conduct a pre-construction meeting on site to review methods and procedures related to automatic aluminum entrance systems including, but not limited to, the following:

- .1 Attended by Contractor, Subcontractor, City and other subcontractors affected by work of this Section to review conditions of installation, installation procedures, and coordinate with adjoining work.
- .2 Review and finalize construction schedule and verify availability of materials, installer's personnel, equipment, and facilities needed to make progress and avoid delays.
- .3 Review and finalize requirements for electronic door hardware and connections.
- .4 Review location and alignment of vertical and horizontal elements as they relate to the aesthetic criteria indicated on the Drawings, and the technical requirements indicated on the shop drawings.

1.04 SUBMITTALS

.1 Provide required information in accordance with Section 01 00 06 – General Requirements: Submittals.

.2 Action Submittals: Provide the following submittals before starting any work of this Section:

.1 Product Data: Submit manufacturer's technical product data for door units, framing systems and operators for each type of entrance required including; but not limited to, the following:

- .1 Include fabrication methods.
- .2 Finishing, hardware and operator sizes.
- .3 Roughing-in and wiring diagrams.
- .4 Parts lists, accessories and other components.
- .5 Include data substantiating that system will perform as specified.

.2 Shop Drawings: Submit shop drawings indicating; but not limited to, the following:

- .1 Layout, dimensions, elevations, detail sections of members and sill conditions.

- .2 Materials, finishes, recesses and hardware including mounting heights
- .3 Anchors and reinforcements.
- .4 Provisions for expansion and contraction.
- .5 Methods of joining sheet metal and joint locations.
- .6 Glass types and glass thicknesses, glazing details and types of sealants.
- .7 Details of other pertinent components of the work, and adjacent construction to which work of this section is attached.
- .8 Identify installation tolerances required, assembly conditions, routing of service lines, locations of operating components, controls and boxes.
- .9 Indicate door signs.

.3 Informational Submittals: Provide the following submittals during the course of the work:

- .1 Installation Templates: Submit manufacturer's templates, diagrams and installation instructions including accepted data to fabricators and installers of related work, as necessary for coordination of the installation.
- .2 Certificates: Submit manufacturer's certificate indicating that automatic entrance door systems meet or exceed specified requirements.

1.05 PROJECT CLOSEOUT SUBMISSIONS

- .1 Provide operations and maintenance information in accordance with Section 01 00 06 – General Requirements: Closeout Submissions.
- .2 Include manufacturer's parts lists, servicing frequencies, instructions for adjustment and operation applicable to each type of component or hardware, sequence of operation, and name, address and telephone number of nearest authorized service representative.

1.06 QUALITY ASSURANCE

- .1 Qualifications: Provide proof of qualifications when requested by City:
 - .1 Manufacturer: Company specializing in the manufacture of automatic entrance door operating equipment and framing assemblies and capable of showing prior production of doors similar to those specified with five years documented experience.
 - .2 Installer: Company that is an authorized representative of the automatic entrance door manufacturer for both the installation and maintenance of the type of units specified, and with three (3) years documented servicing and installing experience; submit references for installer when requested by the City.
 - .3 Maintenance Proximity: Offices and maintenance facilities of installer shall be located not more than one (1) hour normal travel time for the project site.

1.07 PROJECT CONDITIONS

- .1 Site Measurements: Verify dimensions of other construction by site measurements before fabrication and indicate measurements on shop drawings where aluminum curtain wall systems are indicated to fit to other construction.
- .2 Established Dimensions: Establish dimensions and proceed with fabricating aluminum curtain wall without site measurements where site measurements cannot be made without delaying the Work, coordinated with other construction to ensure that actual dimensions correspond to established dimensions.

1.08 WARRANTY

- .1 Manufacturer Warranty: Provide five (5) year manufacturer's warranty on automatic entrance door units and operators effective from the date of Substantial Performance for the Work of the Project covering repair or replacement of components or entire units that fail in materials workmanship; failures will be considered to be; but are not limited to, the following:
 - .1 Structural failures including excessive deflection.

- .2 Excessive leakage or air infiltration.
- .3 Faulty operation of operators, speed control and hardware.
- .4 Deterioration of metals, metal finishes, and other materials beyond normal weathering.

- .2 Warranty Service: Provide complete service and maintenance of operating equipment for one (1) year from date of Substantial Performance of the Work.

2. PRODUCTS

2.01 MANUFACTURERS

- .1 Basis-of-Design Materials: Products named in this Section were used as the basis-of-design for the project; additional manufacturers will not be considered:

- .1 Basis-of-Design Materials: Stanley Access Technologies.

2.02 DESCRIPTION

- .1 System Requirements:

- .1 Automatic Door Equipment: Electro-mechanically operated with motion detector control device.
- .2 Type of Door Operations: Fully automatic.
- .3 Door: Single, bypass sliding, with breakout to full open position in the direction of travel.
- .4 Sidelites: Fixed.
- .5 Traffic Movement: Two way traffic.
- .6 Basis-of-Design Materials: Stanley Access Technologies, Dura-Guard 2000 Series.

- .2 Design Requirements:

- .1 Design automatic entrance doors as emergency exits, as required means of egress from the building, and to comply with the Building Code.
- .2 Design automatic entrances to comply with applicable requirements of CAN/CGSB-69.26.

- .3 Performance Requirements:

- .1 Automatic door equipment shall accommodate high frequency pedestrian traffic of 120 cycles per hour, and weight of doors.
- .2 Operator Equipment: CSA approved.
- .3 Automatic Locks and Panic Hardware to Non-Fire Rated Exit Doors: ULC listed and labelled.
- .4 Design framing members to withstand their own weight, weight of glass, loads imposed by motion of operable elements, and design wind and suction loads, as calculated in accordance with the Building Code and applicable municipal regulations, to maximum allowable deflection of 1/175 of span, when tested in accordance with ASTM E330.
- .5 Design aluminum window systems to account for the following environmental conditions:

- .1 Thermal Movements: Allow for thermal movements resulting from the following maximum change (range) in ambient temperatures, accounting for surface temperatures of materials due to both solar heat gain and night time sky heat loss:

- Temperature Change (Range):
 - ∞ Exterior Ambient: -40°C to +50°C
 - ∞ Interior Ambient: +20°C to +35°C
 - ∞ Adjust calculations to account for colour treatments or coatings on curtain wall framing members.

- Allow for thermal movement with no buckling of frame members, stress on glass, glazing edge seal failure, sealant failure, excess stress on curtain wall framing, anchors and fasteners, or reduction of performance in accordance with AAMA 501.5.
- .6 Provide for dimensional distortion of components during operation.
- .7 Provide manual operation for opening and closing of doors during electrical power failure and when power is manually switched off.
- .8 Provide fully adjustable operators for opening and closing speeds, checking speeds, hold open time and cancellation on activation of fire alarm and smoke detection system.
- .9 Provide exterior door and door frame framing systems with the following maximum air infiltration rates, when tested to ASTM E283, at pressure differential of 75 Pa:
 - .1 Sliding doors: 1.5 L/s.m. of door crack.
 - .2 Condensation Resistance: Not required
- .10 Provide for positive drainage of condensation occurring within thermally broken framing system and water entering at joints, to exterior face of framing in accordance with AAMA Rain Screen Principles.
- .11 Provide framing members and finished metal sheets with uniform appearance and colour.
- .12 Eliminate the possibility of water accumulating and freezing in door power units.
- .13 Design equipment to operate at ambient temperatures between -40°C and 170°C.

2.03 AUTOMATIC SLIDING DOOR SYSTEMS

- .1 Sliding Aluminum Doors: Impact resistant stile door panels with intermediate rails and 250 mm bottom rails with security glass stops and tempered glass:
 - .1 Aluminum Extrusions: Alloy and temper recommended by producer or finisher for type of use and finish indicated, and with not less than strength and durability properties specified in ASTM B221 for Aluminum Association designation 6063-T5 or T6 and as follows:
 - .1 Frame extrusions shall have a minimum 3 mm wall thickness, and door extrusions with minimum 4 mm wall thickness.
 - .2 Glazing stops and other applied trim extrusions shall have a minimum wall thickness of 1.5 mm.
 - .2 Aluminum Sheets: Alloy and temper recommended by producer or finisher for type of use and finish indicated, and with not less than strength and durability properties specified in ASTM B209 for Aluminum Association designations 1100-H14 or 5005-H32 or H34.
 - .3 Fasteners: Aluminum, non-magnetic stainless steel or other non-corrosive metal fasteners compatible with aluminum components, hardware, anchors and other items being fastened using Phillips flat head screws with finish matching item being fastened for exposed hardware.
 - .4 Reinforcement and Brackets: High strength aluminum meeting requirements of ASTM B209.
 - .5 Steel Primer: Oil alkyd primer meeting requirements of CGSB 1-GP-40M.
 - .6 Galvanizing Touch-Up: Zinc rich, organic, ready mixed primer meeting requirements of CAN/CGSB 1.181.
 - .7 Isolation Coating: Acid and alkali resistant bituminous paint.
- .2 Weather Stripping:
 - .1 Compression Weather Stripping: Compressible replaceable type; moulded neoprene gaskets to ASTM D2000.
 - .2 Sliding Weather Stripping:
 - .1 Replaceable nylon woven pile, with nylon fabric or aluminum strip backing to AAMA 701.2.

- .2 Include stripping at jamb rails, head rails and meeting rails, wherever there is no stop or lap to receive compression weather stripping.
- .3 Sill Gasket/Sweep Strips: Resilient seal type, adjustable surface mounted on door, replaceable.
- .4 Sealants and Gaskets: Types recommended by manufacturer to remain permanently elastic, non-shrinking and non-migrating, and required for fabrication and assembly of door framing and as follows:
 - .1 Exposed Sealants and Back-up Required for Installation of System at Project Site: In accordance with Section 07 92 00. Colour selected by City.
- .3 Glass and Glazing Materials: In accordance with Section 08 81 00 for supply of glass and glazing materials.
- .4 Door Hardware: Coordinate with Section 08 06 10 and Section 08 71 00 for supply of finish hardware and as follows:
 - .1 Deadlocks for Sliding Doors: Hook bolt type for sliding entrance doors prepared ready to receive standard five pin tumbler mortise cylinder.

2.04 AUTOMATIC OPERATORS

- .1 Operator Description: Concealed, overhead operator for accommodating door action; fully adjustable without removal of doors; provide adjustable speed control for checking opening and closing cycles, and length of time door remains open and as follows:
 - .1 Fully Concealed On-Off-Hold Open: Keyed switch at inside head of sliding doors, mounted within door framing at a fully concealed location to prevent tampering by public; key matching City standard system specified in Section 08 71 00.
 - .2 Dual Stage Opening: Doors to open half for single traffic and full for larger groups or materials.
 - .3 Emergency Operation: Break away swing feature to sliding doors with spring closing device. Sliding door panels allow breakout to full open position to provide instant egress at any point in door movement. Automatic operation discontinued when panel is in breakout mode.
 - .4 Emergency Stop: Equip operators with back pressure sensing device that will cause door to stop and permit manual operation should the door encounter an obstruction.
 - .5 Provide connections for power and control wiring.
 - .6 Provide for manual operation when power is off.
 - .7 Equip operators with current characteristics to suit building's electrical service.
 - .8 Basis of Design Material: Stanley Access Technologies; Magic Force Series automatic door operator with Sentrex door mounted safety system.
- .2 Operator Power Units:
 - .1 Power Requirements: 120 VAC, 5 Amps, 1/8 hp.
 - .2 Operation: Power open; power close operation.
 - .3 Electro-Mechanical Type: Linear driven.
- .3 Door Operator Control Systems:
 - .1 Provide controls with detection patterns and sensitivity, for both operation and safety, of sizes and quantities required to suit project; but not smaller than requirements of CAN/CGSB-69.26.
 - .2 Electrical Interfaces: Provide devices that prevent activation of operator when door is locked, latched or bolted.

- .3 Sliding Door Opening Width Control Switch: Two position switch which in normal position permits sliding doors to open full width and in alternate position reduces opening to selected partial opening width.
- .4 Motion Detecting Control System (Secondary Sensor)
 - .1 Motion Detector: Manufacturer's standard, self contained, radio frequency microwave two directional sensing device to activate door operator, mounted above opening on each side of door opening; finish housing to match doors.
 - .2 Presence Sensor: Manufacturer's standard, self contained, ultrasonic scanner, mounted as shown on the drawings (interior side), to prevent door from closing until door is clear of traffic, and to recycle sliding doors in openings interrupted by stalled or slow moving traffic; finish housing to match doors.
 - .3 Radiating waves shall be fully adjustable for distance of control sensitivity, and in controlled pattern.
- .5 Touchless Activation Device (Primary Sensor):
 - .1 Flushmount stainless steel device with adjustable – range microwave Doppler technology.
 - .2 Sensing Zone: 2 to 24 inches (adjustable)
 - .3 Hold Time 1 to 30 seconds
 - .4 Audible Alert Signal Mode
 - .5 Visual Alert: (Blue (standby), Green (activation))
 - .6 Supply Voltage 12-24 V AC/DC +/- 10%
 - .7 Enclosure Rating: NEMA 4/IP65
 - .8 Basis of Design: BEA MS11J

2.05 ACCESSORIES

- .1 Sliding Door Sills: Aluminum, mill finish, size and profile as indicated; provide threshold across exterior door opening and inverted roller guide track system at sidelights.
- .2 Door Signs:
 - .1 Sign Material: Self-adhesive type for mounting on glass.
 - .2 Provide arrow sign on approach side of power operated swinging doors; green circle surrounding black arrow on white background, to CAN/CGSB-69.26.
 - .3 Provide "IN EMERGENCY PUSH TO OPEN" sign on power operated sliding doors with breakaway swinging leaves; red background with contrasting letters, design and mounting location to CAN/CGSB-69.26.
 - .4 Provide "AUTOMATIC SLIDING DOOR" sign on each side of power operated sliding door leaves; red horizontal background strip with minimum 25 mm high contrasting letters, each end of horizontal strip with arrow pointing toward nearest door stile. Locate sign centrally on door leaf 900 mm to 1.5 mm above floor.

2.06 FABRICATION

- .1 Prefabricate automatic entrance doors as packaged units complete with doors, sidelights, frames, transoms where indicated, door operators, and related components, hardware, and accessories. complete fabrication, assembly, finishing, hardware applications and other work before shipment to project site:
 - .1 Construct doors, transom panels, and frames to profiles and maximum face sizes indicated.
 - .2 Provide reinforcement for strength, stiffness and connections.
 - .3 Separate metal surfaces at moving joints with non-metallic separators to prevent lock-up of joints.
 - .4 Use structural steel channel sections within void space of framing sections as required.

- .5 Fit intersecting members to flush hairline weather tight joints and mechanically fasten or weld together, except where indicated otherwise.
 - .6 Grind welds smooth, flush and finish to match adjacent surfaces.
 - .7 Reinforce mechanically joined corners of doors by welding and spigotting or by one piece cast aluminum angle to produce sturdy door unit.
 - .8 Conceal fastenings from view; exposed fastenings only where approved by the City.
 - .9 Form cut-outs, recesses, mortising or milling for finishing hardware and operators to templates; reinforce with aluminum or galvanized steel.
- .2 Site apply isolation coating to aluminum, galvanized steel or prime coated steel in contact with dissimilar metals, and cementitious materials; touch-up damaged or scratched surfaces or steel with appropriate primer:
- .1 Install replaceable weather stripping at exterior doors and vestibule door openings, in stiles, head and sill rails; adjust to prevent door from closing incorrectly, or to prevent binding.
 - .2 Place manufacturer's name plates in semi-concealed locations.
 - .3 Fabricate doors and frames by same manufacturer.
 - .4 Use thermally broken frames for door stiles and rails; provide non-thermally broken frames for interior door stiles and rails.
 - .5 Construct doors and frames from aluminum porthole extrusions.
 - .6 Provide interlocking snap-in type glazing stops for dry glazing. Exterior stops: tamper proof type.
 - .7 Shop install hardware, except surface mounted hardware. Remove only as required for final finishing operations, and for delivery and installation of work at project site.

2.07 FINISHES

- .1 Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
- .2 Clear Anodized Finish:
 - .1 Class II Finish: Architectural Class II, clear coating 0.010 mm or thicker in accordance with AAMA 611.
- .3 Exposed Operator and Components: Finish matching door and door hardware.
- .4 Steel Brackets, Reinforcing Steel, and Steel Anchors: One coat of steel primer for interior conditions; galvanized with 380 g/m² zinc coating to CSA G164 for exterior conditions.

3. EXECUTION

3.01 EXAMINATION

- .1 Verify surfaces, openings and recesses are ready to receive work, and opening dimensions are as indicated on shop drawings.
- .2 Verify power supply is available and roughed-in to power operated devices.
- .3 Beginning of installation means acceptance of conditions.

3.02 INSTALLATION

- .1 Perform work in accordance with CAN/CGSB-69.26; install doors and frames in accordance with shop drawings and manufacturer's instructions; attach and seal air vapour barrier materials to perimeter framing.
- .2 Set work plumb, square, level, free from warp, twist and superimposed loads; securely anchor work in required position; do not restrict thermal movement.

- .3 Brace frames rigidly for building-in; provide temporary horizontal spreaders at third points of door openings to maintain frame width; vertically support at centre, heads of openings over 1220 mm wide; remove temporary bracing after framing is set.
- .4 Apply isolation coating to separate aluminum and primed or galvanized steel surfaces at points of contact with cementitious materials.
- .5 Pack fibrous insulation in shim spaces at perimeter of assembly and void spaces between members to maintain continuity of thermal barrier.
- .6 Maintain clearances between head members and structure to ensure that structural loads are not transmitted to frames.
- .7 Install hardware using templates provided by Section 08 71 00.
- .8 Install door operator system in accordance with manufacturer's instructions, including controls, and control wiring.
- .9 Set tracks, header assemblies, operating brackets, rails and guides level and true to location, with adequate anchorage for permanent support.
- .10 Install glass in accordance with Section 08 81 00.
- .11 Sealant Application: Install perimeter sealant and back-up materials, to provide weather tight seal at outside and air, vapour seal at inside in accordance with requirements of Section 07 92 00:
 - .1 Coordinate with Section 07 25 19 for installation of spray foam insulation and air seal.
 - .2 Conceal sealant within aluminum work except where exposed use is permitted by City.
 - .3 Set sill members in bed of sealant.

3.03 CLOSEOUT ACTIVITIES

- .1 Adjusting: After repeated operation of completed installation equivalent to three days of use by normal traffic (100 to 300 cycles), readjust door operators and controls for optimum, smooth operating condition and safety and for weather tight closure:
 - .1 Lubricate hardware, operating equipment and other moving parts.
 - .2 Adjust revolving doors to provide tight fit at contact points with enclosure.
 - .3 Include for demonstrating door features and functions during Commissioning, power failure, and fire alarm testing.
 - .4 Include for all service calls for adjustments or corrections required during 1-year warranty from building turnover to City.
- .2 Cleaning: Clean glass and aluminum surfaces promptly after installation; exercise care to avoid damage to coatings:
 - .1 Remove protective material from prefinished aluminum surfaces.
 - .2 Wash exposed surfaces with mild solution of detergent and warm water, using soft, clean wiping cloths. Remove dirt from corners. Wipe surfaces clean.
 - .3 Remove excess sealant by moderate use of solvent, of type acceptable to sealant manufacturer.
- .3 Demonstration and Training: Demonstrate operation, operating components, adjustment features, safety program, and lubrication requirements to City in accordance with Section 01 00 06 – General Requirements: Project Closeout.

END OF SECTION

1. GENERAL**1.01 SUMMARY**

- .1 This Section includes requirements for design, supply and installation of structural glass system glass curtain walls installed as a unitized system consisting of, but not limited to, the following:
 - .1 Fixed, clear, low emissivity (Low E) sealed structural double glass units and single and double glazed structural glass units.
 - .2 Cast stainless steel point load connectors, spider fittings and related architecturally exposed structural steel components required for structural glass curtain wall assembly.
 - .3 Structural silicone glazed glass panel joints.
 - .4 Structural offsets, tension rods, lateral load rods, load sharing components and other accessories required for complete installation; refer to Structural Drawings for additional requirements.
 - .5 Connections to structural support systems, fasteners, and accessories required for a complete installation of the structural glass system.
- .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.
- .3 Work of this Section is intended to be designed and supplied by a single source structural glass manufacturer and installed by a manufacturer trained and approved glazing installer; having experience designing and installing systems of similar complexity and scope to that described in this Section including glass and glazing, and architectural structural steelwork required for complete installation.

1.02 DEFINITIONS

- .1 Architecturally Exposed Structural Steel: Architecturally exposed steel connections and structural steel components listed in this Section are based on recommended practices and procedures prepared by the Canadian Institute of Steel Construction (CISC), and as defined in Section 05 05 19 – Common Work Results for Metalwork Finishing.
- .2 Delegated Design Professional Engineer: The professional engineer hired or contracted to the fabricator or manufacturer to design specialty elements, produce delegated design submittals and shop drawings to meet the requirements of the Project; who is registered in the province of the Work; and who is not the Consultant.
- .3 Letters of Commitment and Compliance: Documents prepared by the delegated design professional engineer as recommended by APEGA's Responsibilities for Engineering Services for Building Projects.
- .4 Equal Dimensions: Curtain wall assemblies indicating equal dimensions on the drawings shall be calculated to align with in-place structural elements followed by even division of the space between structural elements. This shall mean that curtain wall materials are evenly spaced between adjacent structural members, not necessarily evenly spaced across the entire wall assembly.

1.03 ADMINISTRATIVE REQUIREMENTS

- .1 Coordination: Coordinate installation of structural glass curtain wall system with work specified in other Sections to ensure proper placement and installation of the following:
 - .1 Coordinate structural framing assembly requirements with glass and glazing requirements specified in this Section; design and provide structural framing assembly and structural glass curtain wall as a single source responsibility.
 - .2 Structural connections and supports of structural glass curtain walls; provide loading and deflection criteria to tension framing assemblies to prevent excessive movements, and glass-to-glass or glass-to-metal contact.
 - .3 Vapour barriers, insulation and flashing so that air, vapour and thermal barrier of building are intact and moisture will be diverted to the exterior.
 - .4 Sealants so that ambient and surface temperatures are greater than 5°C from time of application until sealants have cured.
- .2 Pre-Construction Meetings: Schedule and conduct a pre-construction meeting at project site in accordance with Section 01 00 06 – General Requirements: Project Meetings with Contractor, responsible for fabrication and erection of structural glass curtain wall, Subcontractors affected by work of this Section and the Consultant; agenda for meeting will include; but not limited to, the following:
 - .1 Review methods and procedures related to installation of point supported glass curtain wall systems
 - .2 Review glazing procedure and schedule including method of delivery and handling of glass, and installation of glazing materials
 - .3 Review structural load limitations
 - .4 Review and finalize construction schedule and verify availability of materials, installer's personnel, equipment, and facilities needed to make progress and avoid delays
 - .5 Review location and alignment of vertical and horizontal elements as they relate to the aesthetic criteria indicated on the Drawings, and the technical requirements indicated on the shop drawings

1.04 SUBMITTALS

- .1 Provide required information in accordance with Section 01 00 06 – General Requirements: Submittals.
- .2 Action Submittals: Provide the following submittals before starting any work of this Section:
 - .1 Product Data: Submit product data indicating construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of product indicated, in addition to the following specific requirements:
 - .1 Mechanical Fasteners: Indicate sizes, shear, and pull over loading capacity where applicable.
 - .2 Corrosion Protection: Indicate thickness and type of corrosion protection coating.
 - .2 Shop Drawings: Submit shop drawings prepared by or under the supervision of delegated professional engineer detailing fabrication and assembly of curtain wall systems clearly indicating all construction details including, but not limited to, the following:
 - .1 Layout of complete glazed structure in relation to adjacent work including walls, columns, beams, slabs and other structures
 - .2 Connections and anchor requirements
 - .3 Type, size and spacing of fastening devices
 - .4 Design loads
 - .5 Materials, attachments devices and accessories including necessary tolerances

- .6 Connections to adjacent air and vapour membranes
 - .7 Connections of point supported assemblies to structural members
 - .8 Sealant locations
 - .9 Seal of a professional engineer registered in the Province of the Work for details requiring structural design for load bearing, or life and health safety
- .3 Samples: Submit samples for each type of exposed finish required, in manufacturer's standard sizes for Consultant's verification of specified finishes; and fabricated 600 mm x 600 mm sample of each vertical to horizontal intersection of specified systems, made from 300 mm square glass units of full size components indicating details of the following:
- .1 Glass seals and edges
 - .2 Joinery
 - .3 Point supported connectors
 - .4 Anchorage
 - .5 Expansion provisions
 - .6 Glazing
- .3 Informational Submittals: Provide the following submittals during the course of the work:
- .1 Certificates:
 - .1 System Certificate: Statement signed by glass manufacturer clearly stating that glass and fittings used on project are part of manufacturer's system and are acceptable to manufacturer and that they have reviewed contract documents and are able to issue warranty incorporating all components for system; letters signed by installer for this section are not acceptable.
 - .2 Welding Certificate: Submit copies of welder certificates certifying that welders are certified and have the necessary experience to complete work specified in this Section.
 - .2 Test Reports: Submit substantiating engineering data, test results of previous tests performed by independent laboratory indicating that proposed system meets specified performance criteria.
 - .3 Installation Data: Submit manufacturer's written installation requirements.
 - .4 Source Quality Control Submittals: Submit design notes and calculations signed and sealed by delegated design professional engineer including the following:
 - .1 Analysis for all pertinent load cases live, dead, wind, thermal and seismic data
 - .2 Reactions at supports and maximum deflections
 - .3 Calculations for support and other details as necessary; use actual calculations for the project, historical test reports will not be acceptable
 - .4 Size glass panels using finite element analysis
 - .5 Delegated Design Submittals: Submit a Letter of Compliance signed and sealed by Delegated Design professional engineer in accordance with Section 01 33 50 – Delegated Design Submittals and as required by site services for manufacturer's representative identified later in this Section.
 - .6 Site Quality Control Submittals: Submit a report completed by, and signed and sealed by Delegated Design professional engineer as required by site services for manufacturer's representative identified later in this Section.

1.05 PROJECT CLOSEOUT SUBMISSIONS

- .1 Operation and Maintenance Data: Submit manufacturer's written instructions for maintenance and adjustment procedures; include name of original installer and contact information in accordance with Section 01 00 06 – General Requirements: Operation and Maintenance Data.

- .2 Record Documentation: Submit as constructed information in accordance with Section 01 00 06 – General Requirements: Project Record Documents.

1.06 QUALITY ASSURANCE

- .1 Qualifications: Provide proof of qualifications when requested by Consultant:
 - .1 Sole Source Responsibility: Obtain glass and glazing materials, system design and structural support system design, materials, supply and installation from a single source manufacturer using manufacturer certified installer; system must be manufactured from one source, glass cannot be supplied by one manufacturer and hardware from another manufacturer.
 - .2 Manufacturer: Use a manufacturer having a minimum of ten (10) years experience in designing and manufacturing structural glass system similar in scope and complexity as those required for work of this Section.
 - .3 Installer: Use installers having a minimum of three (3) years of experience with installation of structural glass system similar in scope and complexity as that required for work of this Section, and that are certified by the manufacturer of the structural glass system.
 - .4 Materials: Use glazing materials and framing sealants that are chemically compatible with each other and with materials used during glass fabrication.
 - .5 Delegated Design Professional Engineer: 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 Documents requirements including, but not limited to, the following:
 - .1 Perform design, engineering and fabrication of structural glass system under a single source responsibility; outsourcing, subcontracting, or joint ventures to achieve a single source will not be acceptable.
 - .2 Seal and signature to shop drawings and design submittals.
 - .3 Site review and certification of installed components.
 - .4 Preparation of required Letters of Commitment and Compliance.

1.07 DELIVERY, STORAGE AND HANDLING

- .1 Delivery and Acceptance Requirements: Deliver materials with components clearly labelled and inventoried indicating position within building construction; time delivery of material to site to ensure uninterrupted progress of work.
- .2 Storage and Handling Requirements: Store and handle materials and components to prevent damage in accordance with manufacturer's written instructions and as follows:
 - .1 Store units at site on raised wood pallets protected from the elements and corrosive materials; do not remove from crates or other protective covering until ready for installation.
 - .2 Store all glass units vertically on end with solid bearing full thickness of sealed units; or horizontally where structural performance of units can withstand lifting forces to vertical installation.
 - .3 Store factory finished components in a manner that will prevent surfaces from being damages or scratched.

1.08 SITE CONDITIONS

- .1 Site Measurements: Verify dimensions of other construction by site measurements before fabrication and indicate measurements on shop drawings where curtain wall systems are indicated to fit to other construction.

- .2 Established Dimensions: Establish dimensions and proceed with fabricating curtain wall without site measurements where site measurements cannot be made without delaying the Work, coordinated with other construction to ensure that actual dimensions correspond to established dimensions.
- .3 Ambient Conditions: Comply with manufacturer's written requirements for ambient and surface temperature under which products can be installed and verify joint conditions are suitable for installation of materials.

1.09 WARRANTY

- .1 Provide manufacturers written warranty, 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 Structural glass system members and structural glazing: Failure of performance requirements specified in this Section; 3 years; written warranties excluding coverage from nickel sulphide inclusions will not be accepted in replacement of heat soak testing required for this Section.
 - .2 Sealed Glass Units: Misting, dusting and seal failure; as indicated in Section 08 81 00 – Glass Glazing
 - .3 Joint Sealants: Failure to maintain seal; 3 years
 - .4 Structural Silicone Glazing: 10 years
 - .5 Finishes: Failure specified finishes not attributable to normal weathering; 20 years.
- .2 Failures will be considered as, but are not limited to, the following:
 - .1 Structural failures including excessive deflection, loosening or weakening of fasteners, attachments, and other components
 - .2 Noise or vibration created by wind, thermal and structural movements
 - .3 Deterioration of metals, metal finishes, and other materials beyond normal weathering
 - .4 Thermal stresses transferred to building structure.
 - .5 Adhesive or cohesive sealant failures
 - .6 Water leakage
 - .7 Failure of operating components to function normally

2. PRODUCTS

2.01 MANUFACTURERS

- .1 Basis-of-Design Materials: Products named in this Section were used as the basis-of-design for the project; manufacturers listed as additional acceptable materials and that offer similar products may be incorporated into the work of this Section provided they meet the performance requirements established by the named products.
- .2 Additional Acceptable Materials Manufacturers: Subject to matching of colour and compliance with performance requirements specified in this Section; as established by the Basis-of-Design Materials, use any of the listed manufacturers' products in accordance with Section 01 00 06 – General Requirements: Substitutions and Product Options; following manufacturer's do not require submission of a request for substitutions provided required shop drawing and product data submissions are submitted before starting any work of Section:
 - .1 Eckelt Litewall System
 - .2 Lisus Technology
 - .3 Antamex International Inc.
 - .4 Glass Source Inc., Nupress Facades
 - .5 Stella Custom Glass Hardware
 - .6 Innovative Structural Glass, Inc.

- .7 Novum Structures LLC
- .8 Paragon Architectural Specialty Glass
- .9 W and W Glass, LLC

.3 Substitutions: Consultant may consider additional manufacturers having similar products to Acceptable Materials Manufacturers listed above during the construction period, provided they meet the performance requirements established by the named products and provided they submit requests for substitution in accordance Section 01 00 06 – General Requirements: Substitutions and Product Options before starting any work of this Section:

- .1 Do not use substitute materials to establish Bid Price.
- .2 Substitutions that appear as a part of the project without review and acceptance by the Consultant will be rejected, and replaced with one of the specified materials.

2.02 DESCRIPTION OF WORK

- .1 Responsibility: Delegated design professional engineer is responsible for designing structural glass system glass units and connections based on design loads and reactions provided by the Consultant, and verifying that safety factor is appropriate for intended installation and meets requirements of the Authority Having Jurisdiction.
- .2 Design Requirements: Design and size system components in accordance with CGSB 12.20 and ASTM E330; free from defects impairing strength, durability and appearance including anchorage capable of withstanding specified loading without failure, and as follows:
 - .1 Appearance: Design system components and glass system to provide a flush appearance where glass panels abut adjacent glass panels; systems that incorporate additional exposed metal stiffeners and girts will not be permitted.
 - .2 Exposed Fasteners: Fabricated from same materials design to prevent high stress concentration at glass connection points, colour and finish as material as that to which they are applied and having exposed surfaces with same inherent texture and colour for similar locations throughout system.
 - .3 Wind (Horizontal) and Structural (Vertical) Loads: Design and fabricate assemblies and systems to resist loads required by Building Code and as indicated on Drawings.
 - .4 Engineering Design: Use professional engineer, registered in the province of the Work, and that has experience in the work required by this Section to prepare structural calculations and design details.
- .3 Design Loads and Performance Criteria: Design curtain wall framing system capable of withstanding design loads within limits and under design loads indicated in this Section, and as follows:
 - .1 Dead Loads: Use design dead load indicated on Drawings.
 - .2 Axial Loads: Use design axial loads indicated on Drawings
 - .3 Structural Deflection and Movement: Allow for movement and deflection of structural support framing; design tension framing system connections to accommodate structural deflections such that loading is not transferred to glass curtain wall system:
 - .1 Building Movement: Design for movements of supporting structure including twist, column shortening, long term creep, and deflection from uniformly distributed and concentrated live loads and storey drift under combined wind and gravity loads in accordance with the Building Code.
 - .2 Lateral Loads: Design for q50 wind loads using low importance factors listed in the Building Code for deflection and strength, modified by the appropriate exposure, gust and pressure (internal and external) factors in accordance with Building Code structural commentaries.
 - .3 Periodic Maintenance Equipment Loads: Account for loads arising from window cleaning or other maintenance equipment.

- .4 Deflection of Framing Members: Limit deflection to the following requirements with full recovery of glazing materials:
- Deflection Normal to Wall Plane: Limited to $L/175$ of clear span for spans up to 4100 mm, and to $L/240$ of clear span plus 6 mm or spans greater than 4100 mm or an amount that restricts edge deflection of individual glazing lites to 16 mm, whichever is less.
 - Deflection Parallel to Glazing Plane: Limited to amount not exceeding an amount that reduces glazing bite to less than 75% of design dimension and that reduces edge clearance between framing members and glazing or other fixed components to less than 3 mm.
 - Limit length of cantilever deflection to $2/175$ length of the cantilevered member where framing members overhang an anchor point.
- .4 Thermal Loads and Movement: Allow for glass movement arising from thermal changes as follows, accounting for surface temperatures of materials due to both solar heat gain and night time sky heat loss:
- .1 Extreme Ambient Temperature Range: 83°C based on -48°C ambient winter and +35°C ambient summer
- .2 Normal Ambient Temperature Range: 40°C based on -16°C ambient winter and 24°C ambient summer; adjust calculations to account for colour treatments or coatings on curtain wall framing members and glass
- .3 Glass Surfaces Temperature Range: 60°C based on south exposure glass surface temperatures of -16°C at -18°C ambient winter and 44°C at 24°C ambient summer; temperature range derived from LBNL Window 6 for glass type specified
- .4 Structural Movement: Allow for thermal movement with no buckling of structural components, stress on glass, glazing edge seal failure, sealant failure, excess stress on curtain wall framing, anchors and fasteners, or reduction of performance in accordance with AAMA 505.
- .5 Condensation Resistance: Design thermal break to limit frosting and condensation on interior of window surfaces to maximum 5% of glass area in accordance with AAMA 1503 when conditions are:
- Exterior Air Temperature: -34°C
 - Interior Air Temperature: 22°C \pm 1.2°C
 - Interior Relative Humidity: 15%
- .5 Building Envelope Performance Criteria: Design glass and glazing systems to allow for the following:
- .1 Air Infiltration: Design system for maximum air leakage of 0.03 L/m² of fixed wall area when tested in accordance with AAMA 501 or ASTM E283 at a minimum static air pressure differential of 300 Pa
- .2 Water Penetration Under Static Pressure: Design system for zero water penetration when tested in accordance with AAMA 501 or ASTM E331 at a minimum differential static pressure of 20% of positive design wind load, but not less than 475 Pa
- .3 Average Thermal Conductance: Design system having average insulation factor of not more than 2.6 W/m²•K when tested in accordance with AAMA 1503
- .4 Sound Transmission: Design system having minimum STC 32 in accordance with ASTM E413 and an OITC 26 in accordance with ASTM E1332, as determined by testing in accordance with ASTM E90.

- .6 Appearance Criteria: Components within the edge supported structural glass curtain wall assemblies are required to have AESS 1 finishing as defined in Section 05 05 19, at locations indicated on Drawings; maintain a minimum AESS 2 for elements not indicated as having a specific finishing requirement.

2.03 METALLIC MATERIALS

- .1 Structural Support System: Structural support system is integral to and forms a part of the work of this Section, refer to Section 05 12 00 and Structural Drawings or detailed structural requirements of this Section.
- .2 Point Supported Structural Glass Fittings: Design structural glass system glass fittings to meet the spans and loading conditions indicated for this project; design to retain glass at limited points using countersunk rotational fittings; fittings that allow local bending stresses at the support locations will not be acceptable and as follows:
 - .1 Movement: Design fittings to allow a maximum of 12 degrees of rotation of the anchor perpendicular to the plane of glass to allow glass to transfer only translational and axial loads to supporting structure; rotation shall be provided with highly predictable behaviour using ball and socket technology; gasket type rotational devices will not be acceptable.
 - .2 Spider Arm Fittings: Design standard spider arm fittings to connect point supported glass fittings to structural steel components; formed from cast stainless steel as detailed on Drawings, and as follows:
 - .1 Basis-of-Design Materials: Stella Custom Glass Hardware
- .3 Stainless Steel Plate and Strip, and Rod and Bar Stock:
 - .1 Grade: 316 meeting or exceeding the requirements of ASTM A666 and ASTM A276.
 - .2 Mechanical Properties: Tempered to suit structural design requirements.
 - .3 Finish: Satin directionally brushed.
- .4 Stainless Steel Castings:
 - .1 Grade: 316 meeting or exceeding the requirements of ASTM A781 and ASTM A957
 - .2 Mechanical Properties: Tempered to suit structural design requirements.
 - .3 Finish: Satin directionally brushed.
 - .4 Reinforce castings as required to receive fastener threads.
- .5 Stainless Steel Sheet:
 - .1 Grade: 316 meeting or exceeding the requirements of ASTM A167.
 - .2 Finish: Exposed fasteners finished to match castings.
- .6 Stainless Steel Fasteners:
 - .1 Grade: 316 meeting or exceeding the requirements of ASTM A276.
 - .2 Mechanical Properties: Strain hardened or tempered to suit structural design requirements.
 - .3 Self Locking Devices: Provide self locking devices where fasteners are subject to loosening or turnout arising from thermal and structural movements, wind loads, or vibration.
 - .4 Driving Recess: Confirm head style and driving recess profile for architecturally exposed fasteners with Consultant. Provide flat countersunk head profile having hex socket driving recess for exposed fastener locations; provide manufacturers standard driving recess and profile for unexposed locations.
 - .5 Finish: Exposed fasteners finished to match castings.

- .7 Structural Steel Supports: Fabricate structural steel supports forming a part of structural glass system so that they are mechanically connected in the site to prevent damage the paint finish arising from welding operations, and as follows:
- .1 Rolled Sheet or Strip: CSA G40.20/G40.21.
 - .2 Structural Shapes, Plates and Bars: CSA G40.20/G40.21.
 - .3 Surface Preparation: Select surface preparation methods in accordance with recommendations in SSPC-SP COM and prepare surfaces in accordance with applicable SSPC standard required for architecturally exposed steel.
 - .4 Basic geometry for steel layout as indicated on the Drawings.
 - .5 Steel support fins to be as indicated on the Structural Drawings.
 - .6 Fabricate mechanical connections to provide a clean aesthetic appearance.
 - .7 Finish: Factory primed and paint consisting of 2 coat system having a minimum 0.254 mm epoxy primer and 0.635 mm polyurethane top coat; colour as selected by the Consultant.
- .8 Brackets, and Reinforcements: Manufacturer's standard high strength stainless steel type with non-staining, non-ferrous shims for aligning system components.
- .9 Accessories: Provide manufacturer's standard corrosion resistant, non-staining, non-bleeding accessory components compatible with adjacent materials:
- .1 Finish exposed portions to match framing system.
 - .2 Use slip joint linings, spacers, and sleeves at movement joints of material and type recommended by manufacturer.
- .10 Anchors: Three way adjustable anchors that accommodate fabrication and installation tolerances in material and finish compatible with adjoining materials and recommended by manufacturer.
- .11 Concealed Flashing: Manufacturer's standard corrosion resistant, non-staining, non-bleeding flashing compatible with adjacent materials.

2.04 STRUCTURAL GLASS MATERIALS

- .1 Provide structural glass constructed in a monolithic and double sealed insulating configuration as shown on the Drawings; minimum nominal thickness as required to meet delegated design requirements listed in this Section and in accordance with CGSB 12.20, and as follows:
- .1 Annealed Float Glass (GL-1): In accordance with CAN/CGSB 12.3, and as follows:
 - .1 Glass Appearance: Clear Transparent
 - .2 Quality: Glazing with specific defect limitations as defined by Table 3 of CAN/CGSB 12.3 based on area of glass units.
 - .3 Labelling: Not Required
 - .2 Low-Emissivity (Low-E) Glass (GL-2): In accordance with CAN/CGSB 12.10 and as having the following nominal properties:
 - .1 Glass Quality: Float glass, glazing quality as described with specific defect limitations as defined by Table 3 of CAN/CGSB 12.3 based on area of glass units; annealed, heat strengthened or tempered as required by glass manufacturer to prevent glass breakage arising from thermal shock, except that tempered safety glass must be used for entrances and sidelights.
 - .3 Clear Safety Glass (GL-3): Manufactured in accordance with CAN/CGSB 12.1 and ASTM C1048, heat soak tested in accordance with EN14179-1, and as follows:
 - .1 Type: 2 – Tempered
 - .2 Class: B – Float Glass

- .3 Roller Wave Tolerance: Notwithstanding requirements of ASTM C1048, limit distortions arising from tempering process to a maximum nominal 0.08 mm peak to valley at centre of glass and 0.20 mm within 265 mm of leading and trailing edges of the glass.
- .4 Category: I - Heat Strengthened
- .5 Labelling: Required
- .6 Glass Characteristics: Provide clear low iron tempered structural glass unit with Low-E coating on Number 2 glass surface glazed in accordance with referenced standards and Section 08 81 00.

.4 Sealants: Use manufacturer's recommended sealant compounds as follows:

- .1 Structural Sealant: Neutral curing silicone formulation meeting requirements of ASTM C1184; compatible with system components with which it comes in contact, specifically formulated and tested for use as structural sealant in accordance with ASTM C1135, and as follows:
 - .1 Colour: Black
 - .2 Type: Manufacturer's standard single component
 - .3 Minimum Tensile Strength: as required to meet design loading limitation
 - .4 Modulus of Elasticity: As required by structural glass system design to meet performance requirements.
 - .5 Structural silicone sealants shall be designed and certified by manufacturer's engineer.
 - .6 Coordinate sealant compatibility with materials specified for sealed unit fabrication specified in Section 08 81 00.
- .2 Weather Seal Sealant: Neutral curing silicone formulation meeting requirements of ASTM C920 for Type S, Grade NS, Class 25, Uses NT, G, A, and O; compatible with structural sealant and other system components with which it comes in contact; and as follows:
 - .1 Joint Movement Capability: Accommodate 50% increase or decrease in joint width at time of application when measured in accordance with ASTM C719.
 - .2 Type: Manufacturer's standard single component.
 - .3 Colour: Matching structural sealant

2.05 FABRICATION

- .1 Fabricate components that have the following characteristics when assembled:
 - .1 Sharp profiles, straight and free of defects or deformations
 - .2 Accurately fitted joints with ends coped or mitred
 - .3 Physical and thermal isolation of glazing from framing members
 - .4 Accommodations for thermal and mechanical movements of glazing and framing to prevent glazing-to-glazing contact and to maintain required glazing edge clearances
 - .5 Structural sealant joints that do not carry gravity loads of glazing
 - .6 Provisions for site replacement of glazing from exterior; include accommodations for using temporary support devices to retain glazing in place while sealant cures.
- .2 Weld fabricated glass support components in concealed locations to greatest extent possible to minimize distortion or discoloration of finish; remove weld spatter and welding oxides from exposed surfaces by de-scaling or grinding, polish welds in exposed locations to match adjacent finishes.
- .3 Code each part for easy identification on site after fabrication, cross referenced to their locations in the Project and referenced to the Shop Drawings and to shipping lists.

- .4 Size glass joint width to meet calculated movement and function.
- .5 Fabricate detail components and flashings from stainless steel sheet for interfaces between point loaded structural glass curtain walls and adjacent construction.

3. EXECUTION

3.01 EXAMINATION

- .1 Verification of Conditions: Verify anchorage and fastening locations before beginning of installation of products specified in this Section:
 - .1 Installation of structural glass curtain wall assemblies will denote acceptance of site conditions.

3.02 PREPARATION

- .1 Inserts and Anchorages: Provide inserts and anchoring devices that require setting into concrete or attaching to structural steel, and that are required for installation of work of this Section sufficiently in advance to prevent delays.

3.03 INSTALLATION

- .1 Erect structure and accessory items in strict accordance with the manufacturer's written installation instructions and reviewed shop drawings, and as follows:
 - .1 Do not position glass panels by the use of force
 - .2 Do not install damaged components
 - .3 Fit joints to produce hairline joints free of burrs and distortion
 - .4 Rigidly secure joints
 - .5 Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.
 - .6 Seal joints watertight.
 - .7 Touch up paint work with matching air dry paint as necessary.
- .2 Install components plumb and true in alignment with established lines and grades.
- .3 Install glass and glazing in accordance with Section 08 81 00; prepare surfaces that will contact structural sealant in accordance with sealant manufacturer's written instructions to ensure compatibility and adhesion that includes, but is not limited to, cleaning and priming surfaces.
- .4 Install weather seal sealant in accordance with Section 07 92 00 and in accordance with sealant manufacturer's written instructions to produce weatherproof joints; install joint filler behind sealant as recommended by sealant manufacturer.
- .5 Erection Tolerances: Install structural glass systems to the following maximum tolerances:
 - .1 Plumb: 3 mm in 3000 mm with aggregate total not exceeding 6 mm in 12000 mm.
 - .2 Level: 3 mm in 6000 mm with aggregate total not exceeding 6 mm in 12000 mm.
 - .3 Alignment: Limit misalignment of two adjoining glass panes abutting in the same plane as follows:
 - .1 Limit offset from true alignment to 1.5 mm where surfaces meet in-line or are separated by reveal or protruding element up to 13 mm wide.
 - .2 Limit offset from true alignment to 3 mm where surfaces are separated by reveal or protruding element from 13 mm to 25 mm wide.
 - .3 Limit offset from true alignment to 6 mm where surfaces are separated by reveal or protruding element of 25 mm or wider.

- .4 Joint Width: Maintain sealant space between glass and adjacent construction to an average of 16 mm, with a variation of no more than +3 mm and -6 mm
- .5 Location: Limit variation from plane to 3 mm in 300 mm with aggregate total not exceeding 13 mm over total length.

3.04 SITE QUALITY CONTROL

- .1 Manufacturer's Site Services: Provide manufacturer's site representative during installation; representative shall be knowledgeable of erection process for specified tension framing assemblies and provide the following services during construction:
 - .1 Observation of installation and quality control measures;
 - .2 Provide Letter of Compliance signed by Delegated Design professional engineer responsible for the work of this Section indicating that work of this Section substantially meets requirements of the Building Code.
 - .3 Provide written report indicating observations, procedures, noted deficiencies, corrective measures, and certifying that installation meets requirements of this Section.
- .2 Testing Agency: Engage a qualified independent testing and inspecting agency to perform site tests and inspections and prepare test reports.
- .3 Testing Services:
 - .1 Testing and inspecting of representative areas to determine compliance of installed systems with specified requirements shall take place as follows and in successive stages as indicated on Drawings.
 - .2 Do not proceed with installation of the next area until test results for previously completed areas show compliance with requirements.
 - .3 Structural Sealant Compatibility and Adhesion:
 - .1 Test structural sealant in accordance with ASTM C1401, and as follows:
 - Use destructive test method, Method A, Hand Pull Tab (Destructive) listed in ASTM C1401, Appendix X2.
 - Test a minimum of two (2) areas on each building face.
 - Repair installation areas damaged by testing.
 - .4 Structural Sealant Glazing Inspection: Inspect and evaluate structural sealant glazing in accordance with ASTM C1401 recommendations after installation of curtain wall systems are complete.
 - .5 Air Infiltration: Test areas indicated on Drawings for air leakage of 1.5 times the rate specified in this Section, but not more than 0.03 L/s-m² of fixed wall area when tested in accordance with ASTM E783 at a minimum static air pressure differential of 75 Pa.
 - .6 Water Penetration: Test areas indicated on Drawings in accordance with ASTM E1105 at minimum uniform and cyclic static air pressure difference of 0.67 times the pressure specified in this Section, but not less than 300 Pa with no evidence of water penetration.
 - .7 Water Spray Test: After the installation curtain wall system has been completed, but before installation of interior finishes has begun, test a 2 bay area of system designated by the Consultant in accordance with AAMA 501.2 with no evidence of water penetration.
- .4 Non-Conforming Work: Touch-up, repair or replace damaged components before declaring Substantial Performance; replace damaged components; additional testing and inspecting; at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.05 CLEANING AND PROTECTION

- .1 Remove protective coatings and coverings from prefinished components; clean structural components and fittings; remove excess sealants and other substances that detract from finished appearance after completion of installation.
- .2 Coordinate protective measures required to prevent damage or deterioration of structural glass system from subsequent construction activities.

END OF SECTION

1. GENERAL**1.01 SUMMARY**

- .1 This Section includes requirements for supply and installation of commercial door hardware for the following:
 - .1 Swinging doors, hollow metal doors
 - .2 Aluminum Sliding and double swing doors
 - .3 Other doors to the extent indicated
 - .4 Cylinders for doors specified in other Sections
 - .5 Low energy swing operators
 - .6 Electrified door hardware
- .2 Coordinating, purchasing, delivering, and scheduling of items specified in this Section is the responsibility of this Section.

1.02 RELATED REQUIREMENTS

- .1 Drawing A0.01 – Door, Frame and Hardware Schedule: Door and frame characteristics and hardware group numbers.
- .2 Section 06 10 53 – Miscellaneous Rough Carpentry
- .3 Section 08 11 13 – Steel Doors and Frames
- .4 Section 08 41 13 – Aluminum Framed Entrances and Storefronts
- .5 Section 08 42 29 – Sliding Automatic Entrance
- .6 Section 26 05 28 – Conduits, Outlet Boxes and Fittings for Electrical Systems: Supply and installation of conduit, pull boxes, outlets and wiring for electrical hardware.
- .7 Section 28 13 02 – Security and Card Access System: Card readers and other interface controls.

1.03 REFERENCE STANDARDS

- .1 American National Standards Institute (ANSI)/Builders Hardware Manufacturers Association (BHMA):
 - .1 ANSI/ICC A117.1-2017, Standard for Accessible and Usable Buildings and Facilities
 - .2 ANSI/BHMA A156 Series Standards Set
 - .3 ANSI/BHMA A156.10-2017, Power Operated Pedestrian Doors
 - .4 ANSI/BHMA A156.18-2016, Materials and Finishes
 - .5 ANSI/BHMA A156.19-2013, Power Assist and Low Energy Power Operated Doors
- .2 Builders Hardware Manufacturers Association (BHMA):
 - .1 Directory of Certified Products
- .3 Door and Hardware Institute (DHI):
 - .1 Sequence and Format for the Hardware Schedule
 - .2 ANSI/DHI A115.IG -2001 Installation Guide for Doors and Hardware
- .4 Underwriters Laboratories (UL):
 - .1 UL 437-2013, Key Locks

1.04 ADMINISTRATIVE REQUIREMENTS

- .1 Preinstallation Conference: Arrange a preconstruction meeting attended by Contractor, Subcontractor, City and Hardware Consultant to discuss the following:
 - .1 Keying Conference: Conduct keying conference at Project site and incorporate decisions into final keying schedule after reviewing door hardware keying system including the following:
 - .1 Function of building, flow of traffic, purpose of each area, degree of security required, and plans for future expansion.
 - .2 Preliminary key system schematic diagram.
 - .3 Requirements for key control system.
 - .4 Address for delivery of keys.
 - .2 Electrified Hardware Conference: Conduct preinstallation conference at Project site and review methods and procedures related to electrified door hardware including the following:
 - .1 Review and discuss electrical roughing in and other preparatory work performed by other trades.
 - .2 Review sequence of operation for each type of electrified door hardware.
 - .3 Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 - .4 Review required testing, inspecting, and certifying procedures.
- .2 Coordination: Obtain and distribute templates for doors, frames, and other work specified to be factory prepared for installing door hardware and coordinate with shop drawings of other work to confirm that adequate provisions are made for locating and installing door hardware in accordance with indicated requirements, and as follows:
 - .1 Coordinate with Division 26 for type of wire required for electronic hardware, schedule for installation, and connection to electronic hardware.
 - .2 Coordinate layout and installation of electrified door hardware with connections to power supplies, and access control and security system.
- .3 Coordinate the work of all trades, including glass and glazing, masonry, and electrical requirements covered in manufacturer's details and appropriate sections of the specifications and as follows:
 - .1 Coordinate with electrical contractor to provide 120 volt, 60 cycle, single phase 15 Amp service depending on quantity of operators and as follows:
 - .1 Coordinate with electrical contractor for provision of service to each operator from junction box for multiple operators.
 - .2 Coordinate with electrical contractor shall provide electrical conduit and wiring from specified controls to operators as outlined on manufacturer's drawings.

1.05 SUBMITTALS

- .1 Provide required information in accordance with Section 01 00 06 – General Requirements: Submittals.
- .2 Action Submittals: Provide the following submittals before starting any work of this Section:
 - .1 Product Data: Submit product data indicating installation details, material descriptions, dimensions of individual components and profiles, and finishes.

-
- .2 Shop Drawings: Submit shop drawings indicating details of electrified door hardware including the following:
- .1 Wiring Diagrams: Detail wiring for power, signal, and control systems and differentiate between manufacturer installed and site installed wiring, and as follows:
- System schematic
 - Point-to-point wiring diagram
 - Riser diagram
 - Elevation of each door
- .2 Detail interface between electrified door hardware and access control and security system.
- .3 Theory of operation for electrified hardware groups.
- .4 Prepare drawings specifically for the project and submit in hard copy and CAD format:
- Photocopied drawings and hand reproduced drawings are not acceptable.
 - Submit separate elevations and interconnect drawings for each different electrified hardware group.
- .3 Hardware Schedule: Submit door hardware schedule prepared by or under the supervision of qualified Architectural Hardware Consultant (AHC), detailing fabrication and assembly of door hardware, and as follows:
- .1 Coordinate with Drawing A0.01 and Section 08 06 10 for size and thickness of doors, fire rating, and comments relating to door function.
- .2 Comply with the Door and Hardware Institutes recommended scheduling sequence and vertical format for hardware schedules.
- .3 Organize the door hardware schedule into door hardware sets indicating complete designations of every item required for each door or opening; include the following information:
- Type, style, function, size, label, hand, and finish of each door hardware item.
 - Manufacturer of each item.
 - Fastenings and other pertinent information.
 - Location of each door hardware set, cross-referenced to drawings, both on floor plans, and door and frame schedule.
 - Explanation of abbreviations, symbols, and codes contained in schedule.
 - Mounting locations for door hardware.
 - Door and frame sizes and materials.
 - Description of each electrified door hardware function, including location, sequence of operation, and interface with other building control systems.
- .4 Keying Schedule: Submit keying schedule prepared by or under the supervision of qualified Architectural Hardware Consultant (AHC), detailing City's final keying instructions for locks, including schematic keying diagram and index each key set to unique door designations.
- .3 Informational Submittals: Provide the following submittals when requested by the City:
- .1 Certificates: Submit product certificates signed by manufacturer of door hardware certifying that products submitted comply with requirements for labelled fire doors, for types and sizes of doors used for the Project.

- .2 Source Quality Control Submittals: Submit proof of participation in DHI Continuing Education Program, and apply AHC stamp to completed door hardware schedule.

1.06 PROJECT CLOSEOUT SUBMISSIONS

- .1 Operation and Maintenance Data: Provide operations and maintenance information in accordance with Section 01 00 06 – General Requirements: Closeout Submissions.
- .2 Spare Parts and Tools: Submit unique parts and tools for maintaining hardware system in accordance with Section 01 00 06 – General Requirements: Closeout Submissions.
- .3 Final Door Hardware Schedule and Wiring Diagrams as installed.

1.07 QUALITY ASSURANCE

- .1 Regulatory Requirements:
 - .1 Building Code Compliance: Conform to ULC and Building Code requirements, as applicable to hardware, for labelled or rated doors and frames, and for exiting, operation and function.
 - .2 Manufacturing Compliance: Use only products listed in the BHMA Directory of Certified Products for hardware of this Project.
- .2 Qualifications: Provide proof of qualifications when requested by City:
 - .1 Supplier: Use a door hardware supplier ~~having warehousing facilities in Project's vicinity~~ and employing at least one permanent staff member who is a fully certified and licensed Architectural Hardware Consultant (AHC), participating in the DHI Continuing Education Program, who will be responsible for the preparation of the door hardware schedule submittal, and as follows:
 - .1 Door hardware supplier shall be available during the course of the Work to consult with Contractor and City about door hardware and keying.
 - .2 Door hardware supplier shall have completed projects with electrified door hardware similar in material, design, and extent to that indicated for this Project, and who has the capability of preparing data for electrified door hardware, including shop drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.
 - .2 Installer: Installer shall have completed door hardware similar in material, design, and extent to that indicated with a record of successful in-service performance for the last five (5) years.

1.08 DELIVERY, STORAGE, AND HANDLING

- .1 Delivery and Acceptance Requirements: Deliver hardware items in original factory containers, clearly labelling contents and scheduled use for this project and as follows:
 - .1 Inventory door hardware on receipt and provide secure lock up for door hardware delivered to Project site.
 - .2 Store hardware in a clean, well illuminated (500 lux minimum) securely locked storage room accessible only to authorized personnel.

Comment [1]: +benjamin.johnson@edmonton.ca; +vannaphone.phetlathy@edmonton.ca . We can't state this due to trade agreement restrictions. We can not indicate a preference based on geography. However you could revise this statement to indicate a service level, i.e. doors must be available within one day of installation or something like that.
Assigned to Benjamin Johnson

Comment [2]: Proposed deleting reference to warehouse facility locale.

Comment [3]: Sounds good.

- .2 Storage and Handling Requirements: Store hardware items on shelves; not on floors, separated and packaged as a group for each individual door with the door number, and list of items for that door on each package related to the door hardware schedule, and include basic installation instructions with each item or package and as follows:
- .1 Maintain an itemized inventory list of each item, updated on a daily basis, to show items in storage and items installed.
 - .2 Deliver keys to City by registered mail or overnight package service; address to be confirmed at keying conference.

1.09 WARRANTY

- .1 Provide written warranty, executed by manufacturer agreeing to repair or replace components of door hardware that fail in materials or workmanship within specified warranty period.
- .2 Failures include the following:
 - .1 Structural failures including excessive deflection, cracking, or breakage.
 - .2 Faulty operation of operators and door hardware.
 - .3 Deterioration of metals, metal finishes, and other materials beyond normal weathering.
 - .4 Other failures not resulting from normal usage.
- .3 Warranty Period: From date of Substantial Performance, and as follows:

HARDWARE TYPE	WARRANTY TERM
Locks, latches and cylinders	2 year
Closers	10 years
Hinges	1 year
Panics	1 year
Miscellaneous	1 year
Electrical Hardware	5 years

2. PRODUCTS

2.01 MANUFACTURERS

- .1 Acceptable Materials Manufacturers: Subject to compliance with requirements specified in this Section; where multiple listings of manufacturers occur, use any of the following listed manufacturers' products in accordance Section 01 00 06 – General Requirements: Substitutions and Product Options including the following:
 - .1 Hinges:
 - .1 Hager Companies (HAG)
 - .2 McKinney Products Company (MCK)
 - .3 Mont-Hard Corporation (MH)
 - .4 Stanley Commercial Hardware (STH)
 - .2 Mechanical Locks and Latches:
 - .1 Best Lock Corporation (BLC)
 - .2 Corbin Russwin Architectural Hardware (CR)
 - .3 Sargent Manufacturing Company (SGT)
 - .4 Schlage Lock Company (SCH)
 - .3 Electromagnetic Locks and Latches:
 - .1 Sargent Manufacturing Company (SGT)

- .2 Securitron Magnalock Corp. (SMC)
 - .3 Von Duprin, Inc. (VD)
 - .4 Yale Security Inc. (YAL)
 - .4 Electromechanical Locks and Latches:
 - .1 Sargent Manufacturing Company (SGT)
 - .2 Schlage Lock Company (SCH)
 - .3 Yale Security Inc. (YAL)
 - .5 Exit Devices:
 - .1 Sargent Manufacturing Company (SGT)
 - .2 Von Duprin (VD)
 - .3 Yale Security Inc. (YAL)
 - .6 Cylinders:
 - .1 ASSA ABLOY, Inc. (ABL)
 - .2 Best Lock Corporation (BLC)
 - .3 Corbin Russwin Architectural Hardware (CR)
 - .4 Medeco High Security Locks, Inc. (MED)
 - .5 Sargent Manufacturing Company (SGT)
 - .6 Schlage Lock Company (SCH)
 - .7 Yale Security Inc. (YAL)
 - .7 Electric Strikes:
 - .1 Adams Rite Manufacturing Co. (ARM)
 - .2 Folger Adam Security Inc. (FAS)
 - .3 Locknetics Security Engineering (LSE)
 - .4 Precision Hardware, Inc. (PH)
 - .5 Rutherford Controls Inc. (RC)
 - .6 Von Duprin, Inc. (VD)
 - .2 Substitutions: City may consider additional manufacturers having similar products to Acceptable Materials Manufacturers listed above during the construction period, provided they meet the performance requirements established by the named products and provided they submit requests for substitution in accordance with Section 01 00 06 – General Requirements: Substitutions and Product Options before starting any work of this Section:
 - .1 Do not use substitute materials to establish Bid Price.
 - .2 Substitutions that appear as a part of the project without review and acceptance by the City will be rejected, and replaced with one of the specified materials.
 - .3 Scheduled Door Hardware: Scheduled hardware establishes performance requirements for door hardware at each door in accordance with requirements in this Section, door hardware sets indicated in door, frame and hardware schedule in Section 08 06 10, and the Hardware Schedule in Item 3.07.
 - .4 Unsolicited Substitutions: Scheduled hardware represents Basis-of-Design Materials; City indicates that they will accept unsolicited substitutions as a part of Bid Submissions in accordance with Section 01 00 06 – General Requirements: Substitutions and Product Options.
- 2.02 MATERIALS
- .1 Materials and Finishes: Materials and finishes matching scheduled hardware, meeting requirements of BHMA A156.18, and performance required for installation.

- .2 Performance Requirements: Obtain each type and variety of door hardware from a single manufacturer, unless otherwise indicated, and generally comply with the following provisions:
 - .1 Accessibility requirements in accordance with ANSI 117.1.
 - .2 Handles, Pulls, Latches, Locks, and other Operating Devices: Shape that is easy to grasp with one hand and does not require tight grasping, tight pinching, or twisting of the wrist.
 - .3 Door Closers: Maximum opening force requirements as follows:
 - .1 Interior Hinged Doors: Nominal 20 N applied perpendicular to door.
 - .2 Fire Doors: Minimum opening force allowable by authorities having jurisdiction.
 - .4 Thresholds: Maximum 13 mm high; bevel raised thresholds with a slope of maximum 1:2.
 - .5 Latches, Locks, and Exit Devices: Nominal 65 N to release the latch, and shall not require the use of a key, tool, or special knowledge for operation.
 - .6 Delayed Egress Locks: Lock releases within 15 seconds after applying a force nominal 90 N.
 - .7 Door Closers: Nominal 130 N to set door in motion and nominal 65 N to open door to minimum required width.
- 2.03 ACCESSORIES
 - .1 Automatic Swing Door Operators: Provide concealed electromechanical swing door operator, consisting of electromechanical swinging door operator and electronic control, aluminum header, connecting hardware, and power on/off switch and safety sensor, and as follows:
 - .1 Automatic entrance equipment: comply with ANSI A156.10 or ANSI A156.19.
 - .2 Aluminium header extrusions: minimum nominal 4 mm wall thickness with finish to match adjacent aluminum materials.
 - .3 Equipment must operate between -35°C and +55°C in all climate conditions.
 - .4 Bearings: Fully lubricated and sealed to minimize wear and friction.
 - .5 Operator: Electromechanical system installed in a header to resist dust, dirt and corrosion; entire operator shall be removable from the header as a unit.
 - .6 Operator shall open the door with a 1/8 HP motor through reduction gears, door arm, and linkage assembly, and as follows:
 - .1 Low energy operator, door opening time: not be less than 4 seconds.
 - .2 The drive train shall have a positive, constant engagement. The operator shall stop the door in the open position by electrically reducing the motor voltage and stalling against a 90° stop.
 - .3 Close the door by spring energy; controlled by employing the motor as a dynamic brake.
 - .4 Door closing time shall not be less than 4.5 seconds.
 - .5 Pre-load closing spring for positive closing action at a low material stress level for long spring life.
 - .7 Provide obstruction detection to reverse door when closing if an object stops the door.
 - .8 The operator shall function as a manual door closer in the direction of swing with or without electrical power.
 - .2 Keying: Provide manufacturer's standard cores and finish face to match lockset; in accordance with the following:
 - .1 Interchangeable Cores: Core insert, removable by use of a special key, and usable with other manufacturers' cylinders.

- .2 Construction Keying: Construction master keys, having cylinders with feature that permits voiding of construction keys without cylinder removal. Provide 10 construction master keys.
- .3 Keying System: Provide a factory registered keying system in accordance with the following requirements:
 - .1 Existing System: Master key or grand master key locks to City's existing system.
- .4 Keys: Provide nickel-silver keys in accordance with the following:
 - .1 Stamping: Permanently inscribe each key with a visual key control number and notation stating "DO NOT DUPLICATE".
 - .2 Quantity: In addition to one extra blank key for each lock, provide the following:
 - .1 Cylinder Change Keys: Three
 - .2 Master Keys: Five
 - .3 Grand Master Keys: Five
- .5 Key Control Cabinets: Provide key cabinet sized appropriately for number of keys supplied to the project and as follows:
 - .1 Multiple Drawer Cabinet: Cabinet with drawers equipped with key holding panels and key envelope storage, and progressive type ball bearing suspension slides; include single cylinder lock to lock all drawers.
 - .2 Capacity: Able to hold keys for 150% of the number of locks.
- .6 Door Operator Bollard 150 mm x 150 mm x 1250mm tall AFF, clear anodized aluminum (628), surface mount with concealed mounting base; removable black ABS cap.

3. EXECUTION

3.03 EXAMINATION

- .6 Examine doors and frames, with installer present, for compliance with requirements for installation tolerances, labelled fire door assembly construction, wall and floor construction, and other conditions affecting performance.
- .7 Examine roughing-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation.
- .8 Proceed with installation only after unsatisfactory conditions have been corrected.

3.04 INSTALLATION

- .6 Preparation: Prepare doors and frames as follows:
 - .1 Steel Doors and Frames: Comply with DHI A115 series.
- .7 Mounting Heights: Mount door hardware units at heights indicated in following applicable publications, unless specifically indicated or required in accordance with governing regulations:
 - .1 Standard Steel Doors and Frames: DHI's Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames.
- .8 Install each door hardware item in accordance with manufacturer's written instructions.
- .9 Coordinate removal, storage, and reinstallation of surface protective trim units with finishing work specified in Division 9 where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way.

- .10 Install surface mounted items only when finishes have been completed on substrates involved, and as follows:
 - .1 Set units level, plumb, and true to line and location.
 - .2 Adjust and reinforce attachment substrates as necessary for proper installation and operation.
 - .3 Drill and countersink units that are not factory prepared for anchorage fasteners.
 - .4 Space fasteners and anchors according to industry standards.
- .11 Key Control System: Place keys on markers and hooks in key control system cabinet, as determined by final keying schedule.
- .12 Boxed Power Supplies: Locate power supplies as indicated or, if not indicated, in electrical room; verify location with City, and as follows:
 - .1 Configuration: Provide the least number of power supplies required to service doors with electrified door hardware.
- .13 Thresholds: Set thresholds for exterior doors in full bed of sealant in accordance with requirements specified in Section 07 92 00.
- .14 Kick Plates: Install kick plates so top edge of kick plate aligns with top edge of exposed concrete curb / bottom edge of brick, approximately 350 mm above concrete slab.

3.05 SITE QUALITY CONTROL

- .6 Independent Architectural Hardware Consultant: City will engage a qualified independent Architectural Hardware Consultant to perform inspections and to prepare inspection reports.
- .7 Independent Architectural Hardware Consultant will inspect door hardware and state in each report whether installed work complies with or deviates from requirements, including whether door hardware is properly installed and adjusted, and as follows:
 - .1 Testing: Consists of Dynamic, static and system tests.
 - .2 Dynamic tests shall be conducted to before terminating devices to ensure door mechanics, sensors and locking devices mechanically functions correctly and free of grounds and shorts.
 - .3 Static tests shall be conducted before interconnecting devices to ensure all equipment functions correctly when energized.
 - .4 System tests shall be conducted to test system fully and to include fire alarm integration.

3.06 ADJUSTING

- .6 Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and in accordance with referenced accessibility requirements:
 - .1 Spring Hinges: Adjust to achieve positive latching when door is allowed to close freely from an open position of 30 degrees.
 - .2 Electric Strikes: Adjust horizontal and vertical alignment of keeper to engage lock bolt.
 - .3 Door Closers: Adjust sweep period so that, from an open position of 70 degrees, the door will take at least 3 seconds to move to a point 75 mm from the latch, measured to the leading edge of the door.

- .7 Six Month Adjustment: Approximately six months after date of Substantial Performance, perform the following:
- .1 Examine and readjust each item of door hardware as necessary to ensure function of doors, door hardware, and electrified door hardware.
 - .2 Consult with and instruct City's personnel on recommended maintenance procedures.
 - .3 Replace door hardware items that have deteriorated or failed due to faulty design, materials, or installation of door hardware units.
- 3.07 CLEANING AND PROTECTION
- .6 Clean adjacent surfaces soiled by door hardware installation.
 - .7 Clean operating items as necessary to restore proper function and finish.
 - .8 Provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of Substantial Completion.
- 3.08 DEMONSTRATION
- .6 Engage a factory authorized service representative to train City's maintenance personnel to adjust, operate, and maintain door hardware and door hardware finishes.
- 3.09 DOOR HARDWARE SCHEDULE
- .6 Hardware groups as follows, coordinate with Section 08 06 10 and other sections affected by hardware groupings.

Qty.	Item	Description	Manufacturer	Finish
SET #001				
Doors: D111B, D111C				
1	Mortise Cylinder	1E-74 PATD C181 CORMAX PATENTED KEYING RP3	626	CBE
1	Core	1C-7A2	626	CBE
1	Auto Door Slider	Single Slider by Section 08 42 29		BYO
2	Wall Switch	BEA 10MS11J	630	BEA
NOTE: 120 VAC Power.Conduit, and wiring by Division 26. Automatic door operators and controls by Section 08 42 29. Keyed cylinder by Section 08 71 00 Door Hardware.				
SET #002				
Doors: D111A, D111D				
2	Continuous Hinge	661HD UL 95 EPT	DB	CST
1	Exit Device	C TS 2601 36" 8'0" DS	630	CPR
1	Exit Device	C MLR TS 2603 36" 8'0" DS	630	CPR
1	Construction Core	1C-7A2	626	CBE
1	Rim Cylinder	12E-72 PATD CORMAX PATENTED KEYING RP	626	CBE
2	Door Pull	3012-2	32D	CSM
1	Low Energy Operator	Operator by Section 08 71 13		
1	Closer	8916 ISJ DA DPK89	689	CDM

1	Card Reader	CARD READER by Div 28		
2	Power Transfer	EPT-12C		CPR
1	Power Supply	10-1		CRC
2	Wall Switch	BEA 10MS11J	630	BEA
1	Threshold	CT-407 72"	AL	CKN

NOTE: 120 VAC Power Conduit and wiring by Division 26 Card reader by Division 28. Automatic door operators and controls by Section 08 41 13. Keyed cylinder by Section 08 71 00 Door Hardware. Balance of door seals by Aluminum Door Supplier

Qty.	Item	Description	Manufacturer	Finish
SET #003				
Doors: D105, D106				
4	Hinges	CB199 4 1/2 x 4	32D	CST
1	Storeroom	45H-7D16H PATD CORMAX PATENTED KEYING	630	CBE
1	Construction Core	1C-7A2	626	CBE
1	Electric Strike - Fail Secure	2164	32D	CRC
1	Low Energy Operator	ED100 Pull side Mount	628	CDM
1	Kick Plate	K10A 10" x 34"	32D	CSM
1	Restroom Control Kit	CX-WC11		CAM
1	Power Supply	10-1		CRC
1	Pushbutton	980-MO		CRC
2	Wall Switch	BEA 10MS11J	630	BEA
1	Gasket	W-22 x Door Perimeter	BLK	CKN
<p>NOTE: Operation: Door is normally closed and locked, exterior actuator signals the automatic operator to release the electric strike and begin the opening cycle. The restroom control kit deactivate exterior actuator, locks the electric strike, and illuminates an "occupied" light on the exterior when the interior "push to lock" button is pressed. Opening the door from the interior by either using the actuator or by turning the inside lever and manually opening the door will reactivate the exterior actuator and extinguish the occupied light. Door can be remotely unlocked by use of push button at remote site.</p>				

Qty.	Item	Description	Manufacturer	Finish
SET #004				
Doors: D107, D108				
4	Hinges	CB199 4 1/2 x 4	32D	CST
1	Storeroom	45H-7D16H PATD CORMAX PATENTED KEYING	630	CBE
1	Construction Core	1C-7A2	626	CBE
1	Electric Strike - Fail Secure	F2164	32D	CRC
1	Closer	8916 AF89P	689	CDM
1	Kick Plate	K10A 10" x 34"	32D	CSM
1	Wall Stop	S125	32D	CSM
1	Card Reader	CARD READER by Div 28		
1	Power Supply	10-1		CRC
1	Gasket	W-22 x Door Perimeter	BLK	CKN
<p>NOTE: Door is normally closed and locked. Card reader releases the electric strike allowing entry.</p>				

SET #005				
Doors: D101, D102				
4	Hinges	CB168 4 1/2 x 4 NRP	26D	CST
1	Storeroom	45H-7D16H PATD CORMAX PATENTED KEYING	630	CBE
1	Construction Core	1C-7A2	626	CBE
1	Electric Strike - Fail Secure	F2164	32D	CRC
1	Closer	8916-AFP	689	CDM
1	Kick Plate	K10A 10" x 34"	32D	CSM
1	Wall Stop	S125	32D	CSM
1	Card Reader	CARD READER by Div 28		
1	Power Supply	10-1		CRC
1	Gasket	W-22 x Door Perimeter	BLK	CKN
NOTE: Door is normally closed and locked. Card reader releases the electric strike allowing entry.				

SET #006				
Doors: D103, D104				
4	Hinges	CB199 4 1/2 x 4	32D	CST
1	Storeroom	45H-7D16H PATD CORMAX PATENTED KEYING	630	CBE
1	Construction Core	1C-7A2	626	CBE
1	Electric Strike - Fail Secure	F2164	32D	CRC
1	Closer	8916-AFP	689	CDM
1	Kick Plate	K10A 10" x 34"	32D	CSM
1	Wall Stop	S125	32D	CSM
1	Card Reader	CARD READER by Div 28		
1	Power Supply	10-1		CRC
1	Gasket	W-22 x Door Perimeter	BLK	CKN
NOTE: Door is normally closed and locked. Card reader releases the electric strike allowing entry.				

SET #007				
Doors: D109, D110				
4	Hinges	CB199 4 1/2 x 4	32D	CST
1	Storeroom	45H-7D16H PATD CORMAX PATENTED	630	CBE
1	Construction Core	1C-7A2	626	CBE
1	Electric Strike - Fail Secure	F2164	32D	CRC
1	Closer	8916-AFP	689	CDM
1	Kick Plate	K10A 10" x 34"	32D	CSM
1	Wall Stop	S125	32D	CSM
1	Card Reader	CARD READER by Div 28		
1	Power Supply	10-1		CRC
1	Gasket	W-22 x Door Perimeter	BLK	CKN
1	Threshold	CT-10 x Door Width	AL	CKN
NOTE: Door is normally closed and locked. Card reader releases the electric strike allowing entry.				

Manufacturer List

<u>Code</u>	<u>Name</u>
BY	By Others
CAM	Camden
CBE	Best Canada
CDM	Dorma
CKN	K.N. Crowder
CPR	Precision Canada
CRC	RCI
CSM	Standard Metal
CST	Stanley
KABA	KABA/ILCO

Option List

<u>Code</u>	<u>Description</u>
C	QUICK CONNECT WIRING HARNESS
DA	ADJUSTABLE DELAYED ACTION
DS	DOOR POSITION SWITCH
RP	RINGS-RIM CYLINDER
TS	TOUCHBAR MONITORING SWITCH
36"	36" TOUCHBAR
EPT	Power Transfer Prep (Full Mortise)
MLR	MOTORIZED LATCH RETRACTION
RP3	RINGS-7 PIN MORTISE
8'0"	8'0" HIGH
C181	CAM-ADAMS RITE MS CAM
DPK89	All Fasteners to be Self-Drilling
CORMAX PATENTED KEYING	Cormax Patented Keying

Finish List

<u>Code</u>	<u>Description</u>
AL	Aluminum
DB	Dull Bronze
26D	Satin Chrome
32D	Satin Stainless Steel
626	Satin Chromium Plated
628	Satin Aluminum, Clear Anodized
630	Satin Stainless Steel
689	Aluminum Painted
BLK	Black

END OF SECTION

1. GENERAL**1.01 SUMMARY**

- .1 This Section includes the following types of automatic door operators:
 - .1 Exterior and interior, automatic door operators, low energy, with visible header mounting.
 - .2 Automatic door operators shall be configured for doors as follows: Single doors.
- .2 Related Sections:
 - .1 Division 8 Section "Doors and Frames" for entrances furnished and installed separately in Division 8 Section.
 - .2 Division 8 Section "Aluminum-Framed Entrances and Storefronts" for entrances furnished and installed separately in Division 8 Section.
 - .3 Division 8 Section "Door Hardware" for hardware to the extent not specified in this Section.
 - .4 Division 26 Sections for electrical connections provided separately including conduit and wiring for power to, and control of, automatic door operators.

1.02 REFERENCES

- .1 General: Standards listed by reference, including revisions by issuing authority, form a part of this specification section to extent indicated. Standards listed are identified by issuing authority, authority abbreviation, designation number, title or other designation established by issuing authority. Standards subsequently referenced herein are referred to by issuing authority abbreviation and standard designation.
- .2 Underwriters Laboratories (UL):
 - .1 UL/CUL 325 – Standard for Door, Drapery, Gate, Louver, and Window Operators and Systems (CAN/CSA-C22.2 No. 247).
 - .2 UL/CUL 10C – Positive Pressure Fire Tests of Door Assemblies (CAN/ULC-S104).
- .3 American National Standards Institute (ANSI)/Builders' Hardware Manufacturers Association (BHMA):
 - .1 ANSI/BHMA A156.10: Standard for Power Operated Pedestrian Doors.
 - .2 ANSI/BHMA A156.19: Standard for Power Assist and Low Energy Power Operated Doors.
- .4 American Society for Testing and Materials (ASTM):
 - .1 ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
 - .2 ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
- .5 American Association of Automatic Door Manufacturers (AAADM)
- .6 National Fire Protection Association (NFPA):
 - .1 NFPA 101 – Life Safety Code.
 - .2 NFPA 70 – National Electric Code.
- .7 International Code Council (ICC):

- .1 IBC: International Building Code
- .8 Building Officials and Code Administrators International (BOCA), 1999
- .9 International Standards Organization (ISO):
 - .1 ISO 9001 – Standard for Manufacturing Quality Management Systems
- .10 National Association of Architectural Metal Manufacturers (NAAMM):
 - .1 Metal Finishes Manual for Architectural and Metal Products.
- .11 American Architectural Manufacturers Association (AAMA):
 - .1 AAMA 607.1 – Clear Anodic Finishes for Architectural Aluminum.
 - .2 AAMA 611 Voluntary Specification for Anodized Architectural Aluminum.
- 1.03 DEFINITIONS
 - .1 The following definitions apply to the Automatic Door Operators specification:
 - .2 Activation Device: Device that, when actuated, sends an electrical signal to the door operator to open the door.
 - .3 Knowing act: Consciously initiating the opening of a power operated door using acceptable methods including wall mounted switches such as push plates and controlled access devices such as keypads, card readers and key switches.
 - .4 Safety Device: Device that prevents a door from opening or closing, as appropriate.
- 1.04 PERFORMANCE REQUIREMENTS
 - .1 General: Provide automatic door operators capable of withstanding loads and thermal movements based on testing manufacturer's standard units in assemblies similar to those indicated for this Project.
 - .2 Operating Range: -30°F (-34°C) to 130°F (54°C).
 - .3 Opening-Force Requirements for Egress Doors: In the event power failure to the operator, swinging automatic entrance doors shall open with a manual force, not to exceed 30 lbf (133 N) to set door in motion, and not more than 15 lbf to fully open the door. Forces shall be applied at 1" (25 mm) from the latch edge of the door.
- 1.05 SUBMITTALS
 - .1 General: Submit listed submittals in accordance with Conditions of the Contract and Division 01, Section 01 00 06 – General Requirements: Submittals.
 - .2 Shop Drawings: Include plans, elevations, sections, details, hardware mounting heights, and attachments to other work. Indicate wiring for electrical supply.
 - .3 Colour Samples for selection of factory-applied colour finishes.
 - .4 Closeout Submittals: Provide the following with project close-out documents.
 - .1 Owner's Manual.

.2 Warranties.

1.06 QUALITY ASSURANCE

- .1 Installer Qualifications: Manufacturer's authorized representative, with certificate issued by AAADM, who is trained for installation and maintenance of units required for this Project.
- .2 Manufacturer Qualifications: A qualified manufacturer with a manufacturing facility certified under ISO 9001.
- .3 Manufacturer shall have in place a national service dispatch center providing 24 hours a day, 7 days a week, emergency call back service.
- .4 Certifications: Automatic door operators shall be certified by the manufacturer to meet performance design criteria in accordance with the following standards:
 - .1 ANSI/BHMA A156.10 and A156.19.
 - .2 NFPA 101.
 - .3 UL/CUL 325 (CAN/CSA-C22.2 No. 247).
 - .4 UL/CUL 10C (CAN/ULC-S104).
 - .5 IBC
 - .6 BOCA
- .5 Source Limitations: Obtain automatic door operators through one source from a single manufacturer.
- .6 Product Options: Drawings indicate sizes, profiles, and dimensional requirements of swinging doors equipped with automatic door operators and are based on the specific system indicated. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.
- .7 Power Operated Door Standard: ANSI/BHMA A156.19.
- .8 Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- .9 Emergency-Exit Door Requirements: Comply with requirements of authorities having jurisdiction for swinging automatic entrance doors serving as a required means of egress.

1.02 PROJECT CONDITIONS

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

1.03 COORDINATION

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

- .2 Electrical System Roughing-in: Coordinate layout and installation of automatic door operators with connections to, power supplies, remote activation devices, and electric door latching hardware. See Division 8 Section "Door Hardware" for components not provided under this section.
- .3 System Integration: Integrate automatic door operators with other systems as required for a complete working installation. Where required for proper operation, provide a time delay relay to signal automatic door operator to activate only after electric lock system is released.

1.04 WARRANTY

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

2. PRODUCTS

2.01 AUTOMATIC DOOR OPERATORS

- .1 Manufacturer: Stanley Access Technologies; Magic-Force™ Series automatic door operator.
 - .1 Contact: Stanley Access Technologies, 5136 - 75 Street N.W., Edmonton AB T6E 6W2; Attn: Barry Wagg; Phone: 780-570-5471, Fax: 888-281-3336, Email: Barry.Wagg@sbdinc.com.
- .2 Substitutions: See Division 1, Section 01 00 06 – General Requirements: Substitutions and Product Options.

2.02 MATERIALS

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

2.03 COMPONENTS

- .1 Header Case: Header case shall not exceed 6" (152 mm) square in section and shall be fabricated from extruded aluminum with structurally integrated end caps, designed to conceal door operators and controls. The operator shall be sealed against dust, dirt, and corrosion within the header case. Access to the operator and electronic control box shall be provided by a full-length removable cover, edge rabbetted to the header to ensure a flush fit. Removable cover shall be secured to prevent unauthorized access.
- .2 Door Arms: A combination of door arms and linkage shall provide positive control of door through entire swing; units shall permit use of butt hung, center pivot, and offset pivot-hung doors.
- .3 Fasteners and Accessories: Manufacturer's standard corrosion-resistant, non-staining, non-bleeding fasteners and accessories compatible with adjacent materials.

- .4 Signage: Provide signage in accordance with ANSI/BHMA A156.19.

2.04 SWINGING DOOR OPERATORS

- .1 General: Provide door operators of size recommended by manufacturer for door size, weight, and movement; for condition of exposure; and for long-term, maintenance-free operation under normal traffic load for type of occupancy indicated.
- .2 Electromechanical Operators: Self-contained unit powered by a minimum 3/16 horsepower, permanent-magnet DC motor; through a high torque reduction gear system.
 - .1 Operation: Power opening and spring closing.
 - .2 Operator Type: Low energy; readily convertible to full energy; no tools required to change type.
 - .3 Handing: Non-handed; no tools required to change handing.
 - .4 Capacity: Rated for door panels weighing up to 350 lb (159 kg).
 - .5 Mounting: Visible
 - .6 Features:
 - .1 Adjustable opening and closing speeds.
 - .2 Adjustable opening and closing force.
 - .3 Adjustable back-check.
 - .4 Adjustable hold-open time between 0 and 30 seconds.
 - .5 Reverse on obstruction.
 - .6 Closed loop speed control with active braking and acceleration.
 - .7 Variable obstruction recycle time delay.
 - .8 Optional Switch to open/Switch to close operation.
 - .9 Optional push to activate operation.
 - .10 When operators are provided in pairs, adjustable features are independently adjustable for each operator.
- .3 Field Adjustable Spring Closing Operation: The operator shall close the door by spring energy employing the motor, as a dynamic brake to provide closing speed control. The closing spring shall be a helical compression spring, adjustable for positive closing action. The spring shall be adjustable, without removing the operator from the header, to accommodate a wide range of field conditions.
- .4 Independent Adjustable Closing and Latching Speed Control: The operator shall employ a rheostat module to allow for independent field adjustment of closing and latching speeds using the motor as a dynamic brake.
- .5 Field Adjustable Open Stop: The operator shall provide a field adjustable open stop to accommodate opening angles from 80 to 135 degrees without the need for additional components.
- .6 Consistent Cycle: The operator shall deliver an even, consistent open force across the entire transition from door fully closed to door fully open. Additionally, the range of the force shall be field adjustable to accommodate a wide range of on-site conditions.
- .7 Quiet Performance: The operator shall be designed to output audible noise ratios less than or equal to 50dba.
- .8 Manual Use: The operator shall function as a manual door closer in the direction of swing with or without electrical power. The operator shall deliver an even, consistent open force across the entire transition from door fully closed to door fully open.

- .9 Electrical service to door operators shall be provided under Division 16 Electrical. Minimum service to be 120 VAC, 5 amps.

2.05 ELECTRICAL CONTROLS

- .1 Electrical Control System: Electrical control system shall include a microprocessor controller and position encoder. The encoder shall monitor revolutions of the operator shaft and send signals to microprocessor controller to define door position. Systems utilizing external magnets and magnetic switches are not acceptable.
- .2 Performance Data: The microprocessor shall collect and store performance data as follows:
- .1 Counter: A non-resettable counter to track operating cycles.
 - .2 Event Reporting: Unit shall include event and error recording including number of occurrences of events and errors, and cycle count of most recent events and errors.
 - .3 LED Display: Display presenting the current operating state of the controller.
- .3 Controller Protection: The microprocessor controller shall incorporate the following features to ensure trouble free operation:
- .1 Automatic Reset Upon Power Up.
 - .2 Main Fuse Protection.
 - .3 Electronic Surge Protection.
 - .4 Internal Power Supply Protection.
 - .5 Resettable sensor supply fuse protection.
 - .6 Motor Protection, over-current protection.
- .4 Soft Start/Stop: A "soft-start" "soft-stop" motor driving circuit shall be provided for smooth normal opening and recycling.
- .5 Obstruction Recycle: Provide system to recycle the swinging panels when an obstruction is encountered during the closing cycle.
- .6 Programmable Controller: Microprocessor controller shall be programmable and shall be designed for connection to a local configuration tool. Local configuration tool shall be a software driven handheld interface. The following parameters may be adjusted via the configuration tool.
- .1 Operating speeds and forces as required to meet ANSI/BHMA A156.10 A156.19.
 - .2 Adjustable and variable features as specified in 2.4, B.
 - .3 Firmware update.
 - .4 Trouble Shooting
 - .1 I/O Status.
 - .2 Electrical component monitoring including parameter summary.
- .7 Emergency Breakout Switch: A cam actuated emergency breakout switch shall be provided to disconnect power to the motor when an in-swinging door is manually pushed in the emergency out direction. The operator will then automatically reset and power will be resumed.
- .8 Control Switch: Automatic door operators shall be equipped with a three position function switch to control the operation of the door. Control switch shall provide three modes of operation, Automatic, Off, and Hold-Open.
- .9 Power Switch: Automatic door operators shall be equipped with a two position On/Off switch to control power to the door.

2.06 ACTIVATION AND SAFETY DEVICES

- .1 Touchless Activation Switch: Provide touchless activation switches for activation of automatic door operators. Face plates shall be stainless steel, engraved with waving hand logo and "Wave To Open" text.
 - .1 Wall Mounting: Where scheduled, mount touchless activation switches within single gang electrical box, 2 3/4 inch by 4 1/2 inch (70 mm x 114 mm); units shall be hardwired to door operator controls.
 - .2 Post Mounting: Where scheduled, provide 6 inch by 6 inch (152 mm by 152 mm) square aluminum mounting post, with 1/8 inch (3 mm) wall thickness, welded top cap, and concealed aluminum mounting plate with 1/4 inch (6 mm) wall thickness. Post shall be 48 inch (1219 mm) high configured for switch mounting.
 - .3 Touchless activation switches shall incorporate microwave frequency to detect all motion in the detection zone.
 - .1 Detection zone shall be adjustable from 2 inch to 24 inch (51 mm to 610 mm).
 - .2 Dual colour, illuminated center for activation confirmation.
 - .3 Relay shall be rated at 1 A at 30 VAC/VDC.
 - .4 Relay hold time adjustable from 1 to 30 sec.
 - .5 NEMA 4 rated enclosure.
 - .4 Touchless activation switches shall be equal to or better than BEA MS11.
 - .5 Mounting posts shall be equal to or better than BPS SM-INGR-42" x 628 by Wikk Industries.
- .2 Activation Control Module: Provide microprocessor controlled module as required for timed activation of door operators integrated with electric locking. Module shall comply with the following:
 - .1 Power Supply: 12-24 VAC/VDC.
 - .2 Inputs: 4 Dry Contacts, 1 Wet @ 5-24 VAC/VDC.
 - .3 Outputs: 2 Dry Relays @ 3 A, 1 Dry Relay @ 1 A, 1 Wet Relay @ 1 A
 - .4 Unit shall be suitable for mounting in automatic door operators headers.
 - .5 Activation control module shall be equal to or better than BEA Br3.
- .3 Presence Detection Safety Sensors: Provide presence detection system designed to sense people in the swing zone when the swinging automatic entrance door is or in motion. System provided shall consist of door mounted safety sensors and accessories required for a complete working system as follows:
 - .1 Door Mounted Presence Detection Sensors: Door mounted presence detection sensors shall be focused active infrared type designed specifically to sense moving or stationary objects in the swing zone, each side, of a moving door leaf. Sensor housings shall be high impact shock resistant with tinted lenses suitable for door mounting. Door mounted presence detection sensors shall not be affected by ultrasonic, ambient light or radio frequencies, within the vicinity of the swing door.
 - .2 Door mounted presence detection sensors shall be equal to or better than BEA Superscan II.

2.07 ALUMINUM FINISHES

- .1 General: Comply with NAAMM Metal Finishes Manual for Architectural and Metal Products for recommendations for applying and designing finishes. Finish designations prefixed by AA comply with system established by Aluminum Association for designing finishes.

- .2 Class II, Clear Anodic Finish: AA-M12C22A31 Mechanical Finish: as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class II, clear coating 0.40 mils minimum complying with AAMA 611-98, and the following:
 - .1 AAMA 607.1
 - .2 Applicator must be fully compliant with all applicable environmental regulations and permits, including wastewater and heavy metal discharge.

3. EXECUTION

3.01 INSPECTION

- .1 Examine conditions, with Installer present, for compliance with requirements for installation tolerances, header support, and other conditions affecting performance of swinging automatic entrance doors. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- .1 General: Do not install damaged components. Fit joints to produce hairline joints free of burrs and distortion. Rigidly secure non-movement joints.
- .2 Mounting: Install automatic door operators/headers plumb and true in alignment with established lines and grades. Anchor securely in place.
 - .1 Install surface-mounted hardware using concealed fasteners to greatest extent possible.
 - .2 Set headers, arms and linkages level and true to location with anchorage for permanent support.
- .3 Door Operators: Connect door operators to electrical power distribution system as specified in Division 26 Sections.

3.03 FIELD QUALITY CONTROL

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

3.04 ADJUSTING

- .1 Adjust door operators, controls, and hardware for smooth and safe operation, for tight closure, and complying with requirements in ANSI/BHMA A156.19 by AAADM Certified Technician.

3.05 CLEANING AND PROTECTION

- .1 Clean surfaces promptly after installation. Remove excess sealant compounds, dirt, and other substances. Repair damaged finish to match original finish.

END OF SECTION

1. GENERAL**1.01 SUMMARY**

- .1 This Section includes requirements for supply and installation of exterior and interior glass for windows, doors, borrowed lites, storefronts, entrances, curtain walls including glazing sealants and accessories required for a complete and functional installation.
- .2 This Section includes requirements for design of glass thickness based on installation conditions and size of glass lites; and confirmation of glass types subject to potential thermal shock breakage resistance.
- .3 This Section includes requirements for delegated design associated with structural and seismic glass installations and that requires detailed analysis and implementation of safety considerations under the direction of a professional engineer, and forming a part of the work described for the Project.

1.02 DEFINITIONS

- .1 The following definitions apply to the Glass Glazing specification:
- .2 Terminology and definitions for glass and glazing used in this Section are based on definitions provided in ASTM C162.
- .3 Delegated Design Professional Engineer: The professional engineer hired or contracted to the fabricator or manufacturer to design specialty elements, produce delegated design submittals and shop drawings meeting the requirements of the Project; who is registered in the province of the Work; and who is not the Consultant.
- .4 Letters of Commitment and Compliance: Documents prepared by the delegated design professional engineer as recommended by provincial engineering associations in accordance with Section 01 33 50 – Delegated Design Submittals.

1.03 REFERENCE STANDARDS

- .1 American Society for Testing and Materials (ASTM):
 - .1 ASTM C162-05 (2015), Standard Terminology of Glass and Glass Products
 - .2 ASTM C920-14a, Standard for Elastomeric Joint Sealants
 - .3 ASTM C1048-12e1, Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass
 - .4 ASTM C1172-14, Standard Specification for Laminated Architectural Flat Glass
 - .5 ASTM E2190-10, Standard Specification for Insulating Glass Unit Performance and Evaluation
 - .6 ASTM E1300-16, Standard Practice for Determining Load Resistance of Glass in Buildings
- .2 Canadian General Standards Board (CGSB):
 - .1 CAN/CGSB 12.1-2017, Safety Glazing
 - .2 CAN/CGSB 12.3-M91, Flat, Clear Float Glass
 - .3 CAN/CGSB 12.9-M91, Glass, Spandrel
 - .4 CAN/CGSB 12.10-M76, Glass, Light and Heat Reflecting
 - .5 CAN/CGSB 12.13-M91, Glass, Patterned
 - .6 CAN/CGSB 12.20-M89, Structural Design of Glass for Buildings
 - .7 CAN/CGSB 19.2-M87, Glazing Compound, Non hardening, Modified Oil Type

.3 Glass Association of North America (GANA):

- .1 GANA Glazing Manual

.4 Insulating Glass Manufacturers Alliance (IGMA):

- .1 IGMA Insulating Glass Manufacturing Quality Procedures
.2 IGMA Certification Program Manual
.3 IGMA Certified Products Directory

1.04 ADMINISTRATION REQUIREMENTS

.1 Coordination: Coordinate work of this Section with the installation of frames to ensure a continuous, uninterrupted sequence, and to prevent the undue exposure of unprotected frames to weather, and as follows:

- .1 Coordinate glazing channel dimensions to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, using reasonable tolerances.
.2 Install glass lites only after nearby welding is completed.
.3 Mark each lite of glass as it is installed in a manner to make it visible and obvious to all persons.
.4 Do not use materials that may permanently mar, discolour or disfigure the glass.

.2 Pre-Construction Meetings: Conduct a pre-construction meeting before starting any work of this Section in accordance with Section 01 00 06 – General Requirements: Project Meetings, attended by the Consultant, Contractor and others that are affected by work of this Section to discuss the following:

- .1 Review and finalize construction schedule and verify availability of materials, installer's personnel, equipment, and facilities needed to make progress and avoid delays.
.2 Review temporary protection requirements for glazing during and after installation.

.3 Delegated Design Requirements: Coordinate design of glass thicknesses and composition in glass curtain wall in accordance with referenced standards and requirements of this Section.

1.05 SUBMITTALS

.1 Provide required information in accordance with Section 01 00 06 – General Requirements: Submittals.

.2 Action Submittals: Provide the following submittals before starting any work of this Section:

- .1 Glazing Schedule: Submit glazing schedule using same designations indicating in this Section and on Drawings listing glass types and thicknesses for size of opening and location.
.2 Product Data: Submit manufacturer's technical data for each glazing material required, including installation and maintenance, and listing following properties for single and multiple glazings with comparison to specified materials with information submitted in Metric Units:
.1 Nominal U_{SI} -Factors (U-Value)
.2 Visible Light Transmittance (T_{vis})
.3 Specific Heat Gain Coefficient (SHGC)
.4 Shading Coefficient (SC)
.5 Relative Heat Gain (RHG)

- .3 Samples for Verification: Submit the following samples for each glass type specified for verification by Consultant of products supplied to the Project:
 - .1 Sealed Glass Units: Submit one fully double glazed 300 mm x 300 mm sample; indicate which surface low-e coatings have been applied to; attach glass performance requirements to back side of unit.
 - .2 Spandrel Glass Units: Submit one fully double glazed 300 mm x 300 mm sample using material selected from initial sample selection process; and for each additional spandrel type specified.
 - .4 Glazing Accessory Samples: Submit 300 mm long samples for each different sealant and spacers; install sealant samples between two strips of material representative in color of the adjoining framing system.
- .3 Informational Submittals: Provide the following submittals during the course of the work of this Section:
 - .1 Certificates: Separate certification will not be required for glazing materials bearing manufacturer's permanent label designating type and thickness of glass, provided labels represent a quality control program involving a recognized certification agency or independent testing laboratory acceptable to Authority Having Jurisdiction:
 - .1 Low-E Coatings: Submit letter indicating compliance with the specified high-performance window coatings and glazing materials listed in this Section indicating conformance with the specified coating configuration, shading coefficient and solar heat gain coefficient, measured at centre of glass and edge of glass.
 - .2 Heat Soak Treated Tempered Glass: Submit manufacturer's written statement or certificate indicating that glass supplied to this project has been heat soak tested in accordance with EN 14179-1 to reduce the likelihood of spontaneous breakage as a result of nickel sulphide inclusions; heat soak test all structural tempered glass used for project and confirm that delivered materials meet requirements established in this section.
 - .2 Delegated Design Submittals: Provide delegated design for glass indicated to comply with performance requirements and design criteria in accordance with Section 01 33 50 for design criteria described in this Section, and as follows:
 - .1 Submit delegated design professional engineer's design analysis data and calculations upon request of the Consultant, signed and sealed by the qualified professional engineer responsible for their preparation.
 - .2 Submit in conjunction with shop drawings a Letter of Commitment, signed and sealed by professional engineer responsible for work of this Section; professional engineer shall define applicable responsibilities in the completed Letter of Compliance in compliance with the intent of the Building Code.
 - .3 Submit Letter of Compliance, signed and sealed by professional engineer responsible for work of this Section design engineer to certify substantial compliance with the system design before declaration of Substantial Performance for the project.
 - .3 Source Quality Control Submittals: Submit product test listings from a qualified testing agency indicating fire rated glass complies with requirements, based on comprehensive testing of current product.

1.06 PROJECT CLOSEOUT SUBMITTALS

- .1 Operation and Maintenance Data: Submit maintenance brochures on the care and cleaning of glass and glazing materials in accordance Section 01 00 06 – General Requirements: Closeout Submissions.

1.07 QUALITY ASSURANCE

- .1 Qualifications: Provide proof of qualifications when requested by Consultant:
 - .1 Installer: Use installers having experience with projects of similar scope and complexity and approved for installing products by glass manufacturer.
 - .2 Source Limitation: Obtain glass from a single source from a single manufacturer for each glass type, accessory product and installation method.
 - .3 Delegated Design Professional: Engage a qualified professional engineer to design glass and glazing system where glass sizes fall outside of manufacturer's standard design charts and as follows:
 - .1 Perform glazing work in accordance with written recommendations from the glass manufacturer or glass fabricator.
 - .2 Certify glass compatibility with glazing materials; such as insulating glass sealants, structural sealants and silicones, gaskets, setting blocks, and similar components
 - .3 Verify glass design, heat treatment and thickness; analyze for thermal stress and maximum deflection.
 - .4 Quality Limitations for Heat Strengthened and Tempered Glass: Perform tempering or heat strengthening in accordance with CAN/CGSB 12.1 or ASTM C1048 and as follows:
 - .1 Fabricate glass using horizontal roller heating process only, with roller wave distortion parallel to bottom edge of glass as when installed.
 - .2 Maximum deviation from flatness at any peak (peak to valley deviation), 0.08 mm at centre of lite and 0.20 mm within 265 mm of leading or trailing edge.
 - .3 Apply heat treatment prior to the application of low-e coatings to minimize appearance of roller wave distortion.
- .2 Certifications: Provide the following during the course of the Work:
 - .1 Compliance Certification: Provide certificates from manufacturer indicating tested performance requirements and proof of participation in the IGMA Certification Program.

1.08 MOCK-UPS

- .1 Provide sample panel in accordance with Section 01 00 06 – General Requirements: Quality Control delivered to the City's and Consultant's office consisting of the following:
 - .1 Four Unit Sample Panel Assembly: Assembly consisting glass and framing assembly approximately four (4) - 300 mm x 300 mm glazed lite samples accepted for use on project indicating relationship between adjacent glass-to-glass joint conditions, colour of weathering seal and colour of primary and secondary seals, and structural sealant] using specified spacer bar; submit one sample panel for each different combination of glass materials.
- .2 Sample panel will be used to assess the required aesthetic appearance of glass lites installed on the project; Consultant reserves the right to request modifications to sealant colours in used in final assembly.

1.09 DELIVERY, STORAGE AND HANDLING

- .1 Delivery and Acceptance Requirements: Deliver packaged materials in their original containers with manufacturer's labels and seals intact and as follows:
 - .1 Package glass materials to prevent damage to glass and glazing materials resulting from condensation, temperature changes and direct exposure to sun and other causes.
 - .2 Comply with manufacturer's transportation requirements for protecting insulating glass units for venting and sealing to prevent hermetic seal ruptures resulting from changes in altitude.
- .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.

1.10 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, and as follows:
 - .1 Install glazing when ambient temperature is above manufacturer's written minimum requirement and rising.
 - .2 Maintain ventilated environment for 24 hours after installation.
 - .3 Maintain minimum ambient temperature before, during and 24 hours after installation of glazing compounds.

1.11 WARRANTY

- .1 Manufacturer's Special Warranty for Coated Glass Products: Manufacturer's standard form, made out to Owner and signed by coated-glass manufacturer agreeing to replace coated-glass units that deteriorates within the specified warranty period, commencing from date of Substantial Performance of the Work:
 - .1 Coating Failure: Defects developed from normal use that are attributed to the manufacturing process and not to causes other than glass breakage and practices for maintaining and cleaning coated glass contrary to manufacturer's written instructions.
 - .2 Evidence of Failure: Observations indicating conditions such as peeling, cracking, and other indications of deterioration in metallic coating.
 - .3 Warranty Period: Ten (10) years.
- .2 Special Warranty – Glass Seals: Provide manufacturer's warranty for replacement of sealed glass units, covering defects in materials and workmanship for the period indicated, commencing from date of Substantial Performance of the 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 as described in CAN/CGSB 12.3, ASTM C1036 and IGMA Definition TB-1205.
 - .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.

- .3 Special Warranty – Glass Delamination: Provide manufacturer’s warranty covering laminated glass units for a period of ten (10) years, covering defects in materials and workmanship resulting in edge separation or delamination within the field area of glass that obstructs or affects visibility through the laminated unit, commencing from date of Substantial Performance of the Work.

2. PRODUCTS

2.01 MANUFACTURERS

- .1 Basis-of-Design Products: Products named in this Section were used as the basis-of-design for the project; manufacturers listed as additional acceptable materials and that offer similar products may be incorporated into the work of this Section provided they meet the performance requirements established by the named products.

- .2 Additional Acceptable Products Manufacturers: Subject to matching of colour and compliance with performance requirements specified in this Section; as established by the Basis-of-Design Products, use any of the listed manufacturers’ products in accordance with Section 01 00 06 – General Requirements: Substitutions and Product Options; following manufacturer’s do not require submission of a request for substitutions provided required shop drawing and product data submissions are submitted before starting any work of Section confirming performance compared to the named Basis-of-Design Products:

- .1 Glass Materials:

- .1 Cardinal Glass Industries
- .2 Guardian Glass
- .3 Pilkington Glass of Canada
- .4 Schott Glass AG
- .5 Viracon Inc.
- .6 Vitro Architectural Glass (formerly PPG Glass)

- .3 Substitutions: Consultant may consider additional manufacturers having similar products to Basis-of-Design Products listed above during the construction period, provided they meet the performance requirements established by the named products and provided they submit requests for substitution in accordance with Section 01 00 06 – General Requirements: Substitutions and Product Options before starting any work of this Section:

- .1 Do not use substitute materials to establish Bid Price.
- .2 Substitutions that appear as a part of the project without review and acceptance by the Consultant will be rejected, and replaced with one of the specified materials.

2.02 PERFORMANCE REQUIREMENTS

- .1 Building Envelope Performance: Provide continuity of building enclosure vapour and air barrier using glass glazing materials utilizing inner lite of multiple lite insulated units for continuity of air and vapour seal.

- .2 Structural Design Performance: Provide glass products in thicknesses designed in accordance with CAN/CGSB 12.20 based on the following criteria:
- .1 Glass Thickness: As indicated on the Drawings
 - .2 Design Loads: Glass thicknesses listed in the Specification or indicated on the Drawing are minimum thicknesses and used for detailing purposes only; confirm glass thicknesses by analyzing project loads and in-service conditions and provide glass in strengths (annealed or heat treated) and actual thickness required to meet deflection criteria:
 - .1 Ultimate Limit States: Positive and negative pressure acting normal to plane of glass using wind load requirements of Section 4.1.7 of the Alberta Building Code for Normal Importance Category using Importance Factor (I_w) accounting for normal windload and gust velocities.
 - .2 Reference Velocity Pressure: Velocity pressure (q) located in National Building Code Structural Commentaries, Wind Load and Effects, (Part 4 of Division B), based on probability of being exceeded in any one year of 1 in 50.
 - .3 Occupant Safety: Design glass minimum lateral design loads of 0.5 kPa for all glass installed in walls, partitions or barriers having a 600 mm or higher elevation from adjacent slabs or grade; glass acting as guards criteria govern where minimum normal windload pressure (non-gust) is lower than required loads for occupant safety in accordance with Section 4.1.5 of the Alberta Building Code.
 - .4 Limit of Centre of Glass Deflection: Limit centre of glass deflection to a maximum of 1/60 and not exceeding 10 mm relative to the undeflected glass plane.
 - .5 Limit of Edge of Glass Deflection: Limit edge of glass deflection based on maximum 1/175 as required to maintain full contact with glazing throat.
 - .3 Dimensions: Rectangular glass dimensions and aspect ratio as indicated on Drawings.
 - .4 Configuration: Insulating Glass and Monolithic Glass.
 - .5 Multipliers: Modify glass thicknesses based on substituting heat treated or laminated glass configurations as required to obtain the most economical glass assembly.

2.03 MATERIALS

- .1 Annealed Float Glass (GL-1): In accordance with CAN/CGSB 12.3, and as follows:
- .1 Glass Appearance: Clear Transparent
 - .2 Quality: Glazing with specific defect limitations as defined by Table 3 of CAN/CGSB 12.3 based on area of glass units.
 - .3 Labelling: Not Required
- .2 Low-Emissivity (Low-E) Glass (GL-2): In accordance with CAN/CGSB 12.10 and as having the following nominal properties:
- .1 Glass Quality: Float glass, glazing quality as described in Item 2.03.1.2 above; annealed, heat strengthened or tempered as required by glass manufacturer to prevent glass breakage arising from thermal shock, except that tempered safety glass must be used for entrances and sidelights.
 - .2 Tint: Clear glass, having the following similar nominal monolithic properties:

.1	USI Factor	3.22 W/m ² -K
.2	Emissivity:	0.035
.3	Shading Coefficient (SC):	0.50
.4	Solar Heat Gain Coefficient (SHGC):	0.45
.5	Visible Light Transmission (T _{vis}):	0.79
.6	Relative Heat Gain (RHG):	343 W/m ²
 - .3 Labelling: Required
 - .4 Basis-of-Design Products:

- .1 PPG Solarban SB60
- .2 International Glazing Database Identification: 5284
- .3 Clear Safety Glass (GL-3): Manufactured in accordance with CAN/CGSB 12.1 and ASTM C1048 heat soak tested in accordance with EN14179-1, and as follows:
 - .1 Type: 2 – Tempered
 - .2 Class: B - Float Glass
 - .3 Roller Wave Tolerance: Notwithstanding requirements of ASTM C1048, limit distortions arising from tempering process to a maximum nominal 0.08 mm peak to valley at centre of glass and 0.20 mm within 265 mm of leading and trailing edges of the glass.
 - .4 Category: I - Heat Strengthened
 - .5 Labelling: Required
- .4 Ceramic Frit Coated Glass (GL-4) Manufactured in accordance with CAN/CGSB 12.13 and as follows:
 - .1 Ceramic-Coated Vision Glass: Float glass with ceramic enamel applied by silk-screened process and complying with ASTM C 1048, Condition C (other coated glass), Type I (transparent flat glass), Quality-Q3, Specification No. 95-1-31 in GANA Tempering Division's "Engineering Standards Manual," and other requirements specified.
 - .2 Type: 2 – Tempered
 - .3 Class: B - Float Glass
 - .4 Roller Wave Tolerance: Notwithstanding requirements of ASTM C1048, limit distortions arising from tempering process to a maximum nominal 0.08 mm peak to valley at centre of glass and 0.20 mm within 265 mm of leading and trailing edges of the glass.
 - .5 Category: I - Heat Strengthened
 - .6 Labelling: Required
 - .7 Acceptable Applicators:
 - .1 Durapaints Inc.
 - .2 Goldray Corporation.
 - .3 Garibaldi Glass Industries Inc
- .5 Mirrored Glass (GL-5): In accordance with ASTM C1503 or CGSB 12.6 and as follows:
 - .1 Mirrors, Silvered.
 - .2 Type: 1B – Float glass.
 - .3 Tint: Clear
 - .4 Thickness: 5 mm minimum
 - .5 Edges: Pencil polished edge. Seal edges to prevent chemical or atmospheric penetration of backing.

2.04 ACCESSORIES

- .1 Spacer/Separator: Glass Fabricator's standard stainless steel; coloured black, spacer containing desiccant, sealed to provide continuous vapour barrier between interior of sealed unit and secondary seal. Enhanced insulating edge spacer, thermoset foam spacer incorporating primary seal, desiccant, and secondary seal, and as follows:
 - .1 Basis-of-Design Products: Edgetech-Quanex Super Spacer T-Spacer, TriSeal (for SSG Glazed Assemblies), black coloured.
- .2 Sealants for Insulating Glass Units:
 - .1 Primary Seal: Polyisobutylene; colour black.
 - .2 Secondary Seal: Structural silicone based, conforming to ASTM C920, Type S, Grade NS, Class 25, Use NT, G and A; compatible with SSG adhered curtain wall system specified in Section 08 44 26; colour black.

- .1 Momentive Ultraglaze SSG4000
- .2 Dow Corning 995
- .3 Tremco Spectrem 2

- .3 Cleaners, Primers, and Sealers: Type recommended by manufacturer of glass and gaskets.
- .4 Frameless glazing channels: Extruded aluminum alloy shall be type 6063-T5, T6 or T54, and as follows:
 - .1 Top Channel: 45 mm wide x 60 mm high x 4.8 mm thickness.
 - .2 Bottom Channel: 45 mm wide x 50 mm high x 3.2 mm thickness and as indicated on the Drawing 7/A6.02.
- .5 Mirrored Glass Accessories: Provide accessory materials as required for complete installation and as follows:
 - .1 Edge Sealer: Coating compatible with mirrored coating and approved by mirror manufacturer for use in protecting against silver deterioration at mirrored glass edges.
 - .2 Primer: Water resistant surface sealer formulated for priming porous substrates prior to application of mirror mastic, compatible with mirror mastic used for the project.
 - .3 Mirror Mastic: Adhesive compound, produced specifically for setting mirrors and certified by both mirror manufacturer and mastic manufacturer as compatible with glass coating and substrates on which mirrors are installed; containing a maximum of 250 g/L VOC.
 - .4 Mirror Bottom Clips: As recommended by installer.
 - .5 Mirror Top Clips: As recommended by installer.
 - .6 Fasteners: Fabricated of same basic metal and alloy as fastened metal and matching in finish and texture where fasteners are exposed.
 - .7 Anchors and Inserts: Provide devices as required for mirror hardware installation.

2.05 FABRICATION

- .1 Fabrication Tolerances: Cut glass to required size allowing for proper clearances and to produce clean, straight edges with no chips, cracks or flaws; make cut outs and openings to locations and sized indicated on Drawings, and grind edges smooth round off corners.
- .2 Insulating Glass Units: Fabricate insulating glass units in accordance with ASTM E2190 and as required for IGMA certification in configurations indicated and as follows:
 - .1 Stainless Steel Capillary Tube: Provide stainless steel capillary breather tubes to equalize pressure differentials between insulating glass fabricating location and insulating glass installation location when required by manufacturer; seal tube immediately prior to installation in accordance with glass fabricator's written instructions.
 - .2 Manufacture insulating glass units without edge channels or tape with bare glass edges.
 - .3 Manufacture insulating glass units with gap space having a dimension appropriate for the throat dimension of receiving glass frame system.
 - .4 Install edge spacers so that they do not bow in or out more than 5 mm over full length of a side.

3. EXECUTION

3.01 EXAMINATION

- .1 Verification of Conditions: Verify that openings for glazing are correctly sized and within tolerance and confirm the following:
 - .1 Manufacturing and installation tolerances for framing system, including size, squareness and offsets at corners.
 - .2 Functional weep system is in place for exterior glass installation.

- .3 Minimum required face or edge clearances.
- .4 Effective sealing between joints of glass framing components.

.2 Proceed with installation of glass units only after unsatisfactory conditions are corrected.

3.02 PREPARATION

.1 Clean and prepare glazing rebates and confirm that they are smooth and true, free of projections and that fastenings are properly set to prevent contact with glass.

3.03 INSTALLATION

.1 Monolithic and Insulating Glass Units: Glaze glass into framing materials in accordance with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials listed in Related Requirements and as follows:

- .1 Requirements indicated within referenced glazing publications and standards that are more stringent than manufacturer's written instructions will govern in the case of conflict between this specification, manufacturer's instructions and referenced standards.
- .2 Install glass plumb, true, level and rigid.
- .3 Take measures to prevent warp or twist glass to prevent stress or breaking of glass seals.
- .4 Crimp capillary breather tube in accordance with fabricator's written instructions, and as follows:

- .1 Do not trim sealant from around base of tube.
- .2 Do not pull or attempt to remove the tube.
- .3 Crimp tube immediately prior to installing sealed unit by placing pliers perpendicular to tube 25 mm from end of tube.
- .4 Do not permit tube to be exposed to or sit in water.
- .5 Cover tube with stainless steel strip and set in sealant bead compatible with insulated glass sealants.

.2 Ceramic Fritted Glass and Glazing: Install decorative glass in accordance with GANA Glazing Manual and GANA Laminated Glazing Reference Manual, using glass manufacturer's recommended glazing materials and methods.

3.04 GLASS SCHEDULES

MONOLITHIC GLASS UNIT (MGU) SCHEDULE				
MGU Number	Glass Type	Thickness	Locations	Comments
MGU-1 (TG-1)	GL-3	10 mm	Unheated Waiting	Structural Glass Walls. Coordinate with Section 08 44 26
MGU-2	GL-5	6mm	WC (Washrooms)	Size as indicated in Section 10 28 13 – Toilet Accessories

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INSULATING GLASS UNIT (IGU) SCHEDULE									
IGU Number	Composition				Properties				
	Outside	Middle	Inside	Gas Fill 13 mm	U _{SI} Factor W/m ² -K	Shading Coefficient (SC)	Solar Heat Gain Coefficient (SHGC)	Visible Light Transmission (T _{vis})	Relative Heat Gain (RHG) W/m ²

IGU-2 (Clerestory)	GL-2 Low E	None	GL-4	90% Argon 10% Air	3.394	0.653	0.56	.058	494
IGU-3 (Structural Glass Walls)	GL-2 Low E	None	GL-3	90% Argon 10% Air					
IGU-4 (Structural Glass Walls)	GL-2 Low E	None	GL-4 Fritted Glass	90% Argon 10% Air					
IGU-5 (Entrance Doors)	GL2	None	GL-3	90% Argon 10% Air					
Not Used			GL-1	90% Argon 10% Air	1.38	0.34	0.29	0.65	225

These values were derived using LBNL WINDOW 7 Software and information available from the IGDB listings associated with the Basis-of-Design Products listed in the specification, and represent design values used to establish heating and cooling loads for the building.

Substitute materials from Additional Acceptable Manufacturers must show conformance with listed properties prior to purchasing materials.

Substitutions materials from Manufacturers no listed as an Additional Acceptable Manufacturer must submit request for acceptance prior to submitting Bid Price.

3.05 CLOSEOUT ACTIVITIES

- .1 Protection of Glass: Protect glass from damage immediately after installation using non-staining, non-permanent or temporary coverings held away from glass surfaces and as follows:
 - .1 Do not apply markers to glass surface.
 - .2 Remove non-permanent labels and protection immediately prior to declaration of Substantial Performance.
- .2 Protective Measures from Adjacent Work: Protect glass from contact with contaminating substances resulting from construction operations, including weld splatter:
 - .1 Remove deleterious substances immediately as recommended by glass manufacturer when contaminating substances come into contact with glass, despite provision of protective coverings.
 - .2 Schedule daily or weekly examination of glass surfaces adjacent to or below exterior concrete and other masonry surfaces during the progress of construction as appropriate to construction activities, or other such time period mutually agreeable to the Consultant, Contractor and Subcontractor, for buildup of dirt, scum, alkaline deposits, or stains; remove as recommended in writing by glass manufacturer.
 - .3 Remove and replace glass that is broken, chipped, cracked, or abraded or that is damaged from natural causes, accidents, and vandalism occurring during construction period.
- .3 Final Cleaning: Wash glass on both exposed surfaces in each area of Project a maximum of four (4) days in advance of site reviews leading up to Substantial Performance in accordance with Section 01 00 06 – General Requirements: Final Cleaning and written requirements for washing glass provided by glass manufacturer.

END OF SECTION

1. GENERAL**1.01 SUMMARY**

- .1 This Section includes requirements for supply and installation of interior gypsum board for partitions, ceilings and bulkheads, tile backing panels, interior ceiling and suspension systems, non-structural and structural steel stud framing.

1.02 DEFINITIONS

- .1 The following definitions apply to the Gypsum Board Assemblies specification:
- .2 Levels of Finish: Standard levels of finish defined by GA Manual apply to products of this Section as follows, and are used to designate required finish levels for indicated areas:
 - .1 Level 0: Not Used
 - .2 Level 1: Embed tape at joints in ceiling plenum areas, concealed areas, unless a higher level of finish is required for fire resistance rated assemblies and sound rated assemblies.
 - .3 Level 2: Embed tape and apply separate first coat of joint compound to tape, fasteners, and trim flanges where panels are substrate for tile.
 - .4 Level 3: Embed tape and apply separate first and finish coats of joint compound to tape, fasteners, and trim flanges at panel surfaces that will receive medium spray textured finishes prior to final painting.
 - .5 Level 4: Embed tape and apply separate first, fill, and finish coats of joint compound to tape, fasteners, and trim flanges at panel surfaces that will be exposed to view.
 - .6 Level 5: 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 having a length greater than 7500 mm or walls higher than 3600 mm.
- .3 Refer to ASTM C11 for definitions of terms for gypsum board assemblies not defined in this Section or in other referenced standards.

1.03 ADMINISTRATIVE REQUIREMENTS

- .1 Site Quality Control Coordination: Coordinate requirements for Quality Assurance Program (QAP) and arrange for site review and reporting of completed installation in accordance with the requirements listed in this Section.

1.02 DELIVERY, STORAGE AND HANDLING

- .1 Delivery and Acceptance Requirements: Deliver materials in original packages, containers, or bundles bearing brand name and identification of manufacturer or supplier:
 - .1 Deliver gypsum board to site as near to the time of installation as possible.
 - .2 Protect gypsum board from damage during transportation using weather tight coverings.
 - .3 Promptly remove shipping coverings once load is delivered and move to dry storage location.
- .2 Storage and Handling Requirements: Store materials inside under cover and kept dry and protected against damage from weather, direct sunlight, surface contamination, corrosion, construction traffic, and other causes:
 - .1 Protect gypsum board from water, condensation and other forms of moisture.
 - .2 Stack gypsum panels flat and on sufficient spacers to prevent sagging, and not in direct contact with floor surfaces.

- .3 Protection from Mould and Mildew: Protect gypsum board from conditions that have probability of inoculating or causing mould growth during transportation and delivery, storage and handling, and installation in accordance with Gypsum Association GA-238.

1.03 QUALITY ASSURANCE

- .1 Regulatory Requirements: Fire-resistance ratings described on the Drawings and within this Section are based on material contributions listed in the Building Code; provide materials and construction identical to those described in the listed assemblies, or provide proof of performance as evidenced through an independent testing and inspection agency for materials that differ showing identical or better performance acceptable to the Authorities Having Jurisdiction as follows:
 - .1 Fire-Resistance Rated Assemblies: Provide submittals for assembly solutions using manufacturer's proprietary products that are different than those listed on the Drawings.
 - .2 Type-X Gypsum Board: Type-X gypsum board forms the basis for generic fire-resistance ratings described on the Drawings; Type-C gypsum board may be acceptable provided that proof of performance for listed fire-resistance ratings are submitted showing that products have been tested in accordance with listed standards and form a assemblies described in ULC List of Equipment and Materials, Fire Resistance Ratings.
- .2 Site Quality Control: Arrange for; and include costs for, site review and reporting services during the course of the Work as provided by the Alberta Wall and Ceiling Association (AWCA) Quality Assurance Program (QAP) taking into account reasonable costs for travel and accommodation based on location of the Work.

1.04 SITE CONDITIONS

- .1 Ambient Conditions: Maintain room, surface and material within temperature range and for duration before, during and after application in accordance with ASTM C840 and manufacturer's written requirements.

2. PRODUCTS

2.01 MANUFACTURERS

- .1 Basis-of-Design Products: Products named in this Section were used as the basis-of-design for the project; manufacturers listed as additional Acceptable Products and that offer similar products may be incorporated into the work of this Section provided they meet the performance requirements established by the named products.
- .2 Acceptable Products Manufacturers: Subject to compliance with performance requirements specified in this Section, use any of the listed manufacturers' products in accordance with Section 01 00 06 – General Requirements: Substitutions and Product Options; following manufacturer's do not require submission of a request for substitutions provided required shop drawing and product data submissions are submitted before starting any work of Section:
 - .1 CertainTeed Gypsum of Canada
 - .2 CGC Interiors, A USG Company
 - .3 Georgia-Pacific Canada, Inc.
- .3 Acceptable Alternative Products Manufacturers: Subject to compliance with requirements specified in this Section, products listed as Acceptable Alternative Products can be used to establish the Bid Price in addition to Acceptable Products; Acceptable Alternative Products are not required to make a formal request for Substitutions as described below, provided that information supporting specified performance requirements are submitted prior to ordering materials during construction as a part of the Submittals review process.

- .4 Substitutions: Consultant may consider additional manufacturers having similar products to Acceptable Products and Acceptable Alternative Products during the construction period, provided they meet the performance requirements established by the named products and provided they submit requests for substitution in accordance with Section 01 00 06 – General Requirements: Substitutions and Product Options before starting any work of this Section:
 - .1 Do not use substitute materials to establish Bid Price.
 - .2 Substitutions that appear as a part of the project without review and acceptance by the Consultant will be rejected, and replaced with systems using specified materials.

2.02 PERFORMANCE REQUIREMENTS

- .1 Fire Test Response Characteristics: Refer to Section 07 05 53; use materials identical to those listed for ULC assemblies submitted to Consultant for information submittals.
- .2 Mould Resistance: Gypsum Board tested in accordance with ASTM C1396 must have mould resistant facers meeting a rating of 8 or better, showing a maximum of 20% growth based on surface area coverage in accordance with ASTM D3273.
- .3 Suspended Ceiling Fasteners: Provide fasteners having a minimum capacity of 890 N in tension for vertical loading conditions, a minimum capacity of 1960 N in tension and angular and bracing conditions, and as follows:
 - .1 Steel Roof Decking Anchors: Attachment of suspended ceiling systems directly to steel roof decking is not permitted.
 - .2 Steel Structure Fasteners and Anchors: Provide attachment devices having five (5) times design load indicated in ASTM C635, Table 1, Direct Hung, having corrosion protection for moderate service conditions, with holes or loops for attaching hangers having capacity to sustain ceiling loads as indicated in above, selected from one of the following types:
 - .1 Post Installed expansion anchors
 - .2 Chemical anchors

2.03 SUSPENDED CEILING MATERIALS

- .1 Suspended Gypsum Board Ceiling Framed System: Provide components and materials in accordance with ASTM C754 for interior conditions as indicated on Drawings, and as follows:
 - .1 Tie Wire: ASTM A641 Class 1 zinc coating, soft temper, No. 18 gauge wire.
 - .2 Ceiling Hangers:
 - .1 Wire Hangers: ASTM A641, Class 1 zinc coating, soft temper, No. 8 gauge.
 - .2 Rod Hangers: ASTM A510, mild carbon steel; 5 mm Ø minimum; ASTM A153, hot dip galvanized.
 - .3 Flat Hangers: Commercial steel sheet, ASTM A653, Z120, hot dip galvanized; 5 mm x 25 mm x length required.
 - .4 Angle Hangers: ASTM A653, Z120, hot dip galvanized commercial steel sheet; 0.80 mm minimum core metal thickness; 22 mm x 35 mm minimum.
 - .3 Carrying Channels: Cold rolled, commercial steel sheet with a core metal thickness of 1.2 mm x 13 mm minimum wide flange, with ASTM A653, Z120, hot dip galvanized zinc coating; 38 mm minimum depth.
 - .4 Furring Channels: Commercial steel sheet with ASTM A653, Z120, hot dip galvanized zinc coating, as follows:
 - .1 Hat Shaped, Rigid Furring Channels: ASTM C645, 0.45 mm core metal thickness x 22 mm deep.

- .2 Resilient Furring Channels: 13 mm deep members designed to reduce sound transmission having asymmetrical face attached to single flange by a slotted leg (web).
- .2 Ceiling Attachment Devices: Provide anchors and fasteners sized and spaced in accordance with performance requirements indicated above and as required by manufacturer of ceiling suspension components and as follows:
- .1 Rod and Flat Hangers: Mild steel, zinc coated.
- .2 Angle Hangers: Minimum 22 mm x 22 mm x 1 mm thick angles, Z275 (G90) galvanized steel sheet in accordance with ASTM A653; bolted connections using 8 mm Ø bolts.
- 2.04 NON-STRUCTURAL PARTITION FRAMING MATERIALS
- .1 Steel Partition Framing: Provide components and materials in accordance with ASTM C754, modified with CSSBI recommended wall height limitations for non-composite wall construction listed in Lightweight Steel Framing Architectural Design Guide for interior non-load bearing partitions and conditions indicated on Drawings, and as follows:
- .1 Nominal Core metal thickness: Based on stud depth as indicated on drawings and as follows:
- .1 Standard Assemblies up to 3.6 m high: Thickness based on L/240 with 360 Pa loading.
- .2 Tall Assemblies greater than 3.6 m to a maximum of 4.8 m high: Thickness based on L/240 with 360 Pa loading
- .3 Assemblies greater than 4.8 m high: Thickness based on L/240 with 480 Pa loading.
- .2 Exceptions: Based on stud depth as indicated on drawings and as follows:
- .1 Framing Supporting Fire Rated Doors and Frames: Use 0.80 mm nominal core metal thickness or greater as required by wall height.
- .2 Interior Demising Assemblies: Use wind-load bearing steel framing, thickness based on L/360 with 480Pa.
- .2 Steel Sheet Components, Steel Studs and Runners: In accordance with ASTM C645 requirements for metal and with ASTM A653, Z120, hot dip galvanized zinc coating and as follows:
- .1 Runners: Width, nominal thickness and galvanizing to match steel studs, and as follows:
- .1 Slotted Deflection Track: Premanufactured slotted top runner with 63 mm down standing legs and having 6 mm wide x 38 mm high slots spaced at 25 mm o/c along length of runner; tested and certified for use in fire rated wall construction and have a ULC or _cUL_{US} labelled assembly for fire rated assemblies:
- Acceptable Products:
 - ∞ Bailey Metal Products Slotted Stud
 - ∞ Brady Construction Innovations, SliptrackSystems
 - ∞ Cemco CMT Slotted Track
 - ∞ ClarkDietrich Building Systems Metal Framing, SLP-TRK
 - ∞ SCAFCO Slotted Track
 - ∞ Steel Form Slotted Track
 - ∞ Steeler Inc. Slotted Stud System
- .2 Base Runner: Bottom track with 33 mm upstanding legs.

- .2 Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated; 1.2 mm nominal core metal thickness x 406 mm wide.
- .3 Horizontal Cross Bracing: 1.2 mm nominal core metal thickness; 13 mm minimum width flange x 38 mm minimum depth.
- .4 Clip Angle: 38 mm x 38 mm x 1.8 mm nominal core metal thickness.
- .5 Furring Channels: Commercial steel sheet with ASTM A653, Z120, hot dip galvanized zinc coating, as follows:
 - .1 Hat Shaped, Rigid Furring Channels: ASTM C645, 0.80 mm nominal core metal thickness x 22 mm deep.
 - .2 Resilient Furring Channels: 0.45 mm nominal thickness x 13 mm deep members designed to reduce sound transmission having asymmetrical face attached to single flange by a slotted leg (web).
- .6 Fasteners for Metal Framing: Type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.

2.05 STRUCTURAL PARTITION FRAMING MATERIALS

- .1 Heavy Gauge Interior Partition Framing: Steel stud framing for walls supporting cementitious backer board and walls supporting fire rated doors and frames, and as follows:
 - .1 Cold Formed Sheet Steel: Provide commercial steel sheet interior members; not forming a part of the exterior building envelope, having a minimum ASTM A653/A653M, Z180, hot dip galvanized zinc coating, thickness of framing members exclusive of galvanized coating.
 - .2 Studs: Meeting requirements of CSA S136; identified for type, grade and mechanical properties; minimum 92 mm deep x 38 mm wide x metal core nominal thickness 0.80 mm spaced at 406 mm on centre, hot dipped galvanized steel; roll formed with knurled flanges, services and bracing cut outs.
 - .3 Track: Meeting requirements of CSA S136 having minimum metal core nominal thickness 0.80 mm, hot dipped galvanized steel and as follows:
 - .1 Top track flanges of depth to suit vertical deflection; do not fix top of studs to track; width to suit studs; single top track system.
 - .2 Floor track to suit stud width, with 33 mm flanges.
 - .4 Channel Stiffener: 19 mm cold rolled channel of 1.2 mm, electro-galvanized steel.
 - .5 Fasteners:
 - .1 Stud-to-Stud: Steel, self-drilling, self-threading, and case hardened.
 - Material: stainless steel or steel with minimum 0.008 mm cadmium or zinc coating.
 - Head Profile: hex, pan, and low profile type.
 - Length: adequate to penetrate not less than 3 fully exposed threads beyond joined materials.
 - .2 Track-to-Concrete: Hilti drilled insert, sizes as specified; do not use powder actuated fasteners.
 - .3 Track-to-Steel: Secure track to structural steel over 8 mm nominal thickness using Hilti DX fastening system with X-EDNI nails as specified. Provide additional steel back up above interstitial steel deck for wall support.
 - .4 Drilled Inserts: Steel, cadmium plated or hot dip galvanized, sizes as indicated on drawings.
 - .6 Bolts and Nuts: Meeting requirements of ASTM A307, with large flat type steel washers, sized to suit fasteners, hot dip galvanized, 415 MPa Tensile Strength.

- .7 Welding Electrodes: Minimum tensile strength series of 480 MPa, suitable for material being welded.
- .8 Touch-Up Paint: Zinc rich, to CAN/CGSB 1.181.

2.06 GYPSUM MATERIALS

- .1 Panel Sizes: Provide gypsum panels in maximum lengths and widths available that minimize joints in each area and correspond with support system as indicated on drawings, with long edges tapered and using thicknesses indicated on Drawings.
- .2 Gypsum Core: Provide gypsum panels having gypsum core manufactured from recycled gypsum from post-industrial and post-consumer sources, and synthetic gypsum sourced from flue-gas desulfurization to the greatest extent possible to minimize use of natural (mined) gypsum.
- .3 Regular Gypsum Board: Meeting requirements of ASTM C1396M and as follows:
 - .1 Acceptable Products:
 - .1 CertainTeed, Regular Gypsum Board
 - .2 CGC, Sheetrock Gypsum Panels
 - .3 Georgia-Pacific, ToughRock Gypsum Board
 - .2 Acceptable Alternative Products: Use any of the following regular gypsum board products instead of the standard weight products listed above at Contractor's choice:
 - .1 CertainTeed, Easi-Lite Lightweight Gypsum Board
 - .2 CGC, Sheetrock Ultralight Gypsum Panels
 - .3 Georgia-Pacific, Lite-Weight Drywall
- .4 Fire Resistant Gypsum Board: Meeting requirements of ASTM C1396M and having maximum surface burning characteristics of FS-25/SD-5 in accordance with CAN/ULC S102 and as follows:
 - .1 Acceptable Products:
 - .1 CertainTeed, CertainTeed Type-X Gypsum Board
 - .2 CGC, Sheetrock Firecode X
 - .3 Georgia-Pacific, Toughrock Fireguard X
 - .2 Acceptable Alternative Products: Use any of the following fire-rated products instead of the standard Type-X products listed above at Contractor's choice, provided supporting information is submitted showing acceptable fire-resistance ratings and acoustic performance required for the project:
 - .1 CertainTeed, CertainTeed Type-C Gypsum Board
 - .2 CGC, Sheetrock Firecode C
 - .3 Georgia-Pacific, Toughrock Fireguard C
- .5 Span-Rated Ceiling Gypsum Board: Meeting requirements of ASTM C1396M; manufactured to have better sag resistance than regular type gypsum board and as follows:
 - .1 Acceptable Products:
 - .1 CertainTeed, Easi-Lite Interior Ceiling Board
 - .2 CGC Sheetrock, Ultralight Interior Ceiling Board
 - .3 Georgia-Pacific, ToughRock Span 24 Ceiling Board

- .6 Paper Faced Moisture and Mould Resistant Gypsum Board: Paper faced, microbial treated, water resistant gypsum board meeting requirements of ASTM C1396; having water resistance 5% or less after a 2 hour immersion in accordance with ASTM C473 and mould resistant facers meeting a rating of 10 (zero mould growth) in accordance with ASTM D3273; and as follows:
- .1 Fire Rating: Use Type-X moisture and mould resistant gypsum board when assembly requires fire rating.
 - .2 Acceptable Products:
 - .1 CertainTeed, M2Tech Gypsum Board
 - .2 CGC, Sheetrock Mold Tough
 - .3 Georgia-Pacific, ToughRock Mold-Guard Gypsum Board
- .7 Glass Mat Faced Mould Resistant Gypsum Panels: Glass mat faced gypsum board meeting requirements of ASTM C1658 with mould resistant facers meeting a rating of 10 (zero mould growth) in accordance with ASTM D3273; and as follows:
- .1 Fire Rating: Use Type-X moisture and mould resistant gypsum board when assembly requires fire rating.
 - .2 Acceptable Products:
 - .1 CGC, Sheetrock Mold Tough Glass-Mat Panels
 - .2 Georgia-Pacific, DenseArmor Plus
- .8 Tile Backer Gypsum Panels: Glass mat faced gypsum board meeting requirements of ASTM C1178 with mould resistant facers meeting a rating of 10 (zero mould growth) in accordance with ASTM D3273; and as follows:
- .1 Fire Rating: Use Type-X tile backer gypsum board when assembly requires fire rating.
 - .2 Acceptable Products:
 - .1 CertainTeed, Diamondback GlasRoc Tile Backer
 - .2 CGC, Durock Glass-Mat Tile Backerboard
 - .3 Georgia-Pacific, DensShield Tile Backer
- .9 Cementitious Backer Board: Reinforced portland cement board, reinforcing mesh embedded near both faces in accordance with ANSI A118.9 and as follows:
- .1 Acceptable Products:
 - .1 CGC, Durock Next Gen Cement Board
 - .2 Custom Building Products Ltd., Wonderboard Lite

2.07 ACCESSORIES

- .1 Joint Tape: To ASTM C475, Type as recommended by gypsum board manufacturer for type of installation; use only mould resistant materials for mould and moisture resistant materials.
- .2 Joint Treatment Materials for Gypsum Board: Provide joint compound and accessory materials in accordance with ASTM C475; for each coat use formulation that is compatible with other compounds applied on previous or for successive coats, and as follows:
 - .1 Pre-Filling: Setting type taping compound.
 - .2 Embedding and First Coat: Drying Type-Compound.
 - .3 Fill Coat: Drying Type-Compound.
 - .4 Finish Coat: Drying type, sandable topping compound.
 - .5 Skim Coat: Drying type, sandable topping compound.

- .3 Joint Compound for Interior Mould and Moisture Resistant Gypsum Board: Provide joint compound and accessory materials in accordance with ASTM C475; for each coat use formulation that is compatible with other compounds applied on previous or for successive coats and as follows:
- .1 Pre-Filling: Setting type joint compound.
 - .2 Embedding and First Coat: Setting type joint compound.
 - .3 Fill Coat: Setting type, sandable topping compound.
 - .4 Skim Coat: Setting type joint compound, sandable topping compound.
- .4 Trim Caps: Prefabricated extruded aluminum, end-of-wall mounting mullion trim cap, incorporating fire and acoustically rated sound absorbing foam and compressible foam seal from edge of extrusion to interior face of glass lite and as follows:
- .1 Basis-of-Design Products: MULL-it-OVER Products, Mullion Trim Cap with Clear Anodized Anodized to match storefront finish.
- .5 Interior Trim: Galvanized coated steel sheet or rolled zinc meeting the requirements of ASTM C1047, in the following shapes:
- .1 CB Corner Bead: Standard 0.40 mm nominal thickness, corrosion resistant outside corner reinforcements, angle to suit installation.
 - .2 Reinforced Corner Bead: Heavy duty 0.45 mm nominal thickness, corrosion resistant outside corner reinforcements for use at high exposure corners, angle to suit installation.
 - .3 LC Edge Bead: U-shaped trim 0.40 mm nominal thickness to provide a clean finished edge; exposed long flange receives joint compound; use at exposed panel edges, and returns to adjacent materials.
 - .4 Expansion Joints: Back-to-back edge beads at joints spanning building expansion and movement joints.
 - .5 Control Joints: V-shaped trim having strippable joint protection specifically manufactured to provide thermal stress relief to large ceiling and wall areas; confirm locations with Consultant before installation.
 - .6 Strippable Edge Trim: Extruded PVC with pre-masked L-shaped tape on trim with tear away protective serrated strip for removal after compound and paint is applied, for use at areas where gypsum butts aluminum frames and where gypsum butts concrete or concrete block.
 - .7 Acceptable Products:
 - .1 ClarkDietrich Building Systems, Metal Trims and Finishing Products
 - .2 Other materials may be acceptable provided information is submitted to and accepted by the Consultant prior to installation.
- .6 Aluminum Trim: Extruded accessories of profiles and dimensions indicated:
- .1 Aluminum: Alloy and temper with not less than the strength and durability properties of ASTM B221 alloy 6063-T5.
 - .2 Finish: Clear anodized compatible with joint compound and finish materials.
 - .3 Profiles:
 - .1 Reveals R1: 25 mm wide x 13 mm deep.
 - .2 Reveals R2: 19 mm wide x 13 mm deep.
 - .3 Reveals R3: 6 mm wide x 13 mm deep.
 - .4 Additional profiles and configurations as indicated on Drawings.
 - .4 Acceptable Products:
 - .1 Fry Reglet Corporation
 - .2 Gordon Inc.
 - .3 Pittcon Industries

2.08 ACOUSTIC MATERIALS

- .1 Coordinate placement of acoustic materials with wall assembly types.
- .2 Acoustic Sealants for Fire Rated Assemblies: Use only fire rated materials as final seal in fire rated assemblies; apply acoustic sealants prior application of fire seals; fire seal materials are specified in Section 07 84 00.
- .3 Acoustic Sealants for Smoke Rated Assemblies: Lightweight low trigger resistance, non-sag, smooth surface finishing smoke and acoustic sealant in accordance with ASTM C834 and as follows:
 - .1 Basis-of-Design Products: Hilti, CP 506 Smoke and Acoustic Sealant
- .4 Acoustic Sealant for Exposed Joints: Lightweight low trigger resistance, non-sag, paintable, non-staining, latex sealant in accordance with ASTM C834 that effectively reduces airborne sound transmission through perimeter joints and openings in building construction:
 - .1 Basis-of-Design Products: Pecora Corp., AC-20 FTR Acoustic and Insulation Sealant.
- .5 Acoustic Sealant for Concealed Joints: Lightweight low trigger resistance, non-drying, non-hardening, non-skinning, non-staining, gunnable, synthetic rubber sealant recommended for sealing interior concealed joints to reduce airborne sound transmission:
 - .1 Acceptable Products:
 - .1 Pecora Corp., BA-98
 - .2 Tremco, Acoustical Sealant

2.09 AUXILIARY MATERIALS

- .1 Provide auxiliary materials in accordance with referenced installation standards and manufacturer's written recommendations.
- .2 Steel Drill Screws: ASTM C1002, unless otherwise indicated, except use screws in accordance with ASTM C954 for fastening panels to steel members from 0.80 mm to 2.67 mm nominal core metal thickness, and as follows:
 - .1 Type S: Shallow pitch screw; used for single layer gypsum board application.
 - .2 Type G: Steep pitch screw; used for double layer gypsum board application.
- .3 Isolation Strip at Exterior Walls: Adhesive backed, closed cell vinyl foam strips that allow fastener penetration without foam displacement, 3 mm thick, in width to suit steel stud size.
- .4 Access Panels: Refer to Section 08 31 00, rated to suit wall or ceiling fire rating.

3. EXECUTION**3.01 EXAMINATION**

- .1 Verify that wall components and substrates; including welded hollow steel frames, cast in anchors and structural framing and other conditions affecting installation, are satisfactory before starting installation.
 - .1 Proceed with installation only after unsatisfactory conditions are corrected.

3.02 PREPARATION

- .1 Mould Prevention: Do not install gypsum panels that are wet, that have been damaged by moisture, or that have evidence of mould growth such as fuzzy surfaces or dark splotchy surfaces and discolouration:
 - .1 Keep gypsum board dry throughout installation.
 - .2 Do not install gypsum board over other building materials where conditions exist that are favourable to mould growth.
 - .3 Install gypsum board installed on walls with a minimum 6 mm gap between bottom edge of panel and floor surface.
- .2 Suspended Ceilings: Coordinate installation of ceiling suspension systems with installation of overhead structure and verify that inserts and other provisions for anchorages to building structure have been installed to receive ceiling hangers at spacing required to support ceilings and that hangers will develop their full strength and as follows:
 - .1 Provide inserts and other devices indicated to other trades for installation in advance of time needed for coordination and construction where concrete inserts are required.
- .3 Spray Applied Cementitious Fire Rating Materials: Coordinate with sprayed fire resistive materials specified in Section 07 81 00 and as follows:
 - .1 Install gypsum board assemblies to the greatest extent possible before application of spray applied fire rating materials.
 - .2 Attach offset anchor plates or ceiling runners (tracks) to surfaces indicated to receive sprayed on fire resistive materials before sprayed fire resistive materials are applied.
 - .3 Provide continuous plates fastened to building structure not more than 610 mm o/c where offset anchor plates are required.
 - .4 After sprayed fire resistive materials are applied, remove them only to extent necessary for installation of gypsum board assemblies and without reducing the fire resistive material thickness below that required to obtain fire resistance rating indicated. Protect remaining fire resistive materials from damage.
- .4 Access Panels and Doors: Coordinate access panels and wall types with materials specified in Section 08 31 00 and as follows:
 - .1 Coordinate with Mechanical and Electrical for locations and size requirements of access panels.
 - .2 Coordinate and confirm location of access panels before installation with Consultant.
 - .3 Install specified materials in accordance with material manufacturer's written instructions.
- .5 Fire Rated Construction: Install materials forming a part of fire rated construction in accordance with manufacturer's instructions and as required by specific ULC listed construction requirements submitted by Contractor:
 - .1 Install fire rated gypsum wall panels vertically; horizontal installation does not meet testing standard unless horizontal blocking is installed behind horizontal joints.
 - .2 Install fire rated sealants after application of acoustic sealing materials, coordinate joint configuration with manufacturers ULC installation requirements.
- .6 Cold Weather Application of Gypsum Board: Install gypsum board and joint compound in accordance with GA requirements and manufacturer's instructions, and as follows:
 - .1 Provide temporary heat and moisture control for a period sufficiently in advance of gypsum board and joint compound application to allow building and substrates to acclimate to installation temperature and moisture range required by manufacturer.
 - .2 Maintain temporary heat until permanent building heating system is started and continuously running.

- .3 Provide suitable ventilation to allow materials to dry properly; prevent excessive air movement that could dry materials too quickly and that could cause shrinkage cracking.

3.03 INSTALLATION OF STEEL CEILING FRAMING

- .1 Suspended Ceiling Steel Framing: Suspend ceiling hangers from building structure in Install ceiling suspension system in accordance with ASTM C636 and as follows:

3.04 INSTALLATION OF STEEL PARTITION FRAMING

- .1 Installation Standards: ASTM C754, and ASTM C840 requirements that apply to framing installation.
- .2 Install supplementary framing, blocking, and bracing at terminations in gypsum board assemblies to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction in accordance with details indicated and with gypsum board manufacturer's written recommendations or, if none available, with GA, Specification Standards Manual.
- .3 Isolate steel framing from building structure at locations indicated to prevent transfer of loading imposed by structural movement, and as follows:
 - .1 Isolate ceiling assemblies where they abut or are penetrated by building structure.
 - .2 Isolate partition framing and wall furring where it abuts structure, except at floor.
 - .3 Install deflection track at head of assemblies that avoid axial loading of assembly and laterally support assembly, as follows:
 - .1 Non-rated Assemblies: Install deep leg deflection track.
 - .2 Fire Rated Assemblies: Install slotted deflection track.
- .4 Do not bridge building control and expansion joints with steel framing or furring members. Frame both sides of joints independently.
- .5 Installing Steel Partition Framing: Install tracks (runners) at floors, ceilings, and structural walls and columns where gypsum board assemblies abut other construction:
 - .1 Install foam gasket isolation strip between studs where studs are installed directly against exterior walls.
 - .2 Fasten to concrete with expansion anchors, shielded screws not exceeding 600 mm o/c. Do not use powder activated fasteners.
 - .3 Install each steel framing and furring member so fastening surfaces vary not more than 3 mm from the plane formed by the faces of adjacent framing.
 - .4 Extend partition framing full height to structural supports or substrates above suspended ceilings, except where partitions are indicated to terminate at suspended ceilings. Continue framing over frames for doors and openings and frame around ducts penetrating partitions above ceiling to provide support for gypsum board:
 - .1 Cut studs 13 mm short of full height to provide perimeter relief.
 - .2 Install framing around structural and other members extending below floor slabs and roof decks, as needed to support gypsum board closures and to make partitions continuous from floor to underside of solid structure for fire resistance rated and STC rated partitions that extend to the underside of floor slabs and roof decks or other continuous solid structure surfaces.
 - .3 Terminate partition framing at suspended ceilings where indicated.
 - .5 Install steel studs so flanges point in the same direction and leading edge or end of each panel can be attached to open (unsupported) edges of stud flanges first.
 - .6 Install horizontal cross bracing to steel studs at 1220 mm o/c vertically for the entire length of wall for unbraced walls exceeding 3660 mm in length.

- .7 Frame door openings using 0.80 mm core metal thickness steel studs and in accordance with gypsum board manufacturer's applicable written recommendations:
 - .1 Screw vertical studs at jambs to jamb anchor clips on door frame; install runner track section (for cripple studs) at head and secure to jamb studs.
 - .2 Install two studs at each jamb, connected for entire length.
 - .3 Extend jamb studs through suspended ceilings and attach to underside of floor or roof structure above.
- .8 Frame openings other than door openings the same as required for door openings. Install framing below sills of openings to match framing required above door heads.
- .9 Install double row of resilient channels in sound and fire rated assemblies at long and short (butt) edges of gypsum board panels, and provide a minimum of 38 mm from edge of panel to screw location; coordinate screw installation with other requirements of this Section.

3.05 INSTALLATION OF JOINTS AND TRIMS

- .1 Form control joints to account for thermal movements, to account for movement where direction of framing changes direction, and movements arising differing substrate materials using V-Shaped trims by framing back-to-back framing members and a break in gypsum panel at a maximum of 7.5 metres o/c, as follows:

- .1 Install control joints in wall and ceiling construction in accordance with ASTM C840 so that gross area enclosed by joints does not exceed 80 m² between joints using limiting distances as follows:

Partition Type	Maximum Single Dimension
Interior Partitions	9 metres
Interior Ceilings with Perimeter Relief	15 metres
Interior Ceilings without Perimeter Relief	9 metres

- .2 Lay out control joints to coincide as far as possible with door, window or screen frames, but not necessarily to occur at every individual frame; install control joints vertically from corners of openings.
 - .3 Install additional control joints at locations required for architectural or design accents as indicated on Drawings.
 - .4 Provide continuous dust barrier behind joints.
 - .5 Install joints straight and true.
 - .6 Form control joints to meet sound rated construction and fire ratings required for remainder of wall or ceiling construction.
 - .7 Obtain Consultant's acceptance of control joint layout before starting installation of materials specified in this Section.
- .2 Form expansion joints to account for building movements using back-to-back framing members and edge trims, and a break in gypsum panel over structural movement joints and floor slab control joints as follows:
 - .1 Install expansion joints incorporating continuous air and vapour membranes and with sufficient gap to allow for projected building movements.
 - .2 Seal back-to-back edge bead control joints with clear silicone sealant as specified in Section 07 92 00.
 - .3 Provide continuous dust barrier behind joints.
 - .4 Install joints straight and true.

- .5 Form expansion joints to meet sound rated construction and fire ratings required for remainder of wall or ceiling construction.

3.06 INSTALLATION OF PANELS

- .1 Gypsum Board Application and Finishing Standards: ASTM C840 and generally at the following locations and as indicated on Drawings:
 - .1 Regular Type: Vertical surfaces not subject to wetting.
 - .2 Fire Resistant Type: Where required for fire resistance rated assemblies; fire resistant description can modify any of the following gypsum board types.
 - .3 Sag Resistant Type: Overhead and horizontal surfaces not subject to wetting.
 - .4 Mould and Moisture Resistant Type: Vertical and horizontal surfaces subject to wetting.
- .2 Panel Application Methods: Install in accordance with referenced standards and as follows:
 - .1 Single Layer Application:
 - .1 On ceilings, apply gypsum panels before wall/partition board application to the greatest extent possible and at right angles to framing.
 - .2 On partitions, apply gypsum panels vertically (parallel to framing), unless horizontal application is indicated or otherwise required by fire resistance rated assembly, and to minimize end joints.
 - .3 Stagger abutting end joints not less than one framing member in alternate courses of board.
 - .4 At stairwells and other high walls, install panels horizontally, unless otherwise indicated or required by fire resistance rated assembly.
 - .5 Apply gypsum panels to supports using Type S screws fastened 10 mm from edges of board.
 - .3 Install ceiling board panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in the central area of each ceiling; stagger abutting end joints of adjacent panels not less than one framing member spacing.
 - .4 Install gypsum panels with face side out; butt panels together for a light contact at edges and ends with not more than 1.5 mm of open space between panels; do not force into place.
 - .5 Locate edge and end joints over supports:
 - .1 Do not place tapered edges against cut edges or ends.
 - .2 Stagger vertical joints on opposite sides of partitions.
 - .3 Do not make joints other than control joints at corners of framed openings.
 - .4 Stop gypsum board away from underside of roof deck to allow for deflection of structure.
 - .5 Attach gypsum board to vertical studs, not to ceiling track, to allow for deflection.
 - .6 Attach gypsum panels to steel studs so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.
 - .7 Attach gypsum panels to framing provided at openings and cut outs.
 - .8 Cover both faces of steel stud partition framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally:
 - .1 Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 0.7 m² in area.
 - .2 Fit gypsum panels around ducts, pipes, and conduits.

- .3 Cut gypsum panels to fit profile formed by coffers, joists, and other structural members where partitions intersect open concrete coffers, concrete joists, and other structural members projecting below underside of floor/roof slabs and decks; allow 6 mm to 10 mm wide joints to install sealant.
 - .9 Isolate perimeter of non-load bearing gypsum board partitions at structural abutments, except floors. Provide 6 mm to 13 mm wide spaces at these locations, and trim edges with J-bead edge trim where edges of gypsum panels are exposed. Seal joints between edges and abutting structural surfaces with acoustic sealant.
 - .10 Space fasteners in gypsum panels according to referenced gypsum board application and finishing standard and manufacturer's written recommendations, and as follows:
 - .1 Space screws a maximum of 300 mm o/c for vertical applications.
 - .2 Space fasteners in panels that are tile substrates a maximum of 200 mm o/c.
 - .11 Install fire rated and labelled gypsum board at all locations indicated on Drawings; continue fire and smoke rated wall construction behind and around fire hose cabinet recesses and other recessed items larger than a double gang switch box to maintain wall fire rating:
 - .1 Place self-adhering labels or apply stencilled and painting assembly identification in accordance with Section 07 05 53.
 - .12 Tile Backing Panels:
 - .1 Install standard gypsum board panels in areas not subject to wetting to produce a flat surface.
 - .2 Install mould resistant gypsum board in all washrooms and housekeeping rooms.
 - .3 Shim surfaces to produce a uniform plane across panel surfaces where tile backing panels abut other types of panels in the same plane.
 - .13 Finishing Gypsum Board Assemblies:
 - .1 Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.
 - .2 Pre-fill open joints, rounded or bevelled edges, and damaged surface areas.
 - .3 Apply joint tape over gypsum board joints, except those with trim having flanges not intended for tape.
 - .4 Mould Resistant Gypsum Board: Do not tape or fill joints in mould resistant gypsum board used as a substrate for ceramic tile.
- 3.07 INSTALLATION OF FIRE RATING SEALANT
- .1 Seal fire rated partitions strictly in accordance with fire sealant manufacturer's instructions for specific fire rating requirements listed; coordinate with Section 07 84 00.
 - .2 Locate sealant so that it is covered at completion of partition when finishes applied.
 - .3 Seal around mechanical and electrical work and other work in wall to maintain proper fire rating.
- 3.08 INSTALLATION OF ACCESS PANELS
- .1 Install access panels in wall assemblies to maintain fire rating of assembly.
 - .2 Confirm location of access panels with the Consultant before installation.
 - .3 Minor adjustments to location within wall system may be required where panel interferes with architectural appearance.

3.09 INSTALLATION OF TRIM ACCESSORIES

- .1 For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.
- .2 Control Joints: Install control joints at locations indicated on Drawings, confirm locations of joints with Consultant before construction, and in accordance with ASTM C840 and in specific locations approved by Consultant for visual effect where joints are not otherwise indicated.
- .3 Reveals: Cut vertical trims and casing beads at horizontal reveal locations, and install horizontal reveals continuous around corners and edges.

3.10 SITE QUALITY CONTROL

- .1 Quality Assurance Program: Provide AWCA QAP review and report in accordance with Section 01 00 06 – General Requirements: Record Documents and as follows:
 - .1 Work of this Project will be subject to the AWCA Quality Assurance Program review and reporting service and will be visited by an AWCA approved and appointed expert.
 - .2 Gypsum board installation will be reviewed on completion of the work of this Section; inspector will make recommendations based on the referenced standards and workmanship quality established by AWCA.
 - .3 AWCA reviewer will submit report to Consultant indicating any work that requires replacement, rework or refinishing; Consultant will direct Contractor to make corrections identified in the report at no additional cost to the Owner.
 - .4 Include costs for AWCA QAP as a part of the price for this Project.
- .2 Above Ceiling Observation: Before installing gypsum board ceilings, Consultant will conduct an above ceiling observation and report deficiencies in the Work observed. Do not proceed with installation of gypsum board to ceiling support framing until deficiencies have been corrected:
 - .1 Notify Consultant seven (7) working days in advance of date and time when Project, or part of Project, will be ready for above ceiling observation.
 - .2 Before notifying Consultant, complete the following in areas to receive gypsum board ceilings:
 - .1 Installation of 80% of lighting fixtures, powered for operation
 - .2 Installation, insulation, and leak and pressure testing of water piping systems
 - .3 Installation of air duct systems
 - .4 Installation of air devices
 - .5 Installation of mechanical system control air tubing
 - .6 Installation of ceiling support framing
- .3 Owner's Quality Audit for Ceiling Suspension and Partition Anchorage Components: Owner may engage; at their option, a qualified independent testing agency in accordance Section 01 00 06 – General Requirements: Quality Control to perform site testing for the following during successive stages in areas described below:
 - .1 Proceed with installation of suspended ceilings and partitions only after test results for previously installed hangers and anchors comply with requirements.
 - .2 Tests will be performed when installation of ceiling grid or wall framing on each floor has reached 20% completion with no gypsum board installed as follows:
 - .1 One of every 10 post installed anchors used to attach hangers to concrete and test them for 890 N of tension.
 - .2 One of every two post installed anchors used to attach bracing wires to concrete and test them for 1960 N of tension.

- .3 Testing agency will test those anchors not previously tested until 20 consecutively pass and then will resume initial testing frequency when testing discovers fasteners and anchors that do not comply with requirements.
- .3 Testing agency will report test results promptly and in writing to Contractor and Consultant.
- .4 Non-Conforming Work: Remove and replace fasteners and anchors that test results indicate do not comply with specified requirements; additional testing will be performed to determine compliance with specified requirements where fasteners and anchors are removed and replaced.

3.11 CLOSEOUT ACTIVITIES

- .1 Cleaning: Clean exposed surfaces of acoustic panel ceilings, including trim, edge mouldings, and suspension system members in accordance with manufacturer's instructions.
- .2 Repairs: Touch-up minor damage to finishes in accordance with manufacturer's instructions; remove and replace ceiling components that cannot be successfully cleaned and repaired.

END OF SECTION

1. GENERAL**1.01 SUMMARY**

- .1 This Section includes requirements for supply and installation of the following:
 - .1 Porcelain tile
 - .2 Ceramic tile
 - .3 Wall tile
 - .4 Cementitious backer boards
 - .5 Tile setting accessories including movement joints and other accessories required for a complete and finished installation

1.02 REFERENCE STANDARDS

- .1 American National Standards Institute/Ceramic Tile Institute (ANSI/CTI):
 - .1 ANSI A108/A118/A136.1-2017, Specification for the Installation of Ceramic Tile
 - .2 ANSI A137.1-2017, Specification for Ceramic Tile
- .2 American Society for Testing and Materials (ASTM):
 - .1 ASTM A82/A82M-07, Standard Specification for Steel Wire, Plain, for Concrete Reinforcement
 - .2 ASTM A185/A185M-07, Standard Specification for Steel Welded Wire Fabric, Plain, for Concrete Reinforcement
 - .3 ASTM C627-18, Standard Test Method for Evaluating Ceramic Floor Tile Installation Systems Using the Robinson-Type Floor Tester
 - .4 ASTM C847-14a, Standard Specification for Metal Lath
 - .5 ASTM C920-18, Standard Specification for Elastomeric Joint Sealants
 - .6 ASTM C1178/C1178M-18, Standard Specification for Coated Glass Mat Water-Resistant Gypsum Backing Panel
 - .7 ASTM C1658/C1658M-13, Standard Specification for Glass Mat Gypsum Panels
 - .8 ASTM D3273-12e1, Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber
 - .9 ASTM E84-12c, Standard Test Method for Surface Burning Characteristics of Building Materials
- .3 Canadian Standards Association (CSA Group):
 - .1 CSA A3000-08, Cementitious Materials Compendium
 - .2 CSA B79-08(R2013), Commercial and Residential Drains and Cleanouts
- .4 International Concrete Repair Institute (ICRI):
 - .1 Technical Guidelines 03732, Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings and Polymer Overlays.
- .5 Underwriters Laboratories of Canada (ULC):
 - .1 CAN/ULC S102.2-18 Method of Test for Surface Burning Characteristics of Flooring, Floor Coverings and Miscellaneous Materials and Assemblies

1.03 ADMINISTRATIVE REQUIREMENTS

- .1 Pre-Construction Meeting: Arrange a preconstruction meeting to discuss installation techniques, confirm compatibility of materials, identify any concerns arising from site conditions and identify any concerns of the installer or supplier, attended by Contractor, City, tile installer and tile supplier, mortar and grout representative and crack control membrane representative.

1.04 SUBMITTALS

- .1 Provide required information in accordance with Section 01 00 06 – General Requirements: Submittals:
- .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 for Selection: Submit manufacturer's colour charts and samples for initial selection consisting of full range of colours and patterns available for rubber base.
 - .3 Samples for Verification: Submit samples for verification including sample sets showing the full range of variations expected where products involve normal colour and texture variations:
 - .1 Submit two (2) pieces of each tile specified.
 - .2 Metal edge or movement strips in 150 mm lengths.
- .3 Informational Submittals: Provide the following submittals during the course of the work:
 - .1 Certificates: Submit written statements from manufacturers indicating compatibility with respect to other manufacturer's materials where more than one manufacturer's products form a part of a single tile assembly.

1.05 PROJECT CLOSEOUT SUBMISSIONS

- .1 Operation and Maintenance Data: Submit copies of TTMAC Maintenance Guide in accordance with Section 01 00 06 – General Requirements: Closeout Submissions, and additional materials as follows:
 - .1 Provide specific warning of any maintenance practice or materials that may damage or disfigure the finished Work.
 - .2 Provide manufacturer's maintenance data sheets for floor sealers and other non-tile accessories.
- .2 Maintenance Materials: Deliver maintenance materials to City in accordance with Section 01 00 06 – General Requirements: Closeout Submittals as follows:
 - .1 Deliver tile maintenance materials in the following quantities:
 - .1 Ceramic Tile: 2% of total installation with a minimum of 8 pieces of each colour and type
 - .2 Porcelain Tile: 2% of total installation with a minimum of 1 box of each colour and type.
 - .3 Trim Units: 3% of total installation consisting of full size units of each type, composition, colour, and pattern

1.06 QUALITY ASSURANCE

- .1 Qualifications: Provide proof of qualifications when requested by City:
 - .1 Standard of work for this Section: Provide materials and workmanship in accordance with recommendations of Terrazzo, Tile and Marble Association of Canada (TTMAC) and the material and installation standard contained in the referenced standards.
 - .2 Supplier: Obtain materials from one source with resources to provide products from the same production run for each contiguous area of consistent quality in appearance and physical properties.

- .3 Materials: Tile that does not meet a Grade 1 Standard, or is marked as a factory second or discount will be rejected, immediately removed from the site and replaced with specified materials.
- .4 Installers: Execute Work of this Section using qualified personnel skilled in ceramic tile installation, having a minimum of five (5) years proven experience and have completed tile installations similar in material, design, and extent to that indicated for this Project.

1.07 DELIVERY, STORAGE, AND HANDLING

- .1 Delivery and Acceptance Requirements: Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use in accordance with ANSI A108.1 for labelling sealed tile packages.
- .2 Storage and Handling Requirements: Store materials to prevent damage or contamination to materials by water, freezing, foreign matter, and other causes; store cementitious materials in a dry area, and blocked off floor and ground surfaces.

1.08 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 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.

2. PRODUCTS

2.01 MANUFACTURERS

- .1 Basis-of-Design Materials: Products named in this Section were used as the basis-of-design materials for the project; additional manufacturers offering similar products may be incorporated into the work of this Section provided they meet the performance and aesthetic requirements established by the named products and provided they submit requests for substitution in accordance with Instructions to Bidders; Product Approvals a minimum of ten (10) days in advance of Bid Closing, and as follows:
 - .1 Notwithstanding the requirements of the Division 01, the City will review all proposed alternates prior to close of bids when submitted no later than seven (7) days prior to bid closing date.
 - .2 Proposed alternates shall match colour range, texture and performance characteristics of named products, and shall not require a change to the colour board for the Project.
 - .3 Proposed alternates found acceptable by the City will be listed in the form of an Addendum.
 - .4 The City is not obliged to accept any materials presented for their review and does not need to provide reasons for rejection of proposed alternates.

2.02 MATERIALS

- .1 Performance Requirements: Provide tile products manufactured in accordance with ANSI A108.1 or ANSI A137.1 as appropriate to the Basis-of-Design Materials and as follows:
 - .1 Colour Variations: Factory blend tile that exhibits colour variations within the ranges selected; package so tile units taken from one package showing same range in colours as those taken from other packages.
 - .2 Slip Resistance: Provide materials having a minimum Dynamic Coefficient of Friction (DCOF) of 0.42 dry in accordance with ANSI A137.1 when tested using the BOT-3000 Digital Tribometer.
 - .3 Load Bearing Performance: Provide installations rated for the following load bearing performance in accordance with ASTM C627 for ceramic tile installed on walkway surfaces:
 - .1 Extra Heavy: Passes cycles 1 through 14.
 - .4 Floor Level Tolerances: Make slabs flat measured to a minimum of F_F50; equivalent to 3 mm with no more than 2 gaps under 3000 mm straightedge; F_F25 for slabs on grade as specified in Section 03 35 00 is considered as starting flatness; final flatness and level will be measured in same manner as specified in Section 03 35 00.
 - .5 Provide Products used in exits having a flame spread rating of 25 or less when tested in accordance with ASTM E84 or ULC S102.2.

2.03 WALL TILE

- .1 Type CT-1: Ceramic wall tile, conforming to referenced standards and the following:
 - .1 Composition: Ceramic.
 - .2 Type: Wall Tile.
 - .3 Dimensions: Nominal 150 mm x 150 mm.
 - .4 Colour: White, Gloss Finish
 - .5 Basis-of-Design Materials: Ames Tile, White Gloss & Matte Series, GW6

2.04 FLOOR TILE

- .1 Style PT-1: Porcelain, slip resistant, square edge, conforming to referenced standards and the following:
 - .3 Composition: Porcelain.
 - .4 Type: Pavers.
 - .5 Class : MR 1
 - .6 Dimensions: Nominal 305 mm x 610 mm x 10 mm thickness.
 - .7 Colour: Carbonate, Matte Finish
 - .8 Basis-of-Design Materials: Share Series Porcelain Tile, High Traffic Commercial application

2.05 TRIMS

- .1 Provide tile trim shapes and profiles to match colour and finish of adjoining tile, and as follows:
 - .3 Transition Strip – Ceramic Tile to Concrete Slab Transition: Stainless steel transition strip with brushed finish, height 10 mm;
 - .4 Basis-of-Design: Schluter Reno-U

.2 Movement Joint Strips: Extruded aluminum profiles joined by a soft PVC movement joint material, with integral perforated anchoring legs for setting the joint into the setting bed; height as required to suit application; colour as selected by City from standard range:

.3 Basis-of-Design Materials: Schlüter Dilex AKWS.

.3 Control Joint Strips: Decorative extruded rigid PVC profiles joined by soft PVC movement joint material, formed with ribbed hourglass shaped edge extrusions for mechanical anchorage to setting material; height 6 mm or 9 mm required suiting tile installation; colouring as selected by Consultant from standard range:

.3 Basis-of-Design Materials: Schlüter Dilex EZ6 or EZ9 to suit tile depth.

2.06 RESILIENT ACCESSORIES

.1 Resilient Wall Base (RB): Smooth, buffed exposed face and ribbed or grooved bonding surface supplied in maximum practical length, with adhesive recommended by manufacturer, conforming to ASTM F1861 and as follows:

.3 Type: TP – Thermoplastic Rubber

.4 Group: 1 – Homogeneous

.5 Style: A – Straight

.6 Height: 100 mm

.7 Thickness: 3 mm

.8 Length: Manufacturers standard maximum length

.9 Acceptable Materials:

.1 Johnsonite Traditional TP

.2 Mannington Commercial Premium Edge TP

.3 Roppe 700 Series TP

2.07 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:

.3 Job Site Cleaner: Phosphoric acid/nitric acid based cleaning solution mixed in accordance with cleaner manufacturers recommendations and as recommended by tile manufacturer.

.4 Maintenance Cleaner: Non-toxic, electrolytic, biodegradable, non-ammonia containing, pH controlled cleaning solution mixed in accordance with manufacturer's recommendations.

.2 Cementitious Backer Board: As indicated in Section 09 21 16.

2.08 MORTAR SETTING MATERIALS

.1 Manufacturers: Mortar and grout materials as recommended by the tile manufacturer or as 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:

.3 Custom Building Products Ltd.

.4 Flextile Ltd.

.5 Kiesel Bauchemie GmbH

.6 MAPEI Inc.

.7 Parex USA Inc.

- .2 Primer: Low VOC, low viscosity primer as recommended by manufacturer to suit substrate and site conditions; provide proof of bonding ability of setting system where manufacturer recommends that a primer is not necessary to installation.
- .3 Surface Preparation Materials: Provide manufacturer's recommended primer or bond enhancing surface preparation material and provide the following underlayment materials:
 - .3 Levelling Bed/Mortar Additive: Cementitious Performance standard meeting requirements of ANSI A108.1, Type 2; Acceptable Materials:
 - .1 Custom Building Products Level Quik Underlayment
 - .2 Flextile Ltd., Mortar Bed with #43 Additive
 - .3 Kiesel Sercocret RS
 - .4 MAPEI Inc. Mapecem Premix PL50
 - .5 Merkrete Underlay M System
 - .4 Self Levelling and Smoothing Underlayment: Performance standard meeting requirements of ANSI A108.1, Type 2; Acceptable Materials:
 - .1 Custom Building Products Level Quick with Acrylic Mortar Admix
 - .2 Flextile Ltd., Flex Flo Self Level
 - .3 Kiesel Servoplan P200 Plus
 - .4 MAPEI Inc. Ultra/Plan
 - .5 Merkrete Underlay SLU
- .4 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 complete with ANSI A108.1 bond enhancing latex additive:
 - .3 Acceptable mortar materials:
 - .1 Custom Building Products Premium Blend Thinset
 - .2 Flextile Ltd., #51 Floor and Wall Mix
 - .3 MAPEI Inc. Kerabond
 - .4 Kiesel Servolight S2 SuperTec
 - .5 Merkrete 705 Pro Set Polymer Modified Thin Set Mortar
 - .4 Acceptable additive materials:
 - .1 Custom Building Products Acrylic Mortar Admix
 - .2 Flextile Ltd., #43 Acrylic Additive
 - .3 Kiesel, no additive required
 - .4 MAPEI Inc. Kera/Ply
 - .5 Merkrete 705, no additive required
- .5 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 with bond enhancing latex additive:
 - .3 Acceptable mortar materials:
 - .1 Custom Building Products Master Blend Thinset
 - .2 Flextile Ltd., #53 Floor Mix
 - .3 Kiesel Servoflex Trio SuperTec
 - .4 MAPEI Inc. Kerabond
 - .5 Merkrete 200/211 System

- .4 Acceptable additive materials:
 - .1 Custom Building Products Custom Flex
 - .2 Flextile Ltd., #44 High Solids Acrylic Additive
 - .3 Kiesel, no additive required
 - .4 MAPEI Inc. Keralastic
 - .5 Merkrete 200 Krete Latex and 211 Krete Filler

2.09 GROUT

- .1 Epoxy Grout for Floors and Walls (GE): Water cleanable, chemical resistant, factory blended modified portland cement compound with 100% epoxy additives and hardeners meeting requirements of ANSI A108.1:
 - .3 Basis-of-Design Materials: TEC, AccuColor EFX Special Effects; 927 Light Pewter
 - .4 Additional acceptable materials, subject to colour matching:
 - .1 Custom Building Products 100% Solids Epoxy Grout
 - .2 Flextile Ltd., Flex Epoxy 100 Grout
 - .3 Kiesel Okapox Designer Grout, Unsanded Grout
 - .4 MAPEI Inc. Ker 400 Kerapoxy Grout
 - .5 Merkrete Pro Epoxy

2.10 MEMBRANES

- .1 Crack Suppression Membranes: Load bearing, premanufactured self adhering lightweight fabric reinforced crack isolation membrane; nominal 1 mm thick manufactured to accommodate in-plane substrate movement in thin set applications meeting requirements of ANSI A108.1 and as follows:
 - .3 Acceptable Materials:
 - .1 Flextile Ltd., 1000 Flexilastic Crack Isolation Membrane
 - .2 Kiesel Crack Suppression System
 - .3 MAPEI Inc., Mapeguard 2
 - .4 Merkrete Hydro Shield 70

2.11 MIXING MORTARS AND GROUT

- .1 Mix mortars and grouts in accordance with referenced standards, and mortar and grout manufacturers' written instructions.
- .2 Add materials, water, and additives in accurate proportions.
- .3 Obtain and use type of mixing equipment, mixer speeds, mixing containers, mixing time, and other procedures to produce mortars and grouts of uniform quality with optimum performance characteristics for installations indicated.

3. EXECUTION

3.03 EXAMINATION

- .1 Examine materials ordered for the project before delivering to the site; open boxes and confirm that materials match accepted samples, are free from defects and breakage detrimental to final appearance and installation, and as follows:
 - .3 City will only accept Grade 1 Standard, materials appearing on site factory marked as seconds or discounted or that are not consistent with materials submitted for review will be rejected.

- .4 Replace unacceptable materials at no additional cost to the City; order replacement materials using most expedient delivery method to minimize effect on construction schedule.
- .2 Examine substrates, areas, and conditions where tile will be installed for compliance with requirements for installation tolerances and other conditions affecting performance of installed tile and confirm the following:
 - .3 Verify that substrates for setting tile are firm; dry; clean; free from oil, waxy films, and curing compounds; and are within starting flatness tolerances as specified in Section 03 35 00, and are ready for application of levelling materials specified in this Section.
 - .4 Verify that installation of grounds, anchors, recessed frames, electrical and mechanical units of Work, and similar items located in or behind tile have been completed before installing tile.
 - .5 Verify that joints and cracks in tile substrates are coordinated with tile joint locations; adjust joints in consultation with City where joints are not coordinated.
 - .6 Verify that concrete substrates have been allowed to cure for a minimum of 90 days in accordance with TTMAC requirements.
 - .7 Verify that tile subject to colour variations has been blended in the factory and packaged so tile units taken from one package show the same range of colours as those taken from other packages. If not factory blended, blend tiles at site before installing.
 - .8 Verify that back of tile is free from contamination before installation.
- .3 Notify Contractor in writing of any conditions that are not acceptable; do not proceed with installation until unsatisfactory conditions have been corrected.

3.04 PREPARATION

- .1 Make backing surfaces level and true to a tolerance in plane of ± 3 mm in 2440 mm for walls and ± 3 mm in 3050 mm for floors using Levelling Bed Mortar.
- .2 Use trowellable levelling and patching compounds in accordance with tile setting material manufacturer's written instructions to fill cracks, holes, and depressions.
- .3 Remove protrusions, bumps, and ridges by sanding or grinding.

3.05 INSTALLATION

- .1 Install tiling in accordance with requirements of TTMAC Tile Installation Manual and parts of ANSI A108 Series of tile installation standards that apply to types of setting and grouting materials, and to methods required for complete ceramic tile installation.
- .2 Extend tile work into recesses and under or behind equipment and fixtures to form a complete covering without interruptions:
 - .3 Terminate Work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.
 - .4 Cut edges smooth, even and free from chipping.
 - .5 Do not split tile.
- .3 Accurately form intersections and returns; perform cutting and drilling of tile without marring visible surfaces:
 - .3 Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight aligned joints.
 - .4 Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so that plates, collars, or covers overlap tile.

- .4 Lay tile in pattern indicated on Drawings and as follows:
 - .3 Align joints when adjoining tiles on floor, base, walls, and trim are the same size.
 - .4 Lay out tile Work and centre tile sites in both directions in each space or on each wall area.
 - .5 Centre tile patterns between control and movement joints. Notify the City for further instructions where tile patterns do not align with control or movement joints.
 - .6 Cut tile accurately and without damage.
 - .7 Smooth exposed cut edges with abrasive stone, where exposed.
 - .8 Chipped or split edges are not acceptable.
 - .9 Minimum tile width: 1/2 unit unless specifically indicated otherwise on Drawings.
 - .10 Adjust tile layout to minimize tile cutting.
 - .11 Provide uniform joint widths.
 - .12 Cut, drill, and fit tile as required accommodating Work of other trades.
 - .13 Slope floor tile towards floor drains.
- .5 Press setting material into the back of tile having raised or textured backs to provide a minimum of 95% coverage:
 - .3 Set tile in place while bond coat is wet and tacky before it has skinned over.
 - .4 Notch bond coat in horizontal straight lines and set on freshly set setting material while moving tile back and forth at 90° to the notches.
 - .5 Fully support corners and edges of tile with setting material.
 - .6 Set tile with, maximum lippage of 1 mm over a 3 mm wide joint.
- .6 Prevent rapid drying of setting material:
 - .3 Do not set tile on dry bed.
 - .4 Sound tile after setting and replace any hollow sounding units to obtain full bond.
- .7 Provide additional ventilation as required.
- .8 Clean excess setting materials from surface of tiles before final set.
- .9 Sound tiles after setting material have cured and replace hollow sounding tile before grouting.
- .10 Joint Widths: Install tile with the following joint widths:
 - .3 Wall Tile: 1.5 mm
 - .4 Paver Tile: 6 mm
 - .5 Make joints consistent width and alignment within tile area.
 - .6 Maintain 2/3 of grout joint depth free of setting material.
- .11 Back Buttering: Obtain minimum 100% mortar coverage in accordance with applicable requirements for back buttering of tile in referenced TTMAC and ANSI A108 series of tile installation standards for the following applications:
 - .3 Tile installed with chemical resistant mortars and grouts
 - .4 Tile having tiles 305 mm or larger in any direction
 - .5 Tile having tiles with raised or textured backs
 - .6 Tile having tile installation rated for Heavy or Extra Heavy Duty.
 - .7 All porcelain tiles with more than 20% of the tile backs covered with "white firing release" shall be "back buttered" so that 100% of the back is covered with adhesive mortar rated for C627, Extra Heavy Duty rating.
- .12 Install prefabricated edge strips and control joints at locations indicated or where exposed edge of floor tile meets different flooring materials and exposed substrates.

- .13 Protect exposed edges of floor tile with properly sized transition strips, use sloped reducer strips where uneven transitions between 6 mm and 13 mm occur.
- .14 Layout resilient base as follows:
- .3 Fit joints tight and vertical.
 - .4 Joints along one plane shall be at minimum 7000 mm spacing, at inconspicuous locations.
 - .5 Mitre internal corners, groove and shape back side of base to fit around external corners and exposed ends.
 - .6 Install base on solid backing. Adhere tightly to wall and floor surfaces.
 - .7 Scribe and fit to door frames and other obstructions.
 - .8 Install straight and level to variation of plus or minus 3 mm over 3000 mm straight edge.
 - .9 Do not stretch base during installation.
 - .10 Shave back of base where necessary to produce snug fit to substrate.
 - .11 Fill voids along top edge of resilient base with manufacturers recommended adhesive filler material where base is installed on masonry walls.
- .15 Layout resilient accessories as follows:
- .3 Install edge strips at unprotected and exposed edges where flooring terminates.

3.06 CONTROL AND MOVEMENT JOINTS

- .1 Install prefabricated control and movement joints in tile Work in accordance with detail 301EJ from TTMAC Installation Manual to suit installation indicated.
- .2 Locate expansion, control, contraction, and isolation joints, as indicated in following table, unless specifically indicated otherwise on the Drawings:

Environment	Minimum	Maximum	Joint Width
Interior	4880 mm	6100 mm	6 mm
Interior/Sunlight	3660 mm	4880 mm	6 mm

- .3 Do not saw-cut joints after installing tiles:
- .3 Locate joints in tile surfaces directly above joints in concrete substrates.
 - .4 Provide floor control joints over structural control joints.
 - .5 Install prefabricated joint profiles in accordance with manufacturer's written instructions, set with top surface of joint profile slightly below top surface of tile.
 - .6 Prepare joints and apply sealants in accordance with requirements of Section 07 92 00.
 - .7 Keep control and movement joints free from setting materials.
- .4 Form an open joint for sealant in tile Work wherever a change in the backing wall material occurs, at all vertical interior corners, around penetrating pipes and fixtures, and where tile abuts other materials or fixtures.

3.07 GROUT

- .1 Site Applied Temporary Protective Coating: Protect exposed surfaces of tile against adherence of mortar and grout by pre-coating them with a continuous film of temporary protective coating, taking care not to coat unexposed tile surfaces where required by tile manufacturer to prevent adhesion or staining of exposed tile surfaces by grout:
- .3 Petroleum paraffin wax, applied hot.
 - .4 Grout release.
 - .5 Petroleum paraffin wax or grout release.

- .2 Install grout in accordance with manufacturer's written instructions, the requirements of the Terrazzo, Tile and Marble Association of Canada (TTMAC), and as follows:
 - .3 Allow proper setting time before application of grout.
 - .4 Force grout into joints to a smooth, dense finish.
 - .5 Remove excess grout in accordance with manufacturer's written instructions and polish tile with clean cloths.
- .3 Install chemical-resistant epoxy grouts in accordance with ANSI A108.1; clean from tile surfaces as work proceeds in accordance with manufacturer's written instructions using clean water.

3.08 SITE QUALITY CONTROL

- .1 Arrange for mortar and grout manufacturer's representative to review delivered materials and confirm in writing that materials and mixes specified for the project are in accordance with manufacturer's requirements.

3.09 CLEANING AND PROTECTION

- .1 On completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign matter using Job Site Cleaner listed in 2.07.1.1 above:
 - .3 Remove epoxy grout residue from tile as soon as possible.
 - .4 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.
 - .5 Protect metal surfaces, cast iron, and vitreous plumbing fixtures from effects of acid cleaning.
 - .6 Flush surface with clean water before and after cleaning.
 - .7 Remove temporary protective coating by method recommended by coating manufacturer that is acceptable to brick and grout manufacturer. Trap and remove coating to prevent it from clogging drains.
- .2 Leave finished installation clean and free of cracked, chipped, broken, unbonded, or other tile deficiencies:
 - .3 Protect finished areas from traffic until setting materials have sufficiently cured in accordance with TTMAC requirements.
 - .4 Protect floor areas from traffic after grouting is completed in accordance with manufacturer's written instructions.
 - .1 Keep traffic off floors for a minimum of 72 hours after completion of grouting.
 - .2 Use stepping boards where access is required for light foot traffic only after 24 hours from completion of grouting.
 - .3 Do not immerse in water for a minimum of 21 days after completion of tile work.
 - .5 Provide protective covering until Substantial Performance of the Work.
 - .6 Protect wall tiles and bases from impact, vibration, heavy hammering on adjacent and opposite walls for a minimum of 14 days after installation.

3.10 INSTALLATION SCHEDULE

- .1 Install tile on concrete floor substrates to TTMAC detail 329LFT.
- .2 Install tile on cementitious board to TTMAC details 305W.

END OF SECTION

1. GENERAL

1.01 SUMMARY

- .1 This Section includes requirements for supply and installation of wood ceiling panel systems into a suspended ceiling grid for interior installations.

1.02 RELATED REQUIREMENTS

- .1 Section 09 21 16 – Gypsum Board Assemblies: Suspension systems specified in this section for gypsum board ceilings.
- .2 Section 23 37 13 – Diffusers, Registers and Grilles: Air handling system ceiling components.
- .3 Section 23 83 00 – Heating Units: Radiant heating panels fitting into suspension grid.
- .4 Division 26 – Interior Lighting: Lights and other electrical components fitting into suspension grid.

1.03 REFERENCE STANDARDS

- .1 American National Standards Institute (ANSI):
 - .1 ANSI A208.2-2016, Medium Density Fiberboard for Interior Use
- .2 American Society for Testing and Materials (ASTM International):
 - .1 ASTM C423-17, Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method
- .3 Canadian Hardwood Plywood Association (CHPA):
 - .1 CHPA Official Grading Rules for Canadian Hardwood Plywood (1993).
 - .2 CHPA Official Grading Rules for Rotary Cut Birch, Oak and Maple Veneers (June 1986).
- .4 Ceilings & Interior Systems Construction Association (CISCA):
 - .1 CISCA Ceiling Systems Handbook.
- .5 Hardwood Plywood and Veneer Association (HPVA):
 - .1 Hardwood Plywood Reference Guide and Sales Handbook
- .6 Underwriters Laboratories Canada (ULC):
 - .1 CAN/ULC S102-03, Method of Test for Surface Burning Characteristics of Building Materials and Assemblies

1.04 ADMINISTRATIVE REQUIREMENTS

- .1 Coordination: Coordinate layout and installation of acoustic wood ceiling and suspension system with other construction that penetrates ceilings or is supported by them including; but not limited to, light fixtures, HVAC equipment, fire suppression system, and partition assemblies, and as follows:
 - .1 Schedule and coordinate installation of ceiling to occur after completion of overhead mechanical and electrical work.
 - .2 Schedule and coordinate ceiling installation with mechanical and electrical trades building in components into ceiling finish panels.

1.05 SUBMITTALS

- .1 Provide required information in accordance with Section 01 00 06 – General Requirements: Submittals.
- .2 Action Submittals: Provide the following submittals before starting any work of this Section:
 - .1 Product Data: Submit product data for each system specified for review by consultant including product test reports indicating compliance with specified acoustical performance requirements and meeting fire resistance requirements listed in this Section.
 - .2 Samples: Submit two (2) sets of samples to Consultant for verification of materials supplied to the project in sets for each colour, texture, and pattern specified, showing full range of expected variations expected as follows:
 - .1 Full size samples of each acoustic panel type, pattern, and colour.
 - .2 Set of 300 mm long samples of exposed suspension system members, including mouldings, for each colour and system type required.
- .3 Informational Submittals: Provide the following submittals during the course of the work:
 - .1 Coordination Drawings: Submit coordination drawings including reflected ceiling plans drawn to scale and coordinating penetrations and ceiling mounted items indicating the following:
 - .1 Ceiling suspension system members
 - .2 Method of attaching suspension system hangers to building structure
 - .3 Ceiling mounted items including light fixtures; air outlets and inlets; speakers; sprinklers; and special mouldings at walls, column penetrations, and other junctures of acoustic ceilings with adjoining construction
 - .4 Minimum Drawing Scale: 1 to 50

ACOUSTICAL WOOD CEILINGS

- .2 Source Quality Control Testing: Submit fastener test results indicating that fasteners and anchors used to suspend the ceiling system have a minimum capacity of 890 N in tension and that anchors used to attach bracing wires have a minimum capacity of 1960 N in tension.

1.06 PROJECT CLOSEOUT SUBMISSIONS

- .1 Submit manufacturer's written instructions for repair and cleaning procedures, include name of original installer and contact information in accordance with Section 01 00 06 – General Requirements: Operation and Maintenance Manuals:
 - .1 Submit specific maintenance practices indicating any materials that may damage or disfigure the finished Work.

1.07 QUALITY ASSURANCE

- .1 Regulatory Requirements: Provide acoustical wood ceilings meeting flame spread and smoke developed requirements in accordance with ULC S102.
- .2 Qualifications: Provide proof of qualifications when requested by Consultant:
 - .1 Installers: Use installers having proven experience in completing acoustical wood ceilings having similar material, design, and complexity as that required for this project and having a record of successful in-service performance for the previous two (2) years.
 - .2 Manufacturers: Obtain materials from one source with resources to provide products from the same production run for each contiguous area of consistent quality in appearance and physical properties.

1.08 MOCK-UPS

- .1 Provide required Sample Installations in accordance with Section 01 00 06 – General Requirements: Quality Control.
 - .2 Construct Sample Installations for each type of ceiling and finish specified to demonstrate aesthetic effects and qualities of materials, and confirm installation requirements as follows:
 - .1 Locate Sample Installations in location and size as directed by Consultant.
 - .2 Notify Consultant seven (7) days in advance of dates when Sample Installations will be constructed.
 - .3 Sample installation is intended to demonstrate the proposed range of aesthetic effects and workmanship.
 - .4 Obtain Consultant's acceptance of Sample Installations before starting construction of wood ceilings; make modifications to installation as directed by the Consultant.

ACOUSTICAL WOOD CEILINGS

- .5 Maintain Sample Installations during construction in an undisturbed condition as a standard for judging the completed Work.
- .6 Demolish and remove Sample Installations from project site when directed by Consultant. Acceptable Sample Installations in an undisturbed condition at the time of Substantial Performance may become part of the completed Work.

1.09 DELIVERY, STORAGE, AND HANDLING

- .1 Delivery and Acceptance Requirements: Deliver acoustical wood ceiling components to site in original, unopened packages and store in fully enclosed space, protected against damage from moisture, direct sunlight, surface contamination, and other causes, and when temperature and humidity of installation and storage areas approximate conditions that will exist when building is occupied.
- .2 Storage and Handling Requirements: Allow acoustic wood ceiling components to reach room temperature and stabilized moisture content before installing; handle acoustic wood ceiling components to avoid chipping edges or damaging units in any way; replace damaged units when directed by Consultant.

1.10 SITE CONDITIONS

- .1 Site Measurements: Verify dimensions by site measurements before fabrication and indicate measurements on shop drawings where acoustical wood ceilings are indicated to fit between walls and other construction; coordinate fabrication schedule with construction progress to avoid delaying the Work.
- .2 Established Dimensions: Establish dimensions and proceed with fabricating acoustical wood ceilings without site measurements where site measurements cannot be made without delaying the Work; coordinate construction to ensure that actual dimensions correspond to established dimensions; allow for trimming and fitting.
- .3 Environmental Requirements: Perform installation when heating and cooling systems are operational, and temperature and humidity closely approximate the interior operating conditions required for the final construction; allow wood materials to acclimate and stabilize to site conditions a minimum of 72 hours before installation when site is free of wet and dusty work, and above ceiling work is complete.

2. PRODUCTS**2.01 MANUFACTURERS**

- .1 Basis-of-Design Products: Products named in this Section were used as the basis-of-design for the project; manufacturers listed as additional Acceptable Products and that offer similar products may be incorporated into the work of this Section provided they meet the performance requirements established by the named products.
 - .1 Basis-of-Design Products: Linea Ceiling & Wall Systems, Linea Plank
- .2 Additional Acceptable Products Manufacturers: Subject to matching of colour and compliance with performance requirements specified in this Section; as established by the Basis-of-Design Products, use any of the listed manufacturers' products in accordance with Section 01 00 06 – General Requirements: Substitutions and Product Options; following manufacturer's do not require submission of a request for substitutions provided required shop drawing and product data submissions are submitted before starting any work of Section:
 - .1 9Wood
 - .2 Lambri Wood panels
 - .3 Rulon International
 - .4 WoodTrends Wood panels
- .3 Substitutions: Consultant may consider additional manufacturers having similar products to Acceptable Products Manufacturers listed above during the construction period, provided they meet the performance requirements established by the named products and provided they submit requests for substitution in accordance with Section 01 00 06 – General Requirements: Substitutions and Product Options before starting any work of this Section:
 - .1 Do not use substitute materials to establish Bid Price.
 - .2 Substitutions that appear as a part of the project without review and acceptance by the Consultant will be rejected, and replaced with one of the specified materials.

2.02 PERFORMANCE REQUIREMENTS

- .1 Determine the superimposed loads that will be applied to suspension systems by components of the building other than the ceiling and ensure that adequate hangers are installed to support the additional loads (light fixtures, mechanical ducts and similar items) as well as loads of the ceiling system itself to limit deflection to 1/360 of the span in accordance with ASTM C635/C635M.
- .2 Manufacture and install components to provide minimum Noise Reduction Coefficient (NRC) listed for specified products; test in accordance with ASTM C423.
- .3 Limit flame spread rating of materials supplied to the project and that are used in exits to 25 or less, with smoke developed at 450 or less when tested in accordance with CAN/ULC S102.

2.03 MATERIALS

- .1 Wood Ceiling Panel (WS):
 - .1 Wood Species: Eastern Maple Veneer
 - .2 Panel Size 304 mm (12") wide x 2438 mm (96") long
 - .3 Blade Size: 125 mm wide by 17.5 mm thick
 - .4 Spacing: 19 mm gap
 - .5 Finish: Standard Clear Lacquer 20° sheen clear – Manufacturer's standard finish, shop finished
 - .6 Fire Rating: Standard Class A retardant panel with flame spread rating less than 25 and smoke development less than 50. Provide Fire retardant treatment to wood grille panels for a Class A or 1 rating in accordance with ASTM E-84 and CAN/ULC S102.
 - .7 Cross Members: 13 mm x 32 mm black painted plywood
- .2 Ceiling Support System:
 - .1 Manufacturer's standard suspension grid system using main runners, cross-tees, wall angles of types, structural classifications finished as indicated on the Drawings and comply with ASTM 635.
- .3 Wall Panel: Screws finish to match backer wood colour.
- .4 Accessories:
 - .1 Access wood grille panels
 - .2 Perimeter and end trims to be the same as wood grille material and finish.
 - .3 Wall Panels: secured to furring strips with screws to match backer boards colour supplied by Installer.
- .5 Basis-of-Design Products: Linea Ceiling & Wall Systems, Linea Plank

ACOUSTICAL WOOD CEILINGS

3. EXECUTION**3.01 EXAMINATION**

- .1 Examine substrates and structural framing for compliance with requirements specified in this and other Sections that affect ceiling installation, anchorage, and other conditions affecting performance of acoustical wood ceilings.
- .2 Acclimatization to meet moisture requirement as recommended by the Manufacturer.
- .3 Installation of ceiling system indicates acceptance of conditions.

3.02 PREPARATION

- .1 Measure each ceiling area and establish layout of wood panels to balance border widths at opposite edges of each ceiling:
 - .1 Install acoustical wood ceilings in accordance with layout indicated on reflected ceiling plans.
 - .2 Avoid using panels less than ½ width at borders.

3.03 INSTALLATION

- .1 Install acoustical wood ceilings in accordance with manufacturers written instructions and as follows:
 - .1 Install ceiling suspension system in accordance with ASTM C636.
- .2 Suspend ceiling hangers from building's structural members, and as follows:
 - .1 Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
 - .2 Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, counter splaying, or other means that prevents creating kinks in the suspension wires.
 - .3 Install supplemental suspension members and hangers, trapezes or similar devices where width of ducts and other construction within ceiling plenum produces hanger spacing that interferes with location of hangers at required spacing to support manufacturer's suspension system; size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.
 - .4 Secure wire hangers to ceiling suspension members and to supports above using a minimum of three tight turns.

ACOUSTICAL WOOD CEILINGS

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- .5 Connect hangers directly to structure or to flat, angle, channel or rods securely fastened to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices that are:
 - .1 Secure.
 - .2 Appropriate for substrate.
 - .3 Will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
 - .6 Attach hangers to structural members or intermediate supports:
 - .1 Do not support ceilings directly from permanent metal forms or floor deck.
 - .2 Do not attach hangers to steel deck tabs.
 - .3 Do not attach hangers to steel roof deck.
 - .7 Space hangers at 1220 mm maximum along each member supported directly from hangers, and provide hangers not more than 200 mm from ends of each member.
 - .8 Provide additional hangers where there are lay-in electrical or mechanical fixtures, one at each corner and; if required, stabilizer bars to prevent overloading or rotation of suspension members.
 - .9 Level ceilings by adjusting length of suspension wires; do not level ceilings by putting kinks in the suspension wires.
 - .3 Install edge mouldings and trim of type indicated at perimeter of acoustic ceiling area and where necessary to conceal edges of wood panels, and as follows:
 - .1 Mitre corners accurately and connect securely.
 - .2 Do not use exposed fasteners, including pop rivets, on mouldings and trim, unless specifically allowed by the Consultant.
 - .4 Install expansion joints to locations indicated by the Consultant, and as follows:
 - .1 Create expansion joint using manufacturer's standard materials, 25 mm apart, on building expansion joint line.
 - .2 Secure continuous strip of sheet steel angle; painted black, to one side of expansion joint.
 - .3 Make exposed angle leg 25% narrower than tight fit.
 - .5 Install suspension system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.
 - .6 Accurately fit and install wood panels into suspension system runners and edge mouldings:
 - .1 Scribe and cut panels at borders and penetrations to provide a neat, precise fit.

.2 Damaged panels will not be acceptable, and shall be replaced.

3.04 CLEANING

.1 Clean exposed surfaces of suspended unit ceilings, including trim, edge mouldings, and suspension system members.

.2 Comply with manufacturer's written instructions for cleaning and touch-up of minor finish damage.

.3 Remove and replace ceiling components that cannot be successfully cleaned and repaired.

END OF SECTION

1. GENERAL**1.01 DEFINITIONS**

- .1 The following definitions apply to the Painting specification:
- .2 Gloss Levels: Standard coating terms defined by MPI Manual apply to products of this Section as follows:

Mark	Gloss Level	Description
GL1	Matte or Flat	Lustreless or matte finish with a gloss range below 10 when measured at 85° to meter and 0 to 5 when measured at 60°.
GL2	Velvet	Matte to low sheen finishes with a gloss range of 10 to 35 when measured at 85° to meter and 0 to 10 when measured at 60°.
GL3	Eggshell	Low sheen finish with a gloss range of 10 to 35 when measured at 85° to meter and 10 to 25 when measured at 60°.
GL4	Satin	Low to medium sheen with a gloss range of minimum 35 when measured at 85° to meter and 20 to 35 when measured at 60°.
GL5	Semi-Gloss	Medium sheen finish with a gloss range of 35 to 70 when measured at 60° to meter.
GL6	Gloss	High sheen finish with a gloss range of 70 to 85 when measured at 60° to meter.
GL7	High Gloss	Reflective sheen having a gloss range in excess of 85 when measured at 60° to meter.

- .3 Service Areas: Rooms or areas dedicated to fire suppression, plumbing, heating and ventilation, building integration systems, electrical and communications equipment including the following:
- .1 Mechanical Rooms and Closets.
 - .2 Electrical Rooms and Closets.
 - .3 Telecommunications Rooms and Closets.
 - .4 Other rooms or areas containing equipment and systems that provides services to the building.
 - .5 Exterior areas with exposed pipe, ductwork or conduit providing services to the building.
- .4 Unfinished Items and Surfaces: Do not paint prefinished items, concealed surfaces (except for back-priming), finished metal surfaces, operating parts, including the following:
- .1 Prefinished Items: May include the following factory finished components:
 - .1 Washroom vanities
 - .2 Metal toilet enclosures
 - .3 Finished mechanical and electrical equipment
 - .4 Light fixtures
 - .2 Concealed Surfaces: May include walls or ceilings in the following areas considered as inaccessible spaces:
 - .1 Furred areas
 - .2 Ceiling plenums
 - .3 Pipe spaces
 - .4 Duct shafts
 - .3 Finished Metal Surfaces: May include the following:
 - .1 Anodized aluminum
 - .2 Stainless steel

- .3 Chromium plate
- .4 Copper and copper alloys
- .5 Bronze and brass

- .4 Operating Parts: May include moving parts of operating equipment and the following:
 - .1 Valve and damper operators
 - .2 Linkages
 - .3 Sensing devices
 - .4 Motor and fan shafts

- .5 Mechanical Ducts or Pipes: May include the following:
 - .1 PVC or aluminum clad insulated pipes or ducts

- .6 Labels: May include the following:
 - .1 ULC, CSA or other code required labels
 - .2 Equipment name, identification, performance rating, or nomenclature plates

1.02 ADMINISTRATIVE REQUIREMENTS

- .1 Coordination: Coordinate requirements of this Section with other components of the Work of the Project as follows:
 - .1 Condition of Substrates: Coordinate correction of defects and deficiencies in substrates that may adversely affect painting work, except for minimal work specified in this section and preparation of surfaces to receive paint and finishes under this section of work, with trades responsible for installation of deficient substrates:
 - .1 Review other Sections in which primers are provided to ensure compatibility of the total system for various substrates.
 - .2 Provide information to work of other Sections about characteristics of finish materials to ensure use of compatible primers when requested.
 - .2 Coordination with Other Coating Systems: Coordinate with other coating systems such as intumescent fireproofing coatings and similar materials, and account of work performed by this section with products specified in other coating specification sections.
 - .3 Non-Architecturally Exposed Structural Steel Surface Preparation: Coordinate surface preparation and shop priming of non-architecturally exposed structural steel, steel deck, and metal fabrications, metal doors, frames and windows including fittings as specified under those respective sections for type of primer forming a part of the painting system specified in this section and as follows:
 - .1 Specification sections having steel or metal components requiring applied finishes will prime steel with coatings specified in this section.
 - .2 Touch-up primer and apply finish coatings specified for steel or metal components.
 - .3 Failure to coordinate correct shop priming of steel construction will result in the City giving instructions for removal of shop applied primer, and the Contractor assessing costs to the responsible trades.
 - .4 Mechanical and Electrical Finishing: Coordinate requirements for painting and identification of mechanical piping and ducting, and electrical conduits with trades responsible for that part of the work as follows:
 - .1 Obtain quantity or length of materials requiring applied finishes, and identify which colour is required on each surface from mechanical or electrical contractor.
 - .2 Prepare surfaces and apply coating systems specified, in colours required for each surface.

- .3 Mechanical and electrical contractors will be responsible for application of secondary markings and identification labels.
- .5 Previously Painted Surface Preparation: Coordinate touch-up painting resulting from installation or reinstallation of fittings by work of other Sections after painting with responsible subcontractors and Contractor at no additional cost to the City.
- .2 Scheduling: Schedule painting work before installation of miscellaneous hardware, surface fittings, fastenings, fixtures and trim by other paint applicators including the hanging of doors and installation of door hardware:
 - .1 Remove, store, and reinstall items that have been installed before start of work of this Section in accordance with item 3.02.3 below.
 - .2 Schedule work of this Section with the Contractor to allow for:
 - .1 Disruption of work of this section by other trades.
 - .2 Disruption of work to other trades by this section.
 - .3 Do not apply final coat of paint until City has had the opportunity to review and adjust tint under actual lighting conditions.

1.03 SUBMITTALS

- .1 Provide required information in accordance with Section 01 00 06 – General Requirements: Submittals.
- .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 City 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 classification.
 - .2 Base Information: Confirmation of manufacturer's ability to supply paint in a variety of base tints, specific to the range of colours being used on this project; indicate colour of base tint used and amount of colourant added to establish Scheduled colours.
 - .3 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:
 - Apply paint sample in layers to Opacity Charts, by The Leneta Company until paint colour appearance over black and white areas is identical, or the specified level of opacity for translucent products has been achieved.
 - Apply paint to Opacity-Display Charts in an even coat as soon as possible after mixing; apply enough layers to make painted area completely opaque, or to the required level of opacity for translucent products.
 - Order paint only for drawdown cards accepted by City.

- Final colour selection is by City.
- Resubmit until accepted by City.
- City will provide colour chips if alternate colours are selected for rejected cards.

1.04 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 Section 01 00 06 – General Requirements: Closeout Submissions including specific warning of any maintenance practice or materials that may damage or disfigure the finished Work.
- .2 Maintenance Materials: Deliver maintenance materials to City in quantities indicated and in accordance with Section 01 00 06 – General Requirements: Closeout Submissions 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 four (4)-4L containers of field colours and four (4)-1 L containers of each accent colour, and all remnants.

1.05 QUALITY ASSURANCE

- .1 Qualifications: Provide proof of qualifications when requested by City:
 - .1 Applicator: Use 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 Having a minimum of five (5) years proven satisfactory experience; show proof of qualifications when requested by City.
 - .2 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 when requested.
 - .3 Use only qualified journeymen who have a Tradesman Qualification Certificate of Proficiency for painting and decorating work.
 - .4 Apprentices may be employed provided they work under the direct supervision of a qualified journeyman in accordance with trade regulations.

1.06 MOCK-UPS

- .1 Provide required Mock-Ups in accordance with Section 01 00 06 – General Requirements: Quality Control.
- .2 When requested by the City, prepare and paint designated surface, area, room or item in each colour scheme using specified paint or coating, selected colours, gloss, textures and workmanship to MPI Manual standards for review and acceptance.
- .3 Build mock-ups in accordance with the following requirements:
 - .1 Locate mock-ups in the location and size as directed by City.
 - .2 Notify City seven (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 Obtain City's acceptance of mock-ups before starting application of materials specified in this Section.
 - .5 Maintain mock-ups during construction in an undisturbed condition as a standard for judging the completed Work.

- .6 Acceptable mock-ups in an undisturbed condition at the time of Substantial Performance may become part of the completed Work.

1.07 SITE CONDITIONS

- .1 Ambient Conditions: Maintain relative humidity at less than 85%, temperatures at least 3°C above dew point, and as follows:

- .1 Temperature: Maintain temperature of surfaces and surrounding air between the following temperatures for a minimum of 24 hours before, during and after application or until paints and coatings are fully cured, whichever is greater:

- .1 Waterborne paints and coatings: 10° to 32°C.
.2 Solvent thinned paints and coatings: 7° to 35°C.
.3 Maintain temperatures during application and until materials are fully cured.

- .2 Surfaces Conditions:

- .1 Maintain surfaces free from snow, rain, fog, or mist, dampness or wetness that could impair bond; painting may continue during inclement weather if surfaces and areas are enclosed and heated within temperature limits specified in 1.07.1 above during application and drying periods.
.2 Maintain surfaces at less than maximum moisture content indicated below; test wood and plaster surfaces using a properly calibrated electronic moisture meter:

- .1 Concrete and Masonry: 12% maximum moisture content when tested in accordance with ASTM F1869 and as follows:
- Test concrete, masonry and plaster surfaces for alkalinity; apply coatings to surfaces that are within paint and coating manufacturers recommended range.
 - Do not paint concrete or masonry surfaces for a minimum 60 days after installation, unless testing indicates that surface emission rates are within manufacturer's acceptable tolerance range for time periods between 28 and 60 days; in no instance will painting and coating be permitted within 28 days of concrete placement.
 - Concrete and masonry surfaces must be visually dry on both sides and tested for maximum moisture content; this is not to be construed as including a wetting down process that may be required for some latex fillers or coatings.

- .2 Plaster and Gypsum Board: 12% maximum moisture content.

2. PRODUCTS

2.01 MANUFACTURERS

- .1 Acceptable Products Manufacturers: Subject to compliance with requirements specified in this Section; where multiple listings of Acceptable Products occur, use any of the listed manufacturers' products in accordance with Section 01 00 06 – General Requirements: Substitutions and Product Options.

- .2 Substitutions: City may consider additional manufacturers having similar products to Acceptable Products Manufacturers listed above during the construction period, provided they meet the performance requirements established by the named products and provided they submit requests for substitution in accordance with Section 01 00 06 – General Requirements: Substitutions and Product Options before starting any work of this Section:

- .1 Do not use substitute materials to establish Bid Price.

- .2 Substitutions that appear as a part of the project without review and acceptance by the City will be rejected, and replaced with one of the specified materials.

2.02 PERFORMANCE REQUIREMENTS

- .1 Proprietary Colour Codes: Colour and colour matching is a performance requirement for the project and will be administered as follows:
 - .1 Use of manufacturer's proprietary colour codes is not intended to imply that listed manufacturer are used to the exclusion of products of other manufacturers listed as Acceptable Products within this Section, or MPI Approved Product listing where Acceptable Products listing is not included.
 - .2 Tinting by other named manufacturers listed as Acceptable Products or within the MPI Approved Product listing is permitted.
- .2 Quality of Materials: Use only manufacturer's top-line or premium series products when multiple listings from the same manufacturer occur within MPI Approved Product Categories and specific Acceptable Products are not included under the scheduled MPI Architectural Systems Listings in this Section; paint material containers not displaying manufacturer's product identification will not be acceptable:
 - .1 Provide materials from the same manufacturer within the specified MPI Architectural Systems or Acceptable Products listings.
 - .2 Provide materials (primers, paints, coatings, varnishes, stains, lacquers, fillers, thinners, solvents) in accordance with the MPI Approved Product listing, as a minimum; include additional requirements of this specification section for base tint and colourant limitations.
 - .3 Provide other materials (linseed oil, shellac, thinners) not specifically listed of the highest quality product of an approved manufacturer listed in the MPI Manual and that are compatible with other coating materials.
- .3 Material Compatibility: Provide block fillers, primers, and finish coat materials that are compatible with one another and with substrates required for conditions of service and application, as demonstrated by manufacturer based on testing and site experience:
 - .1 Use paint materials that have good flowing and brushing properties, and that dry or cure free of blemishes or sags.
 - .2 Provide paints and coatings that meet flame spread and smoke developed ratings designated by local Code requirements and Authority Having Jurisdiction.

2.03 EQUIPMENT

- .1 Painting and Decorating Equipment:
 - .1 Use decorating equipment that meets or exceeds best trade standards for type of product and application.
 - .2 Use spray painting equipment of capacity suited to the type and consistency of paint or coating being applied; kept clean and in good working order.

2.04 MIXING AND TINTING

- .1 Colours:
 - .1 P1: SW 7006 Extra White, Sherwin Williams
 - .2 P2: SW 7006 Extra White, Sherwin Williams
 - .3 P3: SW B66-660 Series, Sherwin Williams
- .2 Multiple Paint Base Tints: Use only paint systems that offer multiple tint bases that minimize addition of colourants; transparent bases will not be accepted as an acceptable tint base where manufacturer listings within the MPI Approved Products listing have multiple listings.

- .3 Mixing: Provide ready mixed paints; re-mix paints immediately prior to and during application to maintain colour and gloss uniformity:
 - .3 Mix paste, powder or catalyzed paints or coatings in strict accordance with manufacturer's written instructions.
 - .4 Perform all colour tinting operations before delivery to site; limit amount of colourant added to base tint in accordance with Item 2.04.2 above.
 - .5 Add thinner, where allowed by manufacturer, of type and quantity in accordance with paint manufacturer's recommendations.

3. EXECUTION

3.04 CONDITION OF SURFACES

- .1 Apply paint only to dry, clean, properly cured and adequately prepared surfaces in areas where dust is no longer generated by construction activities such that airborne particles will not affect the quality of finished surfaces.
- .2 Thoroughly examine and test substrates for conditions adversely affecting application of coatings prior to commencement of work of this section:
 - .3 Report in writing to the Contractor indicating measures required to correct affected work of this section, and informing other Sections responsible for the condition of substrates of requirements for correcting defects and deficiencies:
 - .1 Notify responsible substrate trade contract installer of conditions that become apparent after application of first coat of paint requiring corrective action.
 - .2 Starting of finish painting of defective surfaces; such as gypsum board, will indicate acceptance of substrate and costs of repairing defects will be borne by the paint applicator of this Section including repainting of entire defective surface; touch-up painting will not be allowed.
 - .4 Proceed with paint application only after unsatisfactory conditions have been corrected and surfaces receiving paint are thoroughly dry.
 - .5 Notify City about anticipated problems when using the materials specified over substrates primed by others.
 - .6 Start of painting will be construed as acceptance of surfaces and conditions within a particular area.

3.05 PREPARATION OF SURFACES

- .1 Provide a minimum lighting level of 325 Lux on surfaces where paint or coatings are being applied; and supply temporary heat and ventilation, scaffolding and platforms, and housekeeping services as required to complete the work of this Section, and as follows:
 - .3 Maintain adequate continuous ventilation and sufficient heating facilities to maintain ambient air and substrate temperatures indicated in 1.07.1 above.
 - .4 Provide supplemental ventilating and heating equipment if existing system is inadequate to meet minimum requirements.
- .2 Prepare substrate surfaces in accordance with MPI Manual requirements including; but not limited to remaining items listed in this article.
- .3 Remove hardware and hardware accessories, plates, machined surfaces, lighting fixtures, and similar items already installed that are not to be painted:
 - .3 Provide surface applied protection before surface preparation and painting where removal is impractical or impossible because of size or weight of the item.

- .4 Reinstall items removed using workers skilled in the trades involved after completing painting operations in each space or area.
- .4 Remove oil and grease then clean substrates of substances that could impair bond of the various coatings before applying paint or other surface treatments:
 - .3 Schedule cleaning and painting so dust and other contaminants from the cleaning process will not fall on wet, newly painted surfaces.
 - .4 Clean and prepare surfaces according to manufacturer's written instructions for each particular substrate condition and as specified.
- .5 Provide barrier coats over incompatible primers or remove and re-prime substrate where paint applicator for this Section failed to coordinate use of MPI Manual recommended primers and surface preparation techniques.
- .6 Prepare concrete by removing efflorescence, chalk, dust, dirt, grease, oils, and release agents; roughen as required to remove glaze; mechanically remove hardeners or sealers used to improve curing; use solvent or mechanical cleaning methods that comply with SSPC recommendations appropriate to surface and exposure location:
 - .3 Use abrasive blast cleaning methods if recommended by paint manufacturer.
 - .4 Determine alkalinity and moisture content of surfaces by performing appropriate tests. If surfaces are sufficiently alkaline to cause the finish paint to blister and burn, correct this condition before application.
 - .5 Do not paint surfaces if moisture content exceeds that permitted in manufacturer's written instructions.
 - .6 Clean concrete floors with a 5% solution of muriatic acid or other etching cleaner; flush floor with clean water to remove acid, neutralize with ammonia, rinse, and allow to dry, vacuum before painting.
- .7 Clean ungalvanized ferrous metal surfaces that have not been shop coated; remove oil, grease, dirt, loose mill scale, and other foreign substances using solvent or mechanical cleaning methods that comply with SSPC recommendations appropriate to surface and exposure location:
 - .3 Blast steel surfaces clean as recommended by paint system manufacturer.
 - .4 Treat bare and sandblasted or pickled clean metal with a metal treatment wash coat before priming.
 - .5 Touch up bare areas and shop applied prime coats that have been damaged; wire brush, clean with solvents recommended by paint manufacturer, and touch up with same primer as shop coat.
- .8 Clean galvanized surfaces with non-petroleum based solvents so surface is free of oil and surface contaminants, mechanically remove pre-treatment materials from galvanized sheet metal fabricated from coil stock.
- .9 Mix and prepare paint materials according to manufacturer's written instructions:
 - .3 Maintain containers used in mixing and applying paint in a clean condition, free of foreign materials and residue.
 - .4 Stir material before application to produce a mixture of uniform density.
 - .5 Stir as required during application to maintain consistent tint density.
 - .6 Do not stir surface film into material, remove surface film and strain material before using.
 - .7 Use only thinners approved by paint manufacturer and only within recommended limits.
 - .8 Tint each undercoat a lighter shade to simplify identification of each coat when multiple coats of same material are applied.
 - .9 Tint undercoats to match the colour of the finish coat; but provide sufficient differences in shade of undercoats to distinguish each separate coat.
- .10 Protect adjacent surfaces and areas from painting operations and damage by drop cloths, shields, masking, templates, or other suitable protective means.

- .11 Correct, refinish or replace any damage caused by failure to provide adequate protection to adjacent surfaces.
- .12 Sand, clean, dry, etch, neutralize or test all surfaces using adequate illumination, ventilation and temperature requirements in accordance with manufacturer's written instructions and the MPI Manual.
- .13 Abrasive Blasting for Concrete:
 - .3 Location: To concrete surfaces indicated on drawings.
 - .4 Finish as follows:
 - .1 SF-1 Brush: Removes surface dirt and stains to give the surface a uniform appearance.
 - .2 SF-2 Light: Exposes some of the fine aggregate as well as removing surface dirt and stains; depth of cut not exceeding 1.5 mm.
 - .3 SF-3 Medium: Exposes the top faces of the coarse aggregate faces near the surface; depth of cut not exceeding 5 mm.
 - .4 SF-4 Heavy: Exposes more of the coarse aggregate particles near the surface; depth of cut not exceeding 10 mm.
- .14 Abrasive Blasting for Steel:
 - .3 Location: To steel surfaces indicated on drawings.
 - .4 Removal of paint as required to adequately prepare steel surface for new paint application.

3.06 APPLICATION

- .1 Apply paint according to manufacturer's written instructions, use applicators and techniques best suited for substrate and type of material being applied, and in accordance with MPI Manual Premium Grade finish requirements, except where additional requirements have been specified.
- .2 Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions detrimental to formation of a durable paint film.
- .3 Provide finish coats that are compatible with primers used.
- .4 The term exposed surfaces includes areas visible when permanent or built-in fixtures, grilles, convactor covers, covers for finned-tube radiation, and similar components are in place; extend coatings in these areas as required, to maintain system integrity and provide desired protection, and as follows:
 - .3 Paint surfaces behind movable equipment and furniture the same as similar exposed surfaces.
 - .4 Paint surfaces behind permanently fixed equipment or furniture with prime coat only before final installation of equipment.
 - .5 Paint interior surfaces of ducts with a flat, non-specular black paint where visible through registers or grilles.
 - .6 Paint back sides of access panels and removable or hinged covers to match exposed surfaces.
 - .7 Finish exterior doors on tops, bottoms, and side edges the same as exterior faces.
 - .8 Sand lightly between each succeeding coating of enamel or varnish.

- .5 Apply first coat to surfaces that have been cleaned, pre-treated, or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration, and as follows:
- .3 Apply paint and coatings within an appropriate time frame after cleaning where environmental conditions encourage flash rusting, rusting, contamination or the manufacturer's paint specifications require earlier applications.
 - .4 The number of coats and film thickness required are the same regardless of application method, except that dark tinted colours will require a minimum of four (4) coats with an additional clear urethane or water based light industrial type of coating applied in high traffic areas.
 - .5 Do not apply succeeding coats until previous coat has cured as recommended by manufacturer.
 - .6 If sanding is required to produce a smooth, even surface according to manufacturer's written instructions, sand between applications.
 - .7 Omit primer over metal surfaces that have been shop primed and touch-up painted.
 - .8 Apply additional coats until paint film is of uniform finish, colour, and appearance if undercoats, stains, or other conditions show through final coat of paint, giving special attention to ensure that edges, corners, crevices, welds, and exposed fasteners receive a dry film thickness equivalent to that of flat surfaces.
 - .9 Allow sufficient time between successive coats to permit proper drying.
 - .10 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.
- .6 Apply paints and coatings by brush, roller, spray, or other application methods according to manufacturer's written instructions and as follows:
- .3 Application methods:
 - .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 and as follows:
 - Apply paint using brush or roller, unless City has given written acceptance for use of spray equipment and methods.
 - The City may at any time prohibit the use of spray painting for such reasons as carelessness, poor masking or protective measures, drifting paint fog, disturbance to other trades or failure to obtain a dense, even, opaque finish.
 - Back roll sprayed surface progressively.
 - .4 Apply paint materials no thinner than manufacturer's recommended spreading rate to achieve dry film thickness recommended by the manufacturer.
 - .5 Sand and dust between each coat to provide an anchor for next coat and to remove defects visible from a distance up to 1220 mm.
- .7 Hollow Steel Doors and Frames: Sand to remove blemishes and fill surface dimples, prime using coating compatible with finishes.

3.07 MECHANICAL AND ELECTRICAL PAINT APPLICATION

- .1 Painting of mechanical and electrical work, including hangers and supports is limited to items exposed in service areas.

- .2 Paint mechanical items including the following:
 - .3 Un-insulated metal piping, interior and exterior.
 - .4 Un-insulated plastic piping, interior and exterior.
 - .5 Pipe hangers and supports, interior and exterior.
 - .6 Tanks that do not have factory-applied final finish.
 - .7 Visible portions of internal surfaces of metal ducts without liner, behind air inlets and outlets.
 - .8 Duct, equipment, and pipe insulation having paintable service jacket or other paintable jacket material; do not paint PVC or aluminum clad insulated ducts.
 - .9 Mechanical equipment that is indicated to have a factory primed finish for site painting which may include the following:
 - .1 Exterior items: Louvers and grilles, air handling units, mechanical ductwork, metal chimney stacks, goosenecks, roof jacks and roof vents.
 - .2 Interior items: Un-insulated valves, valve handles, boilers, fan guards, heat exchangers, cold fluid tanks, hot fluid tanks, integral pump bases, water chiller units, pumps, brine tanks, air handling units and plenums.
 - .10 Painting and colour coding is required on substrates in colours as listed in Section 20 05 43 for system identification.
- .3 Paint electrical items including the following:
 - .3 Switchgear
 - .4 Panel boards
 - .5 Electrical Conduit and cable, interior and exterior.
 - .6 Electrical equipment which is required to be prefinished in coded colours in accordance with electrical colour coding requirements specified in Section 26 05 00.
 - .7 Painting and colour coding is required on substrates in colours as listed in Section 26 05 00 for system identification.
- .4 Locations:
 - .3 Painting and colour coding is required at locations specified in 3.04.6 below, on substrates and by methods indicated.
 - .4 Exposed in Services Areas: Includes; but is not limited to, rooms and areas containing equipment relating to mechanical systems, sprinkler systems, electrical systems, boiler and heating systems, air handling systems, and similar rooms.
 - .5 Exposed in Finished Areas: Includes all other rooms not listed above; mechanical and electrical work will be left exposed as an architectural feature in areas where there are no ceilings.
 - .6 Semi-Concealed Spaces: Includes all non-exposed but accessible spaces behind ceilings, walls and floors, including exposed spaces that will be semi-concealed at some future time.
 - .7 Permanently Concealed Spaces: Includes all non-exposed and permanently inaccessible spaces behind ceilings, walls and floors, including exposed spaces which will be permanently concealed at some future time.
 - .8 Exposed to Exterior: Includes all exposed exterior locations.
- .5 Methods:
 - .3 Painting and colour coding by methods specified below, are required on substrates and at locations indicated in 3.04.6 below.

- .4 Method P1 Full Colour Coding for Mechanical Piping and Equipment:
 - .1 Primary Colour Coding: Paint substrates in their entirety in required primary colour for each type of service in accordance with Colour Coding Requirements. Use applicable 3 coat finish system.
 - .5 Method P2 Intermittent Colour Coding for Mechanical Piping:
 - .1 Paint System: Use one coat semi-gloss enamel or machinery enamel, suitable for type of substrate and surface temperature.
 - .2 Primary Colour Coding: Apply paint in required primary colours for each type of service in accordance with Colour Coding Requirements specified in Division 22 – Mechanical Systems Identification.
 - .6 Method P3 Full Painting in Un-coded Colours:
 - .1 Paint substrates in their entirety. Use applicable 3 coat finish system.
 - .2 Except as otherwise specified below, make colours the same as wall or ceiling background colours.
 - .3 Where interior mechanical and electrical work will be left exposed as an architectural feature, for bidding purposes, colour scheme will include a maximum of 2 colours with approximately 50% deep colour tones, excluding colours for mechanical piping which require primary colour coding as specified under Method P1.
 - .4 Where exterior mechanical and electrical work requires painting, for bidding purposes, colour scheme will include a maximum of 2 colours with approximately 50% deep colour tones, excluding colours for mechanical piping which require primary colour coding as specified under Method P1.
 - .7 Method P4 No Painting and Colour Coding:
 - .1 Painting and colour coding are not required.
- .6 Mechanical and Electrical Paint Codes:

Locations	Substrates				
	Mechanical Piping	Mechanical Equipment	Mechanical Ductwork	Electrical Conduit and Cable	Other Electrical Work
Exposed in Service Areas	P1	P1	P3	P4	P3
Exposed in Unfinished Areas	P4	N/A	P4	P4	P4
Exposed in Finished Areas	P3, P2	N/A	P3	P3	P3
Semi-concealed Spaces	P2	N/A	P4	P4	P4
Permanently Concealed Spaces	P4	N/A	P4	P4	P4
Exposed to Exterior	P1	P4	P3	P3	P4

Key, refer to Item .5 above for full description:

P1 - Full Colour Coding for Mechanical Piping and Equipment, and Electrical Services

P2 - Intermittent Colour Coding for Mechanical Piping and Electrical Services

P3 - Full Painting in Un-coded Colours

P4 - No Painting in Coded or Un-coded Colours.

- .7 Paint natural gas piping painted yellow in interior and exterior locations; whether concealed, semi-concealed or exposed; do not apply other colour applied to gas piping, except as stated for banding identification only or where piping is pre-coloured.

3.08 FINISHING

- .1 Use paint gloss levels specifically listed as follows:
 - .3 Paint wall surfaces using Gloss Level 2.
 - .4 Paint ceiling surfaces using Gloss Level 1.
 - .5 Paint doors, frames and trim using Gloss Level 5.
 - .6 Paint all exposed structural framing using Gloss Level 1.
 - .7 Confirm with City where Gloss Level is not indicated before ordering materials.
- .2 Refer to Drawing A0.01 for identification of colours:
 - .3 Colours will be selected by the City from manufacturer's full range of colours.
 - .4 Match other manufacturer's products where a specific manufacturer and colour are listed, using materials having similar base tint range listed in Item 2.04.2 above.
 - .5 Make gloss level of painted surfaces as specified or as noted on Room Finish Schedule.
 - .6 Contact City for clarification before ordering and applying materials where no gloss level is specified or indicated.

3.09 SITE QUALITY CONTROL

- .1 Painted surfaces will be considered to lack uniformity and soundness if any of the following defects are apparent at time of site review when viewed from a distance of 1220 mm from the painted surface:
 - .3 Runs, sags, hiding or shadowing by inefficient application methods.
 - .4 Evidence of poor coverage at rivet heads, plate edges, lap joints, crevices, pockets, corners and re-entrant angles.
- .2 Painted surfaces will be considered as deficient if any of the following defects are apparent at time of site review, regardless of viewing distance:
 - .3 Damage due to touching before paint is sufficiently dry or any other contributory cause.
 - .4 Damage due to application on moist surfaces or caused by inadequate protection from the weather.
 - .5 Damage or contamination of paint due to windblown contaminants (dust, sand blast materials, salt spray, etcetera).
- .3 Replace or repair painted surfaces found as unacceptable at no cost to the City:
 - .3 Small affected areas may be touched up.
 - .4 Repainted large areas found as not acceptable or areas with insufficient dry film thickness.
 - .5 Remove runs, sags or damaged paint by scraper or by sanding before application of new paint coats.

3.10 CLOSEOUT ACTIVITIES

- .1 Protection: Protect newly painted exterior surfaces from rain and snow, condensation, contamination, dust, salt spray and freezing temperatures until paint coatings are completely dry and as follows:
 - .3 Allow for curing periods that exceed manufacturer's recommended minimum time requirements.
 - .4 Erect barriers or screens and post signs to warn of or limit or direct traffic away or around work area as required.
- .2 Restoration: Clean and re-install all hardware items that were removed before painting operations were undertaken, ensuring that tagged or labelled items are returned to the exact position from which they were removed and as follows:
 - .3 Clean, prime and re-paint all bolts, nuts and fasteners after torqueing or re-tightening following specified paint finish.
 - .4 Remove protective coverings and warning signs as soon as possible after operations cease.
 - .5 Protect freshly painted surfaces from paint droppings and dust to approval of City. Avoid scuffing newly applied paint.
 - .6 Restore areas used for storage, cleaning, mixing and handling of paint to clean condition as approved by City.
- .3 Cleaning: Perform final cleaning in accordance with Section 01 00 06 – General Requirements: Final Cleaning and as follows:
 - .3 Remove all paint where spilled, splashed, splattered or sprayed as work progresses using means and materials that are not detrimental to affected surfaces.
 - .4 Keep work area free from an unnecessary accumulation of tools, equipment, surplus materials and debris.
 - .5 Remove combustible rubbish materials and empty paint cans each day and safely dispose of it in accordance with requirements of authorities having jurisdiction.
 - .6 Clean equipment and dispose of wash water or solvents, and other cleaning and protective materials (rags, drop cloths, masking papers, and etcetera), paints, thinners, paint removers and strippers in accordance with the safety requirements of authorities having jurisdiction.

3.11 EXTERIOR SURFACES PAINT SCHEDULE

- .1 Paint exterior surfaces in accordance with the MPI Manual painting systems listed in this section.
- .2 Metal Fabrications:
 - .3 EXT 5.1L – Pigmented Polyurethane:
 - .1 Primer MPI 19: Low VOC, anti-corrosive or zinc rich primer as recommended by finish coating system manufacturer; Acceptable Materials as follows:
 - Benjamin Moore Super Spec HP, Epoxy Mastic.
 - PPG Metalhide One-Pac Inorganic Zinc Rich Primer.
 - .2 Intermediate Coat MPI 108: Low VOC, anti-corrosive, two-component low gloss epoxy mastic; Acceptable Materials as follows:
 - Benjamin Moore Super Spec HP, Epoxy Mastic.
 - PPG Aquapon High Build Polyamide Epoxy.

- .3 Finish Coat MPI 72: Low VOC, two-component polyurethane high gloss enamel, a minimum of three (3) tint bases, using low VOC colourants; Acceptable Materials:

- Benjamin Moore Super Spec HP Aliphatic Acrylic Urethane.
- PPG PitthaneUltra Urethane Enamel.

3.12 INTERIOR SURFACES PAINT SCHEDULE

- .1 Paint interior surfaces in accordance with the MPI Manual painting systems listed in this section.

- .2 Concrete Vertical Surfaces:

- .3 INT 3.1C – High Performance Architectural Latex:

- .1 Primer MPI 3: Low VOC alkali resistane, tintable primer for ferrous metals, formulated for application concrete surfaces; Acceptable Products as follows:

- Benjamin Moore Super Spec Interior/Exterior High-Build Masonry Primer.
- PPG Architectural, Perma-Crete Int/Ext Alkali Resistant Primer.
- Sherwin Williams, Loxon, Loxon Concrete & Masonry Primer.

- .2 Finish Coats: Low VOC two (2) coats system, minimum four (4) tint bases, using low VOC colourants; Gloss Level 5; having a minimum MPI Environmental/Performance Rating of 6; Acceptable Products as follows:

- Benjamin Moore Regal Select MPI 141.
- PPG Architectural Speedhide MPI 141.
- Sherwin-Williams Duration MPI 141.

- .3 Metal Fabrications:

- .3 INT 5.1R – High Performance Architectural Latex:

- .1 Primer MPI 134: Low VOC acrylic type, tintable anti-corrosive primer for ferrous metals, formulated for application to prepared steel surfaces; Acceptable Products as follows:

- Benjamin Moore Super Spec HP DTM Acrylic Low Lustre.
- PPG Architectural, Pitt-Tech Plus, 100% Acrylic DTM Industrial Primer.
- Sherwin Williams, Pro Industrial, Pro-Cryl Universal Primer.

- .2 Finish Coats: Low VOC two (2) coats system, minimum four (4) tint bases, using low VOC colourants; Gloss Level 5; having a minimum MPI Environmental/Performance Rating of 6; Acceptable Products as follows:

- Benjamin Moore Regal Select MPI 141.
- PPG Architectural Speedhide MPI 141.
- Sherwin-Williams Duration MPI 141.

- .4 Steel Artwall:

- .1 Primer: Basis-of-Design Product: Pro Cryl Primer B66-310

- .2 Finish Coats: Basis-of-Design Product: Pro Industrial Acrylic Coating B66-660 Series(Eggshell)

- .3 Notes:

- Use "waterbased" acrylic art work paint ONLY over the system I have recommended.
 - Perform a "compatibility" test with the art work paint before beginning art work painting.
- .5 Mechanical Shroud
- .1 Primer Basis-of-Design Product: Heat-Flex HI Temp 500
- .2 Finish Coats (2) Basis-of-Design Product: B59-810 Series
- .4 Galvanized Metal (items such as but not limited to doors, frames, railings, misc. steel, pipes, overhead decking, ducts):
- .3 INT 5.3M – High Performance Architectural Latex:
- .1 Primer MPI 134: Water-based low VOC primer formulated for application to prepared galvanized steel; Acceptable Products as follows:
- Benjamin Moore, Super Spec HP DTM Acrylic Low Lustre.
 - PPG, Pitt-Tech Plus, 100% Acrylic DTM Industrial Primer.
 - Sico GoPrime Duo 100% Acrylic Latex Primer/Sealer and Undercoater.
 - Sherwin Williams, Protective and Marine, DTM Acrylic Primer/Finish.
- .2 Finish Coats MPI 141: Low VOC two (2) coats system, minimum four (4) tint bases, using low VOC colourants; Gloss Level 5; having a minimum MPI Environmental/Performance Rating of 6; Acceptable Products as follows:
- Benjamin Moore Aura.
 - PPG Architectural Speedhide.
 - Sico Design.
 - Sherwin-Williams Duration.
- .5 Plaster and Gypsum Board (gypsum board and other sheet gypsum materials):
- .3 INT 9.2B – High Performance Architectural Latex:
- .1 Primer MPI 50: Low VOC, high hiding latex primer/sealer formulated for application to new interior plaster and gypsum board surfaces; tint when recommended by manufacturer to approximate finish coat colour; Acceptable Products as follows:
- Benjamin Moore, Fresh Start Natura Primer.
 - PPG Architectural Speedhide Interior Zero VOC Latex Sealer.
 - Sico GoPrime Sealer/Undercoater (non-MPI).
 - Sherwin-Williams Premium Wall and Wood (non-MPI).
- .2 Finish Coats MPI 138 to 141: Low VOC two (2) coats system; minimum four (4) tint bases, using low VOC colourants; gloss level as indicated; having a minimum MPI Environmental/Performance Rating of 6; Acceptable Products as follows:
- Benjamin Moore Aura.
 - PPG Architectural Speedhide.
 - Sico Design.
 - Sherwin-Williams Duration.

- .1 Paint interior finishes surfaces in accordance with the MPI Manual painting systems listed in this section.

END OF SECTION

-
- 1. GENERAL**
- 1.01 SUMMARY
- .1 This Section includes requirements for application of graffiti resistant coatings to new architectural precast wall assemblies.
- 1.02 RELATED REQUIREMENTS
- .1 Section 03 45 00 – Precast Architectural Concrete Panels: Cleaning graffiti from concrete surfaces.
- 1.03 REFERENCE STANDARDS
- .1 Miscellaneous References:
- .1 Canadian Environmental Assessment Act (CEAA) 1995
- .2 Mine Safety and Health Administration/National Institute for Occupational Safety and Health (MSHA/NIOSH) Standards
- 1.04 ADMINISTRATIVE REQUIREMENTS
- .1 Scheduling: Take measures necessary to complete Work within the Construction Manager's construction schedule time; coordinate cleaning work schedule with other work on site.
- 1.05 SUBMITTALS
- .1 Provide required information in accordance with Section 01 00 06 – General Requirements: Submittals.
- .2 Action Submittals: Provide the following submittals before starting any work of this Section:
- .1 Product Data: Submit product information for cleaning materials used on the Project, installation instructions, and manufacturers written cleaning instructions specific for surfaces being cleaned and substances being removed from surfaces; include written methodology describing cleaning process and rationale for cleaning techniques being used.
- 1.06 PROJECT CLOSEOUT SUBMISSIONS
- .1 Operation and Maintenance Data: Provide maintenance information in accordance with Section 01 00 06 – General Requirements: Operation and Maintenance Manuals indicating proper care of graffiti resistant coating, cleaning instructions, locally available materials used to clean and maintain surfaces, and approximate recoating requirements.
- .2 Maintenance Materials: Provide maintenance materials in accordance with Section 01 00 06 – General Requirements: Spare Parts the following:
- .1 One (1) 4L container of graffiti resistant coating listed below, stored in location directed by the City.
- .2 One (1) 4L container of graffiti remover materials as recommended by coating manufacturer for graffiti resistant coatings listed below, stored in location directed by the City.

1.07 QUALITY ASSURANCE

.1 Qualifications: Provide proof of qualifications when requested by Consultant:

.1 Source of Supply: Use only materials from one manufacturer and a single source of supply; use only proprietary materials from Acceptable Products listing; materials from non-proprietary or materials having an unknown composition will not be permitted as these may contain harmful substances and may cause deleterious effects to surrounding material surfaces.

2. PRODUCTS**2.01 MANUFACTURERS**

.1 Acceptable Products Manufacturers: Subject to compliance with requirements specified in this Section, manufacturers offering products that may be incorporated into the Work include the following:

- .1 AquaTec Coatings Ltd.
- .2 Fabrikem Manufacturing Ltd. Manufacturing Ltd.
- .3 Graffiti Master
- .4 ProSoCo, Inc.
- .5 GAF, Graffiti Shield

2.02 MATERIALS

.1 Water: Clean potable water free from contaminants; treat water that has high metal content before use in cleaning.

.2 Masking Materials: Polyethylene or strippable masking (butyl rubber spray) at choice of Subcontractor.

.3 Graffiti Resistant Coating: Non-sacrificial, fully breathable sealer that does not alter the look of the substrate to which it is being applied, specifically formulated to prevent graffiti from curing into substrate pores.

.1 Acceptable Products:

- .1 AquaTec Coatings Ltd., GraffiTec Invis-100
- .2 Fabrikem, Fabrishield PR Series
- .3 Graffiti Master, Acryli-Master
- .4 ProSoCo, Defacer Eraser Graffiti Barrier NS, with Protective Film Hardener

.4 Maintenance Cleaners: Manufacturer's recommended maintenance cleaners formulated for use with graffiti resistant coating used on project.

2.03 TOOLS AND EQUIPMENT

.1 Use only brushes with natural or soft plastic bristles.

.2 Use only scrapers of wood or plastic.

.3 Use air compressors equipped with on-line oil filters to avoid spraying oil onto concrete surface.

.4 Use only plastic or non-ferrous metal piping and fittings.

.5 Use nozzles that give nebulized droplet spray.

3. EXECUTION**3.01 PREPARATION**

- .1 Place safety devices and signs near work areas as indicated and directed.
- .2 Seal or repair openings and joints where there is potential risk of water or chemical infiltration through the wall assembly.
- .3 Cover surfaces not scheduled for coatings.
- .4 Cover and protect surfaces and finishes with in areas scheduled for coatings as follows:
 - .1 Mask or seal vents, windows, and other openings
 - .2 Mask wood, glass, and metal adjacent to concrete surfaces
 - .3 Protect plants (if any) from excessive watering and chemicals
 - .4 Hang sheeting material from scaffolding to enclose spray
 - .5 Equip workers with eye, head, and face protection; and protective gloves, coveralls, boots and filter mask in accordance with MSHA/NIOSH standard

3.02 APPLICATION

- .1 Apply materials following manufacturer's instructions.

3.03 CLEANING

- .1 Rinse off substrates until no indications of chemicals are present.
- .2 Rinse from bottom to top and from top to bottom.
- .3 Clean up work area as work progresses.
- .4 Remove debris and waste from site at end of each work day.

END OF SECTION

1. GENERAL**1.01 SUMMARY**

.1 This Section includes requirements for shop and site applied materials, equipment, and labour necessary for the application and curing of new coating systems on exterior and interior structural steel components (excluding steel components to be sprayed with fireproofing) , steel art walls and site touch-up and repair requirements, which is intended to protect steel structure against corrosion for an expected service life of 25 years without requiring major repairs or recoating including the following:

.1 Facilities during site application of materials such as:

- .1 Structural steel and components
- .2 Steel column closure piece and components
- .3 Ground and surface covers
- .4 Ventilation equipment
- .5 Other materials that may be required

.2 Surface preparation, application of pre-treatment materials, penetrant materials, sealants and primers for shop applied materials.

.3 Coating systems including protection and curing aids required for final finishing.

.4 Additional materials and labour required to provide finished coating systems described by this Section and meeting required warranty provisions.

.2 Coating systems specified in this section include the following:

.1 Shop Applied, Site Applied and Site Touch-Up Coating Systems: Applied to arch ribs, arch struts, deck support beam, stringers, floor beams, floor beam extensions, edge girders, bracing, shared use path superstructure, utility duct trays and all other metal components of the structure.

.3 Site Applied Coating System: Steel coatings for site applied work will use same materials to those specified for shop applied and site touch-up coatings.

.4 Coordinate with the Contractor regarding access to all parts of the structure for site touch-up painting.

1.02 RELATED REQUIREMENTS

.2 Section 05 05 19 – Common Work Results for Metalwork Finishing: Surface preparation and profiling requirements.

.3 Division 05 – Structural Steel and components: Surface preparation requirements for new steel assemblies and components.

1.03 DEFINITIONS

.2 The following definitions apply to the Steel Coatings specification:

.3 Warranty: A two party agreement between the Warrantor (Fabricator) signed over to the Warrantee (the City) stating that corrections to deficiencies in materials and workmanship will be carried out by the Warrantor during the term of the Warranty.

.4 Stripe Coat: Stripe coating is a process where an extra layer of coating is applied to edges, joints, bolt heads, bolt threads and other critical areas of the structure being coated to reinforce and ensure sufficient thickness in the coating at these locations; all treated areas must have stripe coat lap over affected area by at least 25 mm in all directions.

1.04 REFERENCE STANDARDS

- .2 American Society for Testing and Materials (ASTM):
 - .3 ASTM D2244-07e1, Standard Practice for Calculation of Color Tolerances and Color Differences from Instrumentally Measured Color Coordinates
 - .4 ASTM D2369-07, Standard Test Method for Volatile Content of Coatings
 - .5 ASTM D3960-05, Standard Practice for Determining Volatile Organic Compound (VOC) Content of Paints and Related Coatings
 - .6 ASTM D1475-98 (2008), Standard Test Method for Density of Liquid Coatings, Inks, and Related Products
- .3 Society for Protective Coatings (SSPC):
 - .3 Surface Preparation and Coating Specifications: Coordinate level of surface preparation with coating manufacturer's minimum requirements:
 - .1 SSPC-SP 3 Power Tool Cleaning
 - .2 SSPC-SP 6 Commercial Blast Cleaning
 - .3 SSPC-SP 10 Near-White Blast Cleaning
 - .4 SSPC-SP 11 Power Tool Cleaning to Bare Metal
 - .5 SSPC SP 12 Surface Preparation and Cleaning of Steel and Other Hard Materials by High- and Ultrahigh-Pressure Water Jetting Prior to Recoating
 - .4 Abrasive Specifications:
 - .1 SSPC-AB 2 Cleanliness of Recycled Ferrous SSPC-AB 1 Mineral and Slag Abrasives
 - .2 SSPC-AB 3 Newly Manufactured or Remanufactured Steel Abrasives
 - .5 Paint Application Standards, Guides and Specifications:
 - .1 SSPC-PA COM Commentary on Paint Application
 - .2 SSPC-PA 1 Shop, Site and Maintenance Painting of Steel
 - .3 SSPC-PA 2 Measurement of Dry Film Coating Thickness with Magnetic Gauges
 - .4 SSPC-TU 3 Overcoating
 - .5 SSPC-TU 7 Conducting Ambient Air, Soil, and Water Sampling During Surface Preparation and Paint Disturbance Activities
 - .6 Qualifications:
 - .1 Standard Procedure for Evaluating the Qualifications of Painting Contractors SSPC-QP1

1.05 ADMINISTRATIVE REQUIREMENTS

- .2 Coordination: Cooperate with other parts of the Work of this Project and the Contractor and provide the following:
 - .3 Coordinate supply and installation of common temporary facilities, containment enclosures and surface preparation requirements for site applied repair and retouching materials.
 - .4 Coordinate surface preparation requirements for application of coatings and zinc metallized surfaces with Section 05 05 19.
 - .5 Coordinate with the Contractor regarding access to all parts of the structure for site touch-up painting.

- .3 Shop and Site Quality Control: Provide an experienced quality control person who will be directly responsible for monitoring and correcting work of this Section, and to coordinate with City's NACE certified quality assurance inspector to ensure that the work meets specified requirements.
- .4 Pre-Installation Meeting: Conduct a pre-installation meeting prior to starting any work to coordinate requirements of this Section with work of other sections attended by Contractor, Subcontractor performing work of this Section, Subcontractors performing work of other sections affected by work of this Section, the Consultant and the City to discuss the following:
 - .3 Coordinate surface preparation standard required for specific coating systems.
 - .4 Coordinate anchor pattern and surface profile of blasted steel required for specific coating systems.
 - .5 Coordination of sequencing and scheduling of succeeding painting operations, site repairs and retouching of shop applied coating systems.
 - .6 Identification of methods used to protect the environment and worker safety during site repairs and retouching operations.
 - .7 Other items determined or arising from the preinstallation meeting.
- .5 Scheduling: Schedule application of slow curing shop and site applied coating systems with work of other Sections to prevent damage to finished surfaces from successive work following application of coatings.

1.06 SUBMITTALS

- .2 Provide required information in accordance with Section 01 00 06 – General Requirements: Submittal Procedures.
- .3 Action Submittals: Provide the following submittals before starting any work of this Section:
 - .3 Schedule: Submit detailed schedule indicating start and finish dates for surface preparation and cleaning operations; include major milestone dates identifying where work of other ongoing operations may be impacted by work of this Section; include description of methods being used for storage, handling and disposal of new and contaminated blasting spoil, cleaning water and stripped paint materials.
- .4 Informational Submittals: Provide the following submittals during the course of the work:
 - .3 Site Safety Information: Submit material safety and data sheets (MSDS) for each paint or coating system used for the Project clearly indicating VOC content and compliance with VOC limitations referenced in this Section.
 - .4 Certificates: Submit sample warranty for review by Consultant indicating compliance with required terms and conditions.

1.07 PROJECT CLOSEOUT SUBMISSIONS

- .2 Operation and Maintenance Data: Submit manufacturer's written instructions for repair and cleaning of steel coating systems and completed warranty required by this Section; include name of original installer and contact information.

1.08 QUALITY ASSURANCE

- .2 Regulatory Requirements: Make necessary arrangements and precautions to protect workers, other site personnel and the environment in accordance with Workers' Health and Safety Requirements.
- .3 Acceptance Requirements: Non-compliance with any portion of the requirements of this Section will result in suspension of the Work of the Project until deficiency has been corrected; alteration to the completion date or site occupancy due to work suspension will not be permitted.

- .4 Qualifications: Provide proof of qualifications when requested by Consultant:
 - .3 Applicator: Use a firm or individual experienced in applying 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 Firm or individual must meet or exceed requirements of and be certified in accordance with SSPC-QP1.
 - .2 Be a member in good standing of the Society for Protective Coatings at time of bidding and during entire period that work is undertaken.
 - .3 Have a minimum of five (5) years proven satisfactory experience and maintain a qualified crew of painters and coaters throughout the duration of the work.
 - .4 Only qualified journeymen who have a Tradesman Qualification Certificate of Proficiency shall be engaged in work of this Section.
 - .5 Apprentices may be employed provided they work under the direct supervision of a qualified journeyman in accordance with trade regulations.
 - .4 Supplier: Obtain primers for each coating system from the same manufacturer as the finish coats and as follows:
 - .1 Use only paint manufacturers and products recognized by Alberta Transportation under the Qualified Products List for types of materials used for this project.
 - .2 Use only coatings meeting or exceeding environmental limitations for grams/L of volatile organic compounds (VOC) establish by established by Green Seal GC-11 and South Coast Air Quality Management District Rule #1113 for exterior coatings.
- .5 Certifications: Provide proof of the following during the course of the Work:
 - .3 Environmental Permits: Obtain Permits and Approvals required by Authorities Having Jurisdiction affecting work of this Section and post in a visible location for the duration of the Project.

1.09 DELIVERY STORAGE AND HANDLING

- .2 Delivery and Acceptance Requirements: Deliver materials to the shop or Project site in manufacturer's original, unopened packages and containers bearing manufacturer's name and label with the following information:
 - .3 Name or title of material
 - .4 Product description (generic classification or binder type)
 - .5 Manufacturer's stock number and date of manufacture
 - .6 Contents by volume, for pigment and vehicle constituents
 - .7 Thinning instructions
 - .8 Application instructions
 - .9 Colour name and number
 - .10 Handling instructions and precautions
- .3 Storage and Handling Requirements: Store materials not in use in tightly covered containers in a well ventilated area in accordance with manufacturer's instructions and as follows:
 - .3 Maintain stored containers in a clean condition, free of foreign materials and residue
 - .4 Protect materials from freezing; store unopened paints in a location having a temperature range of 10°C to 25°C
 - .5 Keep storage area neat and orderly
 - .6 Remove oily rags and waste daily
 - .7 Take necessary measures to ensure that workers and work areas are protected from fire and health hazards resulting from handling, mixing, and applying coatings

1.10 SITE CONDITIONS

- .2 Emission Levels and Monitoring: Coordinate requirements of this Section as follows:
 - .3 Provide temporary site enclosures during site repairs and retouching operations meeting requirements of Authority Having Jurisdiction; do not perform surface blasting using unmodified containment that does not meet emission standards.
 - .4 Use monitoring and acceptance criteria described in section 5.5 of SSPC Guide 6, 5.5.1 Method A Visible Emissions to monitor quantity of emissions escaping enclosure.
 - .5 Use General Surveillance to monitor performance of containment system and verify that emissions from containment system meet the requirements of Level 2 Emissions as described in the SSPC Guide 6, 5.5.1.1.
- .3 Ambient Conditions: Apply coatings only when temperature of surfaces being coated and surrounding air temperatures and humidity are within range recommended in writing by coating manufacturer and as follows:
 - .3 Temperature Limitations:
 - .1 Do not apply coatings when air or steel temperatures are at or below 4°C.
 - .2 Do not apply coatings when steel surface temperature is above 50°C, sufficient to cause coatings to blister and produce a porous paint film.
 - .3 Do not apply coatings when forecast indicates that air temperature may drop below 0°C before the paint is dry.
 - .4 Humidity Limitations:
 - .1 Do not apply coatings to damp or frosty surfaces.
 - .2 Do not apply coatings in snow, rain, fog, or mist; when relative humidity exceeds 85%; at temperatures less than 3°C above dew point; or to damp or wet surfaces.
 - .3 Allow wet surfaces to dry thoroughly and attain temperature and conditions specified before proceeding with or continuing coating operation.
 - .4 Work may continue during inclement weather only if areas and surfaces being coated are enclosed and temperature within the area can be maintained within limits specified by manufacturer during application and drying periods.
 - .5 Review with the Consultant any variances from these requirements arising from coating manufacturer's written recommendations or requirements before application of coating systems.
- .4 Emission Levels and Monitoring: Establish methods for containment of volatile organic compounds, effluent, spillage and monitoring systems acceptable to Authority Having Jurisdiction.

1.11 WARRANTY

- .2 Warranty for Shop Applied and Site Applied Coating System and Site Touch-Ups: Provide a Warranty covering the materials and installation of coatings and labour required for application against defects in material and workmanship for a period of five (5) years starting from the Date of Final Acceptance of completed painting contract and as follows:
 - .3 The City and the Consultant will review the coating system during the Warranty period and a minimum of sixty days before the Warranty expires, and will advise the Contractor in writing of any defects or repairs that are required; intermediate reviews may be made requiring repairs and claimed against the Warranty and completed by the Contractor and/or Painting Subcontractor in each year of the Warranty period:

- .1 Failure of the coating system will be considered to include, but not be limited to, the following:
 - De-bonding or failure of adhesion of the coating either to steel or of lack of inter-coat adhesion.
 - Appearance of any rust stains on the structure due to loss of paint or arising from leaking from joints between structural members.
 - Any loss of normal gloss or rapid change of colour of the coating.
 - Damage to the coating due to vehicle impact or snow removal equipment will not constitute failure of the system.
- .2 Repair under the Warranty shall include the supply material, labour, and equipment necessary to restore the coating to a condition equal to that of the system when it was initially installed, performed by the Contractor and/or Painting Subcontractor.

2. PRODUCTS

2.01 MANUFACTURERS

.2 Acceptable Materials manufacturers: Subject to compliance with requirements specified in this Section and as accepted by Alberta Transportation, Qualified Products List, manufacturers offering products that may be incorporated into the Work include; but are not limited to, the following:

- .3 Ameron International, PPG Amercoat Canada
- .4 Carboline Company
- .5 ICI Devoe Coatings
- .6 International Protective Coatings
- .7 Sherwin Williams; Protective and Marine Coatings
- .8 Termarust Technologies:

Acceptable Products are listed in the table below:

Amercoat Canada	General Paint (780) 468-1558 (604) 253-3131	Organic Zn / Epoxy / Polyurethane	Amercoat 68HS	Amercoat
Carboline	Corrosion Service Ltd. (780) 465-3600	Organic Zn / Epoxy / Polyurethane	Carbozinc 859	Carboguard
ICI-Devoe	ICI-Devoe (778) 838-4579	Organic Zn / Epoxy / Polyurethane	Cathacoat 315	Bar Rust
International Paint	International Paint (604) 988- 7191	Organic Zn / Epoxy / Polyurethane	Interzinc 315B	Intergard 4
Sherwin Williams	Sherwin Williams (780) 454-7800 (604)253-5424	Organic Zn / Epoxy / Polyurethane	Zinc Clad III HS	Macropoxy Fast Cure
Termarust Technologies	Termarust Technologies (888) 279-5497	Organic Zn / Epoxy / Polyurethane	Termazinc 1100	Termapoxy

.1

2.02 SYSTEM DESCRIPTION

.2 Coating Systems: Coating systems are broken down by application as follows:

- .3 Shop Applied, Site Applied and Site Repair Coating System: Coating systems applied to arch ribs, arch struts, deck support beam, stringers, floor beams, floor beam extensions, edge girders, stringers, floor beams, bracing, shared use path superstructure and utility duct trays, consisting of organic zinc/epoxy/polyurethane system:
- .1 Surface preparation is not required for the interior surfaces of the arch ribs or the interior of the shared use path provided the plate surfaces have been blast cleaned to SSPC-SP6 prior to fabrication.
 - .2 Interior surfaces of the arch ribs and the shared use path boxes shall be painted with one coat of organic zinc primer suitable for application to the as fabricated surfaces.
 - .3 For all surfaces other than those identified in 1.1.1 and 1.1.2 prepare surface and prime the same as for new steel and provide a minimum SSPC-SP6 with jagged blast profile; vacuum or blow off abrasive dust and ensure that surface remains clean and free from flash rust before coating.
 - .4 Coating is applied to all structural steel and as indicated on the Drawings and hot dip galvanized surfaces. Faying surfaces shall receive primer coating only.
 - .5 Apply coating with stripe coat of mid-coat material after primer is cured.
 - .6 This system may also be applied as a shop applied coating system.
- .3 Site Applied Zinc Coating System: Applied to selected components for touch-ups consisting of a single component zinc coating.
- .2 Volatile Organic Content (VOC) Emissions: VOC limitations of the CCME Volatile Organic Compound (VOC) Concentration Limits for Architectural Coatings Regulations shall apply for all coatings at the time of application.
- .3 Colour Coating by Layer: Vary paint colour by coat so that differences between primer coat, stripe coat, mid-coat and finish coat are readily distinguishable by eye.

2.03

MATERIALS

- .1 Shop Applied and Site Applied Coating System:
- .3 Surface Preparation: Coordinate surface preparation and zinc metallizing requirements.
 - .4 Organic Zinc Primer: Two component epoxy, organic zinc rich primer intended to provide cathodic protection to steel structures.
 - .5 Stripe Coat: Same as epoxy mid-coat with different colour to differentiate between coatings.
 - .6 Mid-Coat: Two component epoxy mastic coating.
 - .7 Topcoat: Two component aliphatic urethane gloss enamel, colour to be determined.
- .2 Site Applied Zinc Coating System:
- .3 Single component zinc coating containing 96% electrolytic zinc dust, synthetic resins, pigments and solvents, containing no lead or cadmium metals or toluene, xylene, methylene chloride, or methyl-ethyl-ketone, and as follows:
 - .1 Zinc Content After Curing: Dry layer containing a minimum of 96% zinc.
 - .2 Acceptable Materials:
 - Zinga Cold Galvanizing System, Zinga Canada.
 - Other materials may be acceptable when submitted to the Consultant for review and acceptance a minimum of 10 days prior to submission of Tenders.
- .3 Slip Resistant Coatings: Slip resistant coating compatible with coating system applied to inside surfaces of arch ribs and as follows:

- .3 Include a minimum of 75 grams per litre (4 oz/gal) of polyolefin beads conforming to the properties in following table to coatings applied to the area shown on the drawings as "extent of slip resistant coating on inside face of bottom flange":

Property	Requirements
Composition	Polyethylene or Polypropylene or a combination thereof
Appearance	White free-flowing powder
Size	210 to 300 μm
Specific Gravity	0.90
Initial Melt/Softening Point	-6°C
Final Melt Point	166°C
Flash Point	Greater than 275°C

- .4 Add beads to finish coat prior to application, mixed and thoroughly dispersed into the coating during normal mixing procedures.
- .5 Cured non-slip coating; following addition of polyolefin beads, shall have a minimum average slip-resistance of 0.50 when wet when tested in accordance with ASTM F1679.
- .6 Add more beads when average slip-resistance fails to meet this requirement as determined by the Contractor's independent laboratory upon testing of a sample of the non-slip coating.
- .7 Verify by testing that all properties are met; physical properties shall be verified by an independent laboratory approved by the Consultant.
- .8 Provide a copy of slip-resistance testing results to Consultant prior to application of the non-slip coating.
- .4 Equipment: Provide equipment required to complete the Work of the Contract including, but not limited to, the following:
- .3 Pressure Spray Painting Equipment.
- .4 Auxiliary lighting to improve visibility where necessary within containment enclosures for touching up the coatings on site.
- .5 Additional equipment and materials as required for complete surface preparation and cleaning operations.

3. EXECUTION

3.02 EXAMINATION

- .1 Verification of Conditions: Verify substrates and conditions to which coatings will be applied for acceptability in accordance with coating manufacturer's application requirements, and as follows:
- .3 Apply coatings only after unsatisfactory conditions have been corrected and surfaces to receive coatings are thoroughly dry.

3.03 PREPARATION

- .1 Site Preparation Requirements: Establish the following requirements before starting any coating repair or retouching operations:
- .3 Protection of Environment: Establish protection requirements for preservation of fish habitat when working on structures over water inhabited by fish; establish measures that prevent any deleterious material spilling into waters frequented by fish.

- .4 Enclosures: Coordinate enclosure requirements with Authority Having Jurisdiction and confirm that enclosure meets requirements listed in this Section; do not perform painting or coating operations using unmodified containment enclosure that does not meet referenced emission standards.
- .5 Protection of Property: Install measures to fully protect the environment, workers and pedestrians, traffic and parked vehicles, adjacent properties, and other portions of structures from damage caused by application of coating systems, equipment oils, solvents, acids, burning matter and paint drifts, drops, or spray and spatter during surface preparation and cleaning operations:
 - .1 Provide tarps, polyethylene or other covering material to protect deck, sidewalks, piers, abutments, slope protection and other portions of the structure adjacent to areas being coated and subject to paint or other damage.
 - .2 Immediately repair any damage or disfigurement arising from coating operations as directed by the Consultant at no additional cost to the City or Consultant.
- .2 Shop Preparation Requirements: Perform the following before starting any application of coatings to steel members:
 - .3 Edge Condition Preparation: Use small angle head grinder having a fine disk to grind burs and sharp edges from members to produce a light chamfer or rounding of the edges; sharp edges will not be permitted.
 - .4 Mixing: Mix coatings using methods that will break up lumps, provide complete dispersion of settled pigment, and provide a uniform composition; agitate paint during application to keep pigment in suspension.

3.04 APPLICATION

- .1 Stripe Coating: Stripe coat edges of plates and rolled sections having sharp profiles, bolt heads, bolt threads and other critical areas such as joints between plates, angles or other adjacent steel, and as follows:
 - .3 Stripe coat may be applied by spray to expedite work of this Section; followed by working stripe coat in using brush to obtain full coverage.
 - .4 Manufacturer's specified drying times and recoat conditions is the same as for remainder of coating requirements.
- .2 Shop Application and Site Application of Coatings: Arch ribs, arch struts, deck support beam, stringers, floor beams, floor beam extensions, edge girders, stringers, floor beams, bracing, shared use path superstructure and utility duct trays: Apply specified shop applied coating system to properly prepared, clean and dry steel in accordance with manufacturer's written instructions. **(Addendum 4)**
- .3 Site Application when Touching-Up Coating Systems: Install coating materials in accordance with manufacturer's recommended thicknesses and written instructions, and as follows:
 - .3 Arrange to have coating manufacturer's representative on site when required to provide guidance and address site specific problems.
 - .4 Only open the anticipated quantity of paint required for one day's work on that day; do not leave leftover paint exposed to air.
 - .5 Apply coatings to flange where coated items such as beam flanges are cast into concrete; immediately remove any coating inadvertently applied to the concrete.
 - .6 Discard any paint that exceeds its pot life; as defined by the manufacturer for the ambient temperature conditions, or becomes oxidized, thickened, ropy, lumpy or dirty during the course of coating operations; do not use this material for any coating operations.

- .4 Application Equipment: Apply coatings using spray equipment, brushing and rolling, or a combination of these methods; other application methods may be used only with written acceptance from the Consultant.
- .5 Film Thickness: Apply coatings to specified thickness ranges listed in Coating Schedule and as follows:
 - .3 Recoat surfaces that have less than the specified film thickness.
 - .4 Remove and recoat surfaces that have more than the specified film thickness as directed by the Consultant; greater thickness than required may detrimentally affect appearance and service life of coatings.
 - .5 Check wet film thickness at the time the paint is applied to ensure that the proper dry film thickness is obtained:
 - .1 Minimum wet film thickness is equal to the dry film thickness divided by the percentage (expressed as a decimal) of volume solids in the paint used with the result rounded up to the next full mil thickness.
 - .2 Equip each painter with their own wet film thickness gauge and conduct frequent checks while coating is applied to ensure that film thickness is achieved.

3.05 QUALITY CONTROL

- .1 Third Party Inspection: Consultant will provide a NACE certified quality assurance inspector to monitor and accept the work; Contractor shall provide the Inspector, the Consultant and the City safe access to all areas of the work in all stages of completion and as follows:
 - .3 Do not apply any coating materials until cleaning, and surface preparation have been reviewed and accepted by the Consultant; failure to follow this requirement will necessitate the complete removal by blast cleaning of coatings placed over surfaces not reviewed and accepted by the Consultant; each coat must be acceptably dry to manufacturers specified recoat time, and thickness of each coat reviewed and accepted by Consultant before applying any subsequent coat.
 - .4 Consultant reserves the right to test each batch of coatings as it arrives to the shop or site to verify that coating being supplied to the project meets the requirements of the specifications for colour, gloss and solids content; testing will require the removal of one sealed 4 Litre kit samples of coating for each batch of primer, mid-coat and topcoat chosen at random by the Consultant.
 - .5 Consultant reserves the right to assess cost of kits to Contractor where testing indicates unacceptable materials.
- .2 Notify Consultant when coatings arrive to the shop or site so that appropriate samples and reports can be prepared; remove and replace coatings failing to meet specified requirements with new materials at no cost to the City or Consultant.
- .3 Hold Points: Establish hold point in the work to allow Consultant to perform quality assurance operations; allow access to the work in a particular area until coating work in that area is finished and accepted; failure to observe hold points may require cleaning of the area down to bare metal and recoating at no additional cost to the City or Consultant; hold points shall include the following:
 - .3 Post priming and before stripe coating the surface
 - .4 Post stripe coating and before mid-coating the surface
 - .5 Post mid-coat and before topcoat
 - .6 Post topcoat
- .4 Inspector will determine coating thickness using a device that measures magnetic plane existing between surface of steel and peaks of coating profile; reapplication of coatings used to fill below this plane will be performed at no additional cost to the City or Consultant.

- .5 Reasons for Rejection: Any newly coated surfaces will be considered to lack uniformity, continuity and soundness, and will be rejected where any of the following defects are apparent:
- .3 Over or under thickness when measured according to SSPC PA2 or agreed alternative.
 - .4 Runs, sags, holidays or shadowing caused by inefficient application methods.
 - .5 Evidence of poor coverage at bolts, plate edges, lap joints, crevices, pockets, corners and re-entrant angles.
 - .6 Surfaces that have been struck, scraped, spotted by rain or otherwise damaged.
 - .7 Surfaces that exhibit an objectionable texture such as orange peel, mud cracking, fish eyes, or similar defects.
 - .8 Surfaces damaged by over spray.

3.06 CLOSEOUT ACTIVITIES

- .1 Repairs to Rejected Work: Repair areas identified by the Consultant by cleaning off all damaged coatings and reapply complete coating system using materials to match original coating system and as follows:
- .3 Cure each coat to manufacturer's recommended minimum recoat time before applying subsequent coats.
 - .4 Apply subsequent coats prior to maximum recoat time listed by the manufacturer.
 - .5 Perform repairs at Contractor's expense.
- .2 Cleaning: Remove all containment, scaffolding and staging when project reaches completion and repair any damage to coating, structure or surrounding property and as follows:
- .3 Leave entire site in a neat and tidy condition with all coating cans, masking materials and other debris removed from site and disposed of in an acceptable manner.

3.07 PROTECTION

- .1 Protection of Finished Surfaces: Protect and maintain the coated surfaces until Final Acceptance of the entire project.
- .2 Protection of Unfinished Surfaces: Protect surfaces not receiving coatings and are as follows:
- .3 Surfaces that are cast into concrete such as the top and sides of the top flange of beams or the side of expansion joints in contact with concrete.
 - .4 Stainless steel components.
 - .5 Hot Dip Galvanized surfaces, unless indicated otherwise.
 - .6 Concrete surfaces adjacent to coated steel surfaces such as sidewalks and architectural precast concrete.

3.08 COATING SCHEDULE

- .1 Structural Steel, Column Closure Piece and steel Components: Organic zinc/epoxy/polyurethane:
- .3 Abrasive blast the steel to meet SSPC SP-6 Commercial Blast; establish a blast profile of 40 to 65 μm and sharp; peened or rounded surface profiles are not acceptable.
 - .4 Apply prime coat within the manufacturers recommended thicknesses, let cure for the manufacturer's recommended time at the ambient temperature. Note: Any faying surfaces shall be coated according to the Manufacturer's Class B certificate conditions for that product. Faying surfaces shall be masked to protect them and to prevent further coating.
 - .5 Stripe coat all applicable areas with mid-coat material; coating materials may be applied by spray, but must be brushed in and around items striped. Allow the coating to cure for the manufacturer's recommended time at the ambient temperature.

- .6 Apply the mid-coat at the manufacturer's recommended thicknesses; let cure for the manufacturer's recommended time at the ambient temperature.
- .7 Once the mid-coat is applied and cured, the topcoat shall be applied and cured prior to shipment.
 - .1 Use sufficient dunnage to prevent damage during shipment and erection procedures.
 - .2 Repair all damage caused by shipping and erection procedures at the Contractor's expense.
- .8 Apply the topcoat at the manufacturer's recommended thicknesses; let cure for the manufacturer's recommended time at the ambient temperature.
- .9 Install protective measures necessary to meet requirements of this Section.

3.08 SAMPLE AGREEMENT TO PROVIDE WARRANTY

- .1 Following page contains sample agreement form required by Item 1.11 above.
- .2 Submit completed Form at time of Tender Submission.

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AGREEMENT TO PROVIDE 5 YEAR BRIDGE COATING WARRANTY (Addendum 4)

(Name of Coating manufacturer)

manufacturer of _____
(Coating System Name)

and _____
(Applicator's Company Name)

who is an approved coating Applicator of the coating system, hereby certify that in the event that the Contractor is awarded the coating contract for

(Contract Number)

(Contract/Bridge Name)

the undersigned parties jointly agree to provide a 5 year Warranty for the work. Warranty period will commence at the completion of the work. The Warranty shall include all repair costs needed within the 5 year period.

APPLICATOR:

(Name of Company Officer) _____
(Corporate Position) _____
(Signature of Company Officer)

(Name of Witness) _____
(Signature of Witness) _____
(Date)

CONTRACTOR:

(Name of Company Officer) _____
(Corporate Position) _____
(Signature of Company Officer)

(Name of Witness) _____
(Signature of Witness) _____
(Date)

END OF SECTION

1. GENERAL

1.01 RELATED REQUIREMENTS

- .1 Section 05 12 00 – Structural Steel
- .2 Section 05 58 00 – Formed Metal Fabrication
- .3 Section 07 92 00 – Joint Sealants
- .4 Section 06 00 10 – Electrical Specifications

1.02 SUBMITTALS

- .1 Provide required information in accordance with Section 01 00 06 – General Requirements: Submittals.
- .2 Action Submittals: Provide the following submittals before starting any work of this Section:
 - .1 Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of sign.
 - .2 Shop Drawings: Include plans, elevations, and large-scale sections of typical members and other components; including:
 - .1 Detail the construction of the various parts of the work
 - .2 Methods of joining
 - .3 Thickness of materials
 - .4 Finishes to be applied to the various exposed surfaces
 - .5 Details of anchoring joints, welds, fastenings
 - .6 Relation of work to other trades, including all required cutouts, and all other pertinent data and information
 - .7 Layouts of all signs in this contract
 - .8 Wiring diagrams and related hardware (by manufacturer's numbers)
 - .9 Show mounting methods, grounds, mounting heights, layout, spacing, reinforcement, accessories, and installation details.
 - .10 Provide message list for each sign, including large-scale details of wording, lettering artwork layout.
 - .3 Samples:
 - .1 Submit 1 - full size sample of glass sign. Once accepted by City keep in location readily accessible for review of final Work; remove when instructed by Consultant
 - .2 Submit 1 – 150 mm x 150 mm sample of galvanized steel, painted as specified.

1.03 PROJECT CLOSEOUT SUBMISSIONS

- .1 Operation and Maintenance Data: Submit manufacturer's written instructions for repair and cleaning procedures, include name of original installer and contact information in accordance with Section 01 00 06 – General Requirements: Operation and Maintenance Manuals.

1.04 SITE CONDITIONS

- .1 Site Measurements: Verify dimensions by site measurements before fabrication and indicate measurements on shop drawings where signage is indicated to fit between other building elements. Coordinate fabrication schedule with construction progress to avoid delaying the Work

- .2 Established Dimensions: Establish dimensions and proceed with fabricating signage 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; adjust character spacing to suit actual site dimensions where required.

2. PRODUCTS

2.01 MATERIALS

- .1 Clock Tower Foundation and Base: Concrete foundation and base as indicated on Structural Drawings.
- .2 Structural Steel: Refer to Section 05 12 00.
- .3 Formed Stainless Steel Column Cover: Refer to Section 05 51 13.
- .4 Galvanized Steel (Tower Cap): Steel Plates in accordance with CSA G40.20/G40.21, Grade 300W, hot dip galvanized as indicated in Section 05 12 00, paint P1: ETS Blue, match adjacent glass colour, paint system indicated in item 2.03.
- .5 Formed Aluminum Trim and closures panels: Refer to Section 05 58 00
- .6 Clock and Temperature Display:
 - .1 Display Size: .790 mm H x 1270 mm W x 130 mm D
 - .2 Basis of Design Manufacture: Daktronics Galaxy 19.8 mm Amber Double face sign, model GS6-32x60-19.8-2V Copper communications (RJ-45 Ethernet).
- .7 Lighting: Refer to Electrical Drawings
- .8 Glass Signage Panel:
 - .1 Laminated Glass: Nominal 11 mm thickness glass unit, as follows:
 - .1 Glass Type: Heat strengthen, laminated glass in accordance with ASTM C1172
 - .2 Glass Colour: Ultra Clear (Low iron)
 - .3 Edge Treatment for Exterior Installation: Exposed, protected with clear sealant recommended by glass manufacturer
 - .4 Interlayers: Custom printed laminates, as indicated on Drawing A2.01
 - .5 Basis-of-Design Materials: Gold Ray, Sample No. S23517
 - .6 Colour Schedule:

- 9. ● P1: ETS Blue: Pantone 294
- 10.
- 11. ● P2: White – Refer to Sample No. S23517
- P3: Black – Match clock cabinet colour

2.02 ACCESSORIES

.1 Fasteners:

.1 Exposed Fasteners:

- .1 Stainless steel fasteners in locations indicated, counter sunk into metal surface.
 - Pre-punch fastener holes for counter sinking.
- .2 Painted exposed fasteners as require, heads to be painted to match finish metal, counter sunk into metal surface.
 - Pre-punch fastener holes for counter sinking.

.2 Concealed Fasteners: Fabricator's standard metal fasteners.

.2 Adhesives and Tapes: Fabricator's standard, for the purposes of work of this Section.

.3 Weather Sealants: As indicated in Section 07 92 00.

.4 Structural Sealant: As indicated in Section 07 92 00.

.5 Gasket: As indicated in Section 07 91 00.

2.03 FINISH

.1 Primer and Finish System for Galvanized Steel: As follows:

- .1 Surface preparation: Minimum SSPC-SP1 for galvanized steel as required by Paint Manufacturer's requirements.
- .2 Zinc Rich Anticorrosive Primer: Epoxy based, high solids 2 component primer, applied to minimum 75 µm dry film thickness; type as recommended by finish coating manufacturer.
- .3 Siloxane Based Coating System: Acrylic modified polysiloxane, 2 component, isocyanate-free base and curing agent, providing superior gloss and colour retention, long term impact resistance and flexibility, applied to a minimum 125 µm dry film thickness
- .4 Colour: As indicated.
- .5 Gloss Level: A indicated
- .6 Edge Treatment: Stripe coat all edges to maintain minimum dry film thickness requirements
- .7 Acceptable Material:

- .1 Carboline, Carboxane 2000 System
- .2 International Protective Coatings, Interfine 979 System

3. EXECUTION

3.01 INSTALLATION

- .1 General: Locate signs and accessories where indicated, using mounting methods of types described and in compliance with manufacturer's written instructions.
 - .1 Install clock tower elements level, plumb, and at heights indicated, with surfaces free from distortion and other defects in appearance.
 - .2 Mechanical Fasteners: Use non-removable mechanical fasteners placed through predrilled holes. Attach with fasteners and anchors suitable for secure attachment to substrate as recommended in writing by sign manufacturer.
- .2 Installation:
 - .1 Install foundations to levels recommended by Geotechnical investigation in conformance with the Alberta Building Code and Structural Drawings.
 - .1 Top of foundation as indicated.
 - .2 Clock Tower Base, smooth formed concrete
 - .3 Structural Steel: Install support structure as indicated in reviewed shop drawings.
 - .4 Power: Provide power as indicated on Electrical Drawings and shop drawings.
 - .5 Clock and weather probe, install as indicated by Manufacture and as indicated on Shop Drawings.
 - .6 Architectural Features: Install stainless steel column cover and aluminum trim/ closures as indicated.
 - .1 All fasteners are to be concealed unless indicated as exposed on Drawings. Exposed fasteners to match adjacent metal finish.
 - .7 Glass Sign Installation: As indicated and in conformance with Manufacturer's written requirements.

3.02 CLEANING AND PROTECTION

- .1 Use all means necessary to protect materials before, during and after installation and to protect the installed work of other trades.
- .2 Following installation, clean all surfaces ensuring removal of all fingerprints, dirt, shavings, adhesives, dust particles, etc. Prior to leaving the installation location, clean the work area, walls, floor, etc., that may be soiled during the installation process.
- .3 Protect signs from damage until acceptance by City.

END OF SECTION

1. GENERAL

1.01 SUMMARY

- .1 This Section includes requirements for supply and installation of toilet compartments and accessories required for a complete and functioning installation.

1.02 RELATED REQUIREMENTS

- .1 Section 09 21 16 – Gypsum Board Assemblies
- .2 Section 09 30 00 – Tiling
- .3 Section 10 28 13 – Toilet Accessories

1.03 REFERENCE STANDARDS

- .1 American Society for Testing and Materials (ASTM):
 - .1 ASTM A167-99 (2009), Stainless Steel and Heat-Resisting Chromium-Nickel Steel Plate, Sheet and Strip
 - .2 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 Standards Association (CSA):
 - .1 CAN/CSA B651-04, Accessible Design for the Built Environment

1.04 ADMINISTRATION REQUIREMENTS

- .1 Coordination: Coordinate site dimensions affecting work of other Sections and provide data, dimensions and components, anchors and assemblies installed by other Sections in sufficient time for installation of products specified in this Section.

1.05 SUBMITTALS

- .1 Provide required information in accordance with Section 01 00 06 – General Requirements: Submittals.
- .2 Action Submittals: Provide the following submittals before starting work of this section:
 - .1 Product Data: Submit product data from manufacturer indicating proposed components and installation requirements.
 - .2 Shop Drawings: Submit shop drawings indicating anchoring and construction details, hardware, finish, relevant dimensions, plan layout and elevations. Refer to CAN/CSA B651 standard for mounting of barrier free stall grab bars, handles and toilet paper dispensers.
 - .3 Samples for Initial Selection: Provide manufacturer's colour charts showing the full range of colours for initial selection of materials.
 - .4 Samples for Verification: Provide samples for verification for each product selected.

1.06 PROJECT CLOSEOUT SUBMISSIONS

- .1 Operation and Maintenance Data: Submit manufacturer's written instructions for repair and cleaning procedures, include name of original installer and contact information in accordance with Section 01 00 06 – General Requirements: Closeout Submissions.

-
- 1.07 DELIVERY, STORAGE AND HANDLING
- .1 Delivery and Acceptance Requirements: Deliver, handle and store prefabricated units in accordance with manufacturer's directions.
 - .2 Storage and Handling Requirements:
 - .1 Store units at site on raised wood pallets protected from the elements and corrosive materials, and as follows:
 - .1 Do not remove from crates or other protective covering until ready for installation.
- 1.08 SITE CONDITIONS
- .1 Site Measurements: Verify dimensions by site measurements before fabrication and indicate measurements on shop drawings where toilet compartments are indicated to fit between or around other construction; coordinate fabrication schedule with construction progress to avoid delaying the Work.
 - .2 Established Dimensions: Establish dimensions and proceed with fabricating glass toilet compartments 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.
- 2. PRODUCTS**
- 2.01 MANUFACTURERS
- .1 Acceptable Materials Manufacturers: Subject to compliance with requirements specified in this Section; where multiple listings of manufacturers occur, use any of the following listed manufacturers' products in accordance with Section 01 00 06 – General Requirements: Substitutions and Product Options including the following:
 - .1 Global Partitions
 - .2 GSS (General Storage Systems)
 - .3 Hadrian Manufacturing Inc.
 - .4 Shanahan's Limited
 - .2 Substitutions: City may consider additional manufacturers having similar products to Acceptable Materials Manufacturers listed above during the construction period, provided they meet the performance requirements established by the named products and provided they submit requests for substitution in accordance with Section 01 00 06 – General Requirements: Substitutions and Product Options before starting any work of this Section:
 - .1 Do not use substitute materials to establish Bid Price.
 - .2 Substitutions that appear as a part of the project without review and acceptance by the City will be rejected, and replaced with one of the specified materials.
- 2.02 MATERIALS
- .1 Type: Floor Mounted partitions
 - .2 Doors, Panels, and Pilasters: Sheet steel with commercial quality hot dipped zinc coating, in accordance with ASTM A653/A653M, Commercial Steel (CS), ZF001 (A01) galvanized, bonded each side of paper honeycomb core with returned and sealed edges; minimum steel thickness for doors and panels 0.80 mm thick for doors and panels, pilasters, reinforcement 3 mm.
 - .3 Pilaster support: Adjustable bolts with stainless steel collar to ASTM A167.

- .4 Pilaster Shoes: 100 mm high; Stainless steel.
- .5 Anchor Hardware: Wall and panel brackets, 1,473 mm long "U" channel mounting bracket for privacy with stainless steel finish.
- .6 Finish Hardware: Hinge housing, surface mounted, coat hook and bumper, and pull handles for barrier free doors, door stop and keeper, to manufacturer's standard bright finish.
- .7 Latch Hardware: Built-in, vandal resistant, emergency access feature, manufacturer's standard bright finish, operable with one hand and not requiring tight grasping, pinching or twisting of the wrist.
- .8 Exposed Fasteners: Cadmium plated steel, vandal resistant type.
- .9 Concealed Fasteners: Steel, hot dipped galvanized.
- .10 Urinal Stall Screens:
 - .1 Provide urinal stall screens consisting of panel as specified for toilet compartments.
 - .2 For urinal stalls provide 450 mm wide x 1050 mm high screen.

2.03 ACCESSORY MATERIALS

- .1 Provide accessories as required for complete installation.

2.04 FABRICATION

- .1 Fabricate standard access stall doors minimum 610 mm wide inward swinging and barrier-free access stall doors minimum 815 mm wide outward swinging with stall widths to minimum dimensions indicated on Drawings and in accordance with CAN/CSA B651.
- .2 Fabricate formed doors, panels and pilasters with closed edges; mitre and weld corners to make a smooth and tight hygienic joint.
- .3 Provide internal reinforcement for accessory attachment.

2.05 FINISHES

- .1 Colour selected by City from manufacturer's standard colour selection.

3. EXECUTION

3.01 EXAMINATION

- .1 Examine site conditions where Work will be applied and ensure acceptability for complete and satisfactory installation; beginning of installation will denote acceptance of site conditions.

3.02 INSTALLATION

- .1 Install partitions secure, plumb and square.
- .2 Leave 13 mm space between wall and panel or end pilaster.
- .3 Anchor mounting brackets to hollow walls using bolts and toggle type anchors and to steel supports with bolts in threaded holes.
- .4 Attach panel and pilaster to "U" channel mounting brackets with through type sleeve bolt and nut.
- .5 Provide for adjustment of floor variations with screw jack through steel saddles made integral with pilaster. Conceal floor fixings with pilaster shoes.

- .6 Equip each door with hinges, latch set, and coat hooks, and as follows:
 - .1 Mount coat hook on door.
 - .2 Provide 1 coat hook at 1650 mm for standard stalls.
 - .3 Adjust and align hardware for easy, proper function.
 - .4 Install door bumper wall mounting.
 - .5 Set standard doors open position at 30° to front.
- .7 Full length door stop fit over edge of door.
- .8 Mount door pulls on out swinging doors on inside and outside of door in accordance with CAN/CSA B651.
- .9 Install hardware specified in Section 10 28 13 and in accordance with CAN/CSA B651.

3.03 FLOOR SUPPORTED PARTITION ERECTION

- .1 Secure pilasters to floor with pilaster supports anchored with minimum 50 mm penetration in structural floor.
- .2 Level, plumb and tighten installation with levelling device.
- .3 Secure pilaster shoes in position.
- .4 Set tops of doors level with tops of pilasters when doors are in closed position.

3.04 SCREENS ERECTION

- .1 Anchor screen panels to walls with 3 panel brackets.
- .2 Install at 150 mm A.F.F.

3.05 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 panel surfaces using mild soap or other cleaning agent approved by manufacturer.

END OF SECTION

1. GENERAL

1.01 SUMMARY

- .1 This Section includes requirements for supply and installation of toilet accessories.

1.02 RELATED REQUIREMENTS

- .1 Section 09 21 16 – Gypsum Board Assemblies
- .2 Section 09 30 00 – Tiling
- .3 Section 10 21 13 – Toilet Compartments: Compartments and screens.

1.03 REFERENCE STANDARDS

- .1 American National Standards Institute (ANSI):
 - .1 ANSI/ICC A117.1-2003, Standard for Accessible and Usable Buildings and Facilities
- .2 American Society for Testing and Materials (ASTM):
 - .1 ASTM A666-10, Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar
 - .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 Canadian General Standards Board (CGSB):
 - .1 CAN/CGSB-12.5-M86, Mirrors, Silvered
- .4 Canadian Standards Association (CSA):
 - .1 CAN/CSA B651-12, Accessible Design for the Built Environment

1.04 ADMINISTRATIVE REQUIREMENTS

- .1 Coordination: Coordinate accessory locations with other affected work to prevent interference with clearances required for access by disabled persons, proper installation within substrate, blocking requirements, adjustment, operation, cleaning, and servicing of accessories including the following:
 - .1 Installation of grab bars to metal toilet partitions, provide templates and detail to partition manufacturer for shop fabrication of steel reinforcing plates. Instruct whether shop or field, drill and tap technique will be used.
 - .2 Reinforcement locations indicated on Drawing VLW-0412-02-pe-A0.01.

1.05 SUBMITTALS

- .1 Provide required information in accordance with Section 01 00 06 – General Requirements: Submittals.
- .2 Action Submittals: Provide the following submittals before starting work of this section:
 - .1 Submit product data including construction details, material descriptions and thicknesses, dimensions, profiles, fastening and mounting methods, specified options, and finishes for each type of accessory specified.

-
- 1.06 PROJECT CLOSEOUT SUBMISSIONS
- .1 Operations and Maintenance Data: Submit maintenance data for accessories in accordance with Section 01 00 06 – General Requirements: Closeout Submissions; include lists of sources for disposable supplies, replacement parts and service recommendations.
- 1.07 QUALITY ASSURANCE
- .1 Regulatory Requirements: Install toilet accessories in accordance with CAN/CSA B651 at accessible washroom locations.
- 1.08 DELIVERY, STORAGE AND HANDLING
- .1 Delivery and Handling Requirements: Deliver washroom accessories in manufacturer's original, undamaged packaging, clearly marked for contents and location within building.
- 1.09 WARRANTY
- .1 Manufacturer's Mirror Warranty: Submit manufacturer's standard written warranty, executed by mirror manufacturer agreeing to replace mirrors that develop visible silver spoilage defects and as follows:
- .1 Minimum Warranty Period: 15 years from date of Substantial Performance for the Project.
- 2. PRODUCTS**
- 2.01 MANUFACTURERS
- .1 Acceptable Materials Manufacturers: Subject to compliance with requirements specified in this Section; where multiple listings of manufacturers occur, use any of the following listed manufacturers' products in accordance with Submittals including the following:
- .1 ASI Specialties Inc.
- .2 Bobrick Washroom Equipment of Canada Ltd.
- .3 Bradley Corporation
- .4 Dyson Canada Ltd.
- .5 World Dryer
- .2 Substitutions: City may consider additional manufacturers having similar products to Acceptable Materials Manufacturers listed above during the construction period, provided they meet the performance requirements established by the named products and provided they submit requests for substitution in accordance with Section 01 00 06 – General Requirements: Substitutions and Product Options before starting any work of this Section:
- .1 Do not use substitute materials to establish Bid Price.
- .2 Substitutions that appear as a part of the project without review and acceptance by the City will be rejected, and replaced with one of the specified materials.
- 2.02 DESIGN REQUIREMENTS
- .1 Fastener and Mounting Requirements: Install grab bars to withstand a minimum 1.3 kN downward shear force when tested in accordance with ASTM F446; provide fasteners and mountings of types suitable for substrates, and as required for permanent and durable installation.
- .2 Labels: Provide unobtrusive stamped manufacturer logo on exposed surfaces; with printed, waterproof label or stamped nameplate indicating manufacturer's name and product model number mounted to non-exposed faces.

- .3 Surface Mounted Units: Provide units having tight seams and joints, and with exposed edges rolled; doors and access panels having continuous stainless steel hinges; and concealed anchorage where possible.
- .4 Framed Glass Mirror Units: Provide frames for glass mirror units designed to protect glass edges from damage, and as follows:
 - .1 Mirror Backing: Backing and support system that permits rigid, tamper resistant glass installation and prevents moisture accumulation consisting of minimum nominal 0.8 mm galvanized steel sheet same size as full mirror size with non-absorptive filler material; corrugated cardboard is not an acceptable filler material.
 - .2 Mirror Unit Hangers: Provide rigid, tamper and theft resistant, heavy duty wall hanging device consisting of one piece galvanized steel security type concealed locking devices requiring a special tool to remove.

2.03 MATERIALS

- .1 Stainless Steel: Type 304, stretcher levelled stainless steel sheet in accordance with ASTM A666; minimum nominal thickness as established by product type and manufacturers standard.
- .2 Sheet Steel: Steel: Cold rolled, commercial quality, stretcher levelled steel sheet in accordance with ASTM A366; minimum nominal thickness as established by product type and manufacturers standard; surface preparation and metal pretreatment as required for applied finish.
- .3 Galvanized Steel Sheet: Minimum Z180 coating designation, cold rolled commercial quality, stretcher levelled galvanized steel sheet in accordance with ASTM A653/A653M; minimum nominal thickness as established by product type and manufacturers standard.
- .4 Mirror Glass: In accordance with CGSB 12.5; 3A tempered mirror, 6 mm nominal thickness, with silvering, electroplated copper coating, and protective organic coating.
- .5 Fasteners: Manufacturer's standard for installation; through bolts for mounting to toilet partitions; expansion anchors of type designed to accept anticipated loads and as follows:
 - .1 Galvanized Steel Mounting Devices: In accordance with ASTM A153/A153M, hot dip galvanized after fabrication.
 - .2 Screws, Bolts, and other Devices: Same material as accessory unit, tamper and theft resistant when exposed, and galvanized steel when concealed.
- .6 Keys: Provide universal keys for internal access to accessories for servicing and re-supplying. Provide minimum of six (6) keys to City's representative.

3. EXECUTION

3.01 EXAMINATION

- .1 Examine site conditions and verify that the following are complete:
 - .1 Wall thickness and construction will accept recessed accessories.
 - .2 Solid blocking for support and anchoring of washroom accessories is installed where required.
 - .3 Frames and anchors provided are correctly and securely installed ready to accept the accessory scheduled for the specific location.
 - .4 Painting is complete and dry in area of installation before accessories are installed.
- .2 Beginning of installation will denote acceptance of site conditions.

3.02 INSTALLATION

- .1 Install accessories in accordance with manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer; install toilet accessory units level, plumb, and firmly anchored in locations and at heights indicated.
- .2 Conform to mounting heights indicated on Fixture Mounting Schedule as indicated on Drawing A0.01 and meeting accessibility requirements listed in CAN/CSA B651; confirm locations prior to site installation.
- .3 Secure mirrors to walls using concealed, tamper resistant hangers, toggle bolts, or screws; set mirrors level, plumb, and square at locations indicated, centred over lavatory.
- .4 Install and secure fixtures rigidly in place using tamper proof headed screws and bolts for fasteners and as follows:
 - .1 Stud Walls: Install steel back plate to stud prior to gypsum board finish; provide threaded studs or plugs in back plates.
 - .2 Toilet Compartment Partitions: Install items using male/female through bolts.

3.03 ADJUSTING AND CLEANING

- .1 Adjust accessories for unencumbered, smooth operation and verify that mechanisms function properly. Replace damaged or defective items.
- .2 Remove temporary labels and protective coatings.
- .3 Clean and polish exposed surfaces in accordance with manufacturer's written recommendations.
- .4 Provide a list of paper towel, toilet paper and other disposable supplies required to make accessories usable.
- .5 Instruct City in proper adjustment, operation and refilling procedures.

3.04 WASHROOM AND CUSTODIAL ACCESSORY SCHEDULE

No.	Description/Model
BT	Baby Change Table: Surface mounted, horizontal design, prefabricated baby changing station with built-in sanitary liner dispenser and safety belt, provide initial stocking list and as follows: Acceptable Materials: Koala Kare KB200-00 Horizontal Change Station Safe Strap Wall Mounted Changing Station
CH	Coat Hooks: Satin finished stainless steel or chrome plated brass, square profiled robe hook with concealed mounting, provide 2 for each stall, located as directed by City and as follows: 1. Acceptable Materials: 1. ASI 7340-S 2. Bobrick B-76717 Bradley 911
G1	Straight Grab Bars: Heavy duty, 38 mm Ø satin finished type 304 stainless steel

G2	<p>tube having nominal 1.2 mm wall thickness and slip resistant grip, concealed mounting plate and anchors with stainless steel cap secured using vandal resistant set screws, length as indicated in Schedule on Drawing VLW-0412-02-PE-A0.01 and as follows:</p> <p style="text-align: center;">Acceptable Materials:</p> <table style="margin-left: auto; margin-right: auto;"> <tr> <td>ASI</td> <td>3200 Series</td> </tr> <tr> <td>Bobrick</td> <td>6806 Series</td> </tr> <tr> <td>Bradley</td> <td>812 Series</td> </tr> </table>	ASI	3200 Series	Bobrick	6806 Series	Bradley	812 Series			
ASI	3200 Series									
Bobrick	6806 Series									
Bradley	812 Series									
HD	<p>Hand Dryer: Surface mounted, 115 Volt AC, 12.5 Amp, 900 Watts, 60 Hz, automatic sensor cycle air hand dryer, GREENSPEC approved, colour white and as follows:</p> <p style="text-align: center;">2. Acceptable Materials:</p> <table style="margin-left: auto; margin-right: auto;"> <tr> <td>1.</td> <td>XLERATOR</td> <td>XL-W</td> </tr> <tr> <td>2.</td> <td>Dyson</td> <td>Airblade</td> </tr> <tr> <td>3.</td> <td>ASI</td> <td>Turbo-Dri 0197</td> </tr> </table>	1.	XLERATOR	XL-W	2.	Dyson	Airblade	3.	ASI	Turbo-Dri 0197
1.	XLERATOR	XL-W								
2.	Dyson	Airblade								
3.	ASI	Turbo-Dri 0197								
M1	<p>Mirror: Frameless mirror, size as indicated on the Drawings, mounted 1000 mm AFFL maximum to bottom of frame and as follows:</p> <p style="text-align: center;">3. Acceptable Materials:</p> <table style="margin-left: auto; margin-right: auto;"> <tr> <td>1.</td> <td>ASI</td> <td>0600x2436</td> </tr> <tr> <td>2.</td> <td>Bobrick</td> <td>B-165x2436</td> </tr> <tr> <td>3.</td> <td>Bradley</td> <td>781x2436</td> </tr> </table>	1.	ASI	0600x2436	2.	Bobrick	B-165x2436	3.	Bradley	781x2436
1.	ASI	0600x2436								
2.	Bobrick	B-165x2436								
3.	Bradley	781x2436								
MS	<p>Mop Strip: Stainless steel mop and broom holder with non-slip handle restraints, designed to hold three (3) handles 19 mm to 30 mm Ø and as follows:</p> <p style="text-align: center;">4. Acceptable Materials:</p> <table style="margin-left: auto; margin-right: auto;"> <tr> <td>1.</td> <td>ASI</td> <td>8215-3</td> </tr> <tr> <td>2.</td> <td>Bobrick</td> <td>B-223x24</td> </tr> <tr> <td>3.</td> <td>Bradley</td> <td>9953</td> </tr> </table>	1.	ASI	8215-3	2.	Bobrick	B-223x24	3.	Bradley	9953
1.	ASI	8215-3								
2.	Bobrick	B-223x24								
3.	Bradley	9953								
ND	<p>Feminine Napkin Disposal: Surface mounted, concealed fastening, self closing disposal push flap door and stainless steel removable receptacle and as follows:</p> <p style="text-align: center;">Acceptable Materials:</p> <table style="margin-left: auto; margin-right: auto;"> <tr> <td>ASI</td> <td>0852</td> </tr> <tr> <td>Bobrick</td> <td>B-270]</td> </tr> <tr> <td>Bradley</td> <td>4722-15</td> </tr> </table>	ASI	0852	Bobrick	B-270]	Bradley	4722-15			
ASI	0852									
Bobrick	B-270]									
Bradley	4722-15									
PD	<p>Paper Towel Dispenser and Disposal: Semi recessed, handicap accessible, capable of holding 'C' fold, multi-fold or single fold paper towels, with leak proof waste container and as follows:</p>									

	<p>Acceptable Materials:</p> <p>ASI 64676-2</p> <p>Bobrick B-38032</p> <p>Bradley 2017-100000</p>
SD	<p>Soap Dispenser: All purpose valve, half recessed, horizontal mounting stainless steel surface mounted dispenser, refillable from top with keyed lock cap, 1.18 L capacity with visible viewing window and as follows:</p> <p>5. Acceptable Materials:</p> <p>1. ASI 0345</p> <p>2. Bobrick B-2112</p> <p>3. Bradley 6542</p>
TD	<p>Toilet Tissue Dispenser: Double roll, surface mounted, tissue dispenser with concealed mounting, stainless steel construction, bright polished finish with theft resistant spindles and as follows:</p> <p>6. Acceptable Materials:</p> <p>1. ASI 7305-2 Series</p> <p>2. Bobrick B-686-60</p> <p>3. Bradley 5234-52</p>

END OF SECTION

1. GENERAL**1.01 SUMMARY**

- .1 This Section includes requirements for design, supply and installation of bird control landing barriers on exposed or protected ledges where birds settle, roost or nest, to prevent damage from droppings and nesting materials.

1.02 ADMINISTRATIVE REQUIREMENTS

- .1 Pre-construction Meeting: Arrange for preconstruction meeting with City and installers to discuss placement of specified materials and confirm architectural layout; failure to conduct this meeting may result in removal and replacement of bird control devices that are visually distracting in the final installation.

1.03 SUBMITTALS

- .1 Provide requested information in accordance with Section 01 00 06 – General Requirements: Submittals.
- .2 Action Submittals: Provide the following submittals before starting any work of this Section:
 - .1 Product Data: Submit manufacturer's detailed installation instructions.
 - .2 Shop Drawings: Submit manufacturer's shop drawings indicating specific installation locations, methods of attachment, preservation of architectural features and means of access.
 - .3 Samples for Verification: Submit sample of specified material for confirmation to the City, minimum length 150 mm of strip materials.

1.04 PROJECT CLOSEOUT SUBMISSIONS

- .1 Submit maintenance instructions for inclusion in operating and maintenance manual in accordance with Section 01 00 06 – General requirements: Closeout Submissions.

1.05 QUALITY ASSURANCE

- .1 Qualifications: Provide proof of qualifications when requested by City:
 - .1 Installer: Use installer who is certified by bird control device manufacturer for installation of the specified products and having experience with projects of similar scope and complexity.

1.06 DELIVERY, STORAGE AND HANDLING

- .1 Delivery and Acceptance Requirements: Protect products from damage before, during and after installation; replace damaged materials immediately.

1.07 SITE CONDITIONS

- .1 Site Measurements: Verify dimensions by site measurements before fabrication and indicate measurements on shop drawings where bird control devices are indicated to fit between or around other construction; coordinate fabrication schedule with construction progress to avoid delaying the Work.
- .2 Established Dimensions: Establish dimensions and proceed with fabricating bird control devices 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.

2. PRODUCTS**2.01 MANUFACTURERS**

- .1 Acceptable Materials Manufacturers: Subject to compliance with requirements specified in this Section; where multiple listings of manufacturers occur, use any of the following listed manufacturers' products in accordance with Section 01 00 06 – General Requirements: Substitutions and Product Options including the following:
- .1 Bird-B-Gone Inc.
 - .2 Bird Barrier America Inc.
 - .3 BirdMaster Bird Control Systems
 - .4 Nixalite of America Inc.
- .2 Substitutions: City may consider additional manufacturers having similar products to Acceptable Materials Manufacturers listed above during the construction period, provided they meet the performance requirements established by the named products and provided they submit requests for substitution in accordance with Section 01 00 06 – General Requirements: Substitutions and Product Options before starting any work of this Section:
- .1 Do not use substitute materials to establish Bid Price.
 - .2 Substitutions that appear as a part of the project without review and acceptance by the City will be rejected, and replaced with one of the specified materials.

2.02 DESIGN RESPONSIBILITY

- .1 Review drawings and design bird control landing barriers of sufficient width, locations and having appropriate fasteners for attachment to substrates indicated on Drawings; use one of the specified products or a combination of products to design an installation that provides minimum visual distraction for building architectural elements.

2.03 MATERIALS**.1 Bird Control Landing Barrier**

- .1 Spikes: Stainless steel blunt spikes, Type 316 spaced to humanely prevent birds from landing on surfaces indicated on Drawings; mounted to central flexible base strip complete with manufacturer's recommended mounting system, and as:
- .1 Width of Coverage: Minimum nominal 100 mm, to manufacturer's next size standard.
 - .2 Height: Nominal 100 mm to 115 mm to manufacturer's standard.
 - .3 Length: Minimum 600 mm per section, cut sections where shorter lengths are required.
 - .4 Number of Rows: As designed by the manufacturer and based on project conditions.
 - .5 Mounting System: As designed by the manufacturer and based on project conditions.
 - .6 Acceptable materials:
 - Bird-B-Gone, Bird Spike 2001
 - Bird Barrier, Bird Flite Spikes
 - BirdMaster SpringGuard Trident System
- .2 Bird Wire:
- .1 Wire: 0.45mm 1 x 7 stainless steel wire, U.V. stabilized clear nylon coated to 0.7mm finished diameter.
 - .2 Crimps: Nickel-plated copper.
 - .3 Metal Hardware: 316-grade stainless steel.

- .4 Plastic Hardware: High impact U.V. stabilized thermoplastic.
- .5 Number of Rows: As determined by the manufacturer and based on project conditions.
- .6 Mounting System: As determined by the manufacturer and based on project conditions.
- .7 Nylon coated stainless steel wire, wire attached to springs and posts.
- .8 Acceptable Materials:
 - Bird-B-Gone, Bird Wire 2000 Modular Post and Wire System
 - Nixalite, Fliteline
 - Bird Master, Springuard Bird Proofing System

3. EXECUTION

3.01 EXAMINATION

- .1 Examine installation area and verify site dimensions and other conditions affecting installation; proceed with work after detrimental conditions are corrected.

3.02 PREPARATION

- .1 Clean ledges and mounting surfaces, dry and free of peeling paint, rust, bird droppings or other debris affecting installation.
- .2 Treat and neutralize bird droppings, and remove in accordance with local occupational health and safety requirements; equip installers with appropriate personal protective equipment and respiratory protection, provide wash down and change facilities.

3.03 INSTALLATION

- .1 Bird Control Landing Barrier: Install bird control in accordance with manufacturer's written instructions and reviewed shop drawings and as follows:
 - .1 Install bird control landing barrier to overhang ledge by minimum 6 mm, and maximum 65 mm from vertical surfaces at back face of ledge.
 - .2 Install bird control landing barrier to completely cover top surface, and from corner to corner, of ledges, parapets and similar flat surfaces; installation at the outer perimeter will not be acceptable.
 - .3 Install bird control landing barrier straight and level, following contours of architectural features, spaced evenly with no spaces that could present a landing opportunity for deterred birds.

3.04 REPAIRS AND ADJUSTMENTS

- .1 Verify that bird control devices are fastened or adhered to mounting surfaces securely in accordance with manufacturer's requirements, or are subject to other installation or surface preparation that could impair long term performance of bird control devices; repair as necessary immediately.

END OF SECTION

1. GENERAL

1.01 SUMMARY

- .1 This Section includes requirements for supply and installation of waste receptacles, backless and backed benches designed specifically for use as transit seating.

1.02 RELATED REQUIREMENTS

- .1 Section 05 50 00 – Metal Fabrications: Tamperproof expansion fastenings for attachment to concrete slabs.

1.03 SUBMITTALS

- .1 Provide required information in accordance with Section 01 00 06 – General Requirements: Submittals.
- .2 Action Submittals: Provide the following submittals before starting any work of this Section:
 - .1 Product Data: Submit manufacturer's standard product data clearly indicating standard components that will be used for the project.
 - .2 Shop Drawings: Submit shop drawings indicating installation methods and materials, and layouts within transit shelters.
 - .3 Samples for Initial Selection: Provide manufacturer's colour charts showing the full range of colours for initial selection of materials.

1.04 QUALITY ASSURANCE

- .1 Qualifications: Provide proof of qualifications when requested by City:
 - .1 Manufacturer: Obtain materials from a single source having a minimum of 5 years of experience manufacturing transit site seating materials; provide a list of most recent projects indicating transportation authority, municipality or other high use public environment where similar materials as those required for this project have been used.

1.05 DELIVERY, STORAGE AND HANDLING

- .1 Storage and Handling Requirements: Handle products in accordance with manufacturer's instructions; store in manufacturer's original packaging until ready for installation and protect from impacts and abrasion during storage.

1.06 MOCK UPS

- .1 Provide a mock up of each custom made seating listed in Transit Specialty Items.

2. PRODUCTS

2.01 MANUFACTURER

- .1 Basis-of-Design Materials: Products named in this Section were used as the basis-of-design for the project;
 - .1 Basis-of-Design: Forms + Surfaces

1.02 TRANSIT SPECIALTY ITEMS

- .1 Custom made seating: 100% solid Kebony wood slats, natural/unfinished; brushed stainless steel frame and spacers complete with stainless steel hardware for exterior and commercial grade; surface mounted with stainless steel base plate; dimensions as indicated on the Drawings.
- .1 BN1: Four seat system, backed as indicated on plan/details A6.05.
- .2 BN2: Four seat system, backless as indicated on plan/details A6.05
- .2 Waste Receptacles (GB1 and GB2):
- .1 Heated and Unheated Waiting Areas Waste Receptacles (GB1): Cast aluminum receptacles with polyester powder coating; 135 L capacity, nominal 1100 mm high x 650 mm wide x 5500 mm deep; split-stream litter/recycling with two 60 L liners; lid with internal baffle plate with one opening for litter and one opening for bottles and cans; surface mount with concrete base for exterior installation and surface mount without concrete base for interior installation; colour to match seating specified above, and as follows:
- .1 Basis-of-Design Materials: Forms+Surfaces, Dispatch Litter and Recycling Receptacle, Model No. SLDIS-216
- .2 Accessories: Provide installation hardware and accessories required for complete installation.
- .2 Site/Exterior Waste Receptacles (GB2) free standing, split stream receptacle c/w two (2) 18 gallon half liners for litter and recycling streams; corrosion-resistant aluminum lid and body with powder coat finish; with FSC 100% kurnaru hardwood wood slats;, low density PE black liners with UL94HB fire rating; Side access door, swing out door; Rain cover: powdercoated to match lid.
- Basis-of-Design Product: Forms + Surfaces Apex Litter and Recycling Receptacle

3. EXECUTION**3.02 EXAMINATION**

- .2 Verify that substrates are stable and capable of supporting the weight of items covered under this section.
- .3 Verify that substrates are adequately prepared to securely anchor surface mounted items.

3.03 INSTALLATION

- .2 Install according to the manufacturer's installation instructions.

END OF SECTION

1. GENERAL

1.01 SUMMARY

- .1 It is the responsibility of Contractor to make requirements for affected related specification sections, and any requirements for alternates and substitutions available to Subcontractors:
 - .1 Subcontractors shall receive a complete set of documents for preparation of their bids, and to provide a clear understanding of the complete scope-of-work for the Project.
 - .2 Failure to provide required information to Subcontractors during the bid and Construction Phases of the Work will not relieve the Contractor of their responsibility for coordination of the affected Work.
 - .3 Contractor will be responsible for any additional costs to the Contract arising from Subcontractors not receiving a complete package of documents.
 - .4 Provide complete coordination between Mechanical Divisions to attain a complete and functional building mechanical system; Mechanical Divisions include, but are not limited to, the following:
 - .1 Division 20 – Mechanical General Provisions
 - .2 Division 22 – Plumbing
 - .3 Division 23 – Heating, Ventilating and Air Conditioning
 - .4 Division 25 – Integrated Automation
- .2 Provide complete, fully tested and operational mechanical systems to meet requirements described herein and in complete accord with applicable codes and ordinances:
 - .1 Include costs to obtain permits and to pay for fees and charges, including inspection charges by Authorities Having Jurisdiction that issue permits; coordinate related inspections; permits, fees and inspections include, but are not limited to, the following:
 - .1 Plumbing and Gas
 - .2 Ventilation
 - .3 Building HVAC
 - .4 CSA Requirements
 - .3 Documents for the Project, including Specifications and Drawings, are generally diagrammatic and approximately to scale unless specifically detailed otherwise; they establish scope, material and installation quality and shall not be considered as detailed installation instructions.

1.02 RELATED REQUIREMENTS

- .2 Special Provisions, Part 2 General Requirements – Temporary Utilities: Temporary heating.
- .3 Special Provisions, Part 2 General Requirements – Construction Facilities: Site storage and offices.
- .8 Section 03 31 00 – Cast-In-Place Concrete: Coordination with concrete and formwork for placement of sleeving required for mechanical penetrations.

- .9 Section 26 05 06 – Common Motor Requirements for Electrical: Electric motor power characteristics.
- .10 Section 26 05 07 – Mechanical Equipment Connections: Connecting mechanical systems having electrical components to building electrical system.

1.03 SUBMITTALS

- .8 Coordinate requirements for submittals with [Section 01 00 06 – General Requirements: Submittals](#). Provide shop drawings, product data and samples listed in mechanical technical specification sections.
- .9 Identify materials and equipment submittals by listing manufacturer, trade name, and model number, and as follows:
 - .1 Include copies of applicable brochure or catalogue material.
 - .2 Do not assume that applicable catalogues are available in Consultants office.
 - .3 Maintenance and operating manuals will not be considered as suitable submittal material.
 - .4 Leave space on shop drawing to accommodate Consultants review stamp.
 - .5 Clearly mark each shop drawing with identical name or number where equipment is identified by name or number on drawings or in specifications.
 - .6 Clearly identify dimensional and technical data sufficient to verify that equipment meets specified requirements.
 - .7 Clearly identify wiring, piping, service connection data and motor sizes.
 - .8 Clearly mark each submittal sheet using arrows, underlining, or circling to indicate differences between specifications and options proposed for use on in the Work, i.e.: differences in sizes, types, model numbers, rating, capacities, and similar criteria.
 - .9 Specifically note specified features included as a part of the submittal, i.e.: special tank linings, pump seals, materials or painting.
 - .10 Strike out non-applicable material.
- .10 Review shop drawings prior to submittal to Consultant certifying that:
 - .1 Field measurements are verified and correct.
 - .2 Field construction criteria, materials, catalogue numbers and similar data are coordinated with shop drawings and requirements of the Work.
 - .3 Certify review of each shop drawing by placing Subcontractor and Contractor review stamp, date and signature of a responsible person.
 - .4 Installed materials and equipment shall meet specified requirements where shop drawings are not provided to Consultant for review.
- .11 Use of Metric Units and Conversions in Submittals:
 - .1 Units expressed in these documents are written in Systems International (SI) Metric Units; soft metric conversions are used throughout. Submit shop drawings and maintenance manuals in SI Units; use same SI Units for submittals as stated in specification or drawings.
 - .3 Equivalent Nominal Diameters of Pipes – Metric and Imperial:
 - .1 Provide equivalent nominal Imperial sized pipe and provide adapters to ensure compatible connections to SI Metric sized fittings, equipment and piping where pipes are specified with SI Metric dimensions and only Imperial sized pipes are available.
 - .2 Provide adapters to ensure compatible connections between SI Metric pipes and new and existing pipes, fittings, and equipment when CSA approved SI Metric pipes are available and are provided.

- .3 Record accurately on "as-built" documents the type of pipe (i.e., Metric or Imperial) installed.
- .4 SI Metric Duct Sizes:
 - .1 Metric duct sizes are expressed as 25 mm = 1 inch.

1.04 QUALITY ASSURANCE

- .8 Quality of Material and Equipment:
 - .1 Materials and equipment installed shall be new, full weight and of quality specified; use same brand or manufacturer and model for each specific application.
 - .2 Each major component of equipment shall bear manufacturer's name, address, catalogue and serial number in a conspicuous place.
 - .3 Replace materials or workmanship below specified quality and relocate work wrongly placed to satisfaction of Consultant and at no cost to City.
 - .4 Install materials and equipment in a quality manner providing good workmanship by competent tradesmen.
 - .5 Price submitted for this contract shall be based on the use of materials and equipment as specified or as contained within the listing of Acceptable Materials contained in specification Sections.
 - .6 HVAC equipment and components included in the scope of the Model National Energy Code of Canada for Buildings (MNECB) must comply with the MNECB or the relevant local energy efficiency act.
- .9 Availability of Material and Equipment:
 - .1 **Notify the City in writing a minimum of ten (10) days prior to Bid Closing Date of any materials specified that are required to complete Work and that are not currently available or will not be available for use as specified in these documents as follows:**
 - .1 Bid submission denotes that specified products are available to meet specified requirements.
 - .2 Acceptance of Bid obliges Contractor and Subcontractors to place orders and provide specified products in a timely manner to meet Project Schedule.
 - .3 Failure to secure specified products will not relieve Contractor and Subcontractor's for providing acceptable substitutions, including other associated costs to secure substitute products, at no additional cost to the City or impact on Project Schedule.
 - .4 Submit proposed substitutions to Consultant for acceptance in accordance with **Section 01 00 06 – General Requirements: Substitutions and Product Options.**
- .10 Proposed Substitutions to Specified Material and Equipment:
 - .1 Requests for substitutes will not be considered during Bidding Period; this does not preclude the submission of proposed substitutes by Subcontractors, manufacturers and suppliers, provided they submit information to General Contract Bidders in accordance with **Section 01 00 06 – General Requirements: Substitutions and Product Options.**

Comment [1]: +benjamin.johnson@edmonton.ca; +vannaphone.phetlathy@edmonton.ca ; Please review this section with +cindy.kieu@edmonton.ca. Bidders can not contact the consultant directly during tender period. All communications must flow through CPSS. What does "Acceptance of bid" mean? Do you mean award of contract? We shouldn't be advising Contractors and subs to order product based on acceptance of bid but should advise on award of contract.

Comment [2]: We can delete this section if it is covered in the Front End.

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- .2 Acceptance of proposed substitutions to specified products will be based on evaluation of equal or better performance and materials to those specified in every respect, operate as intended, meet the space, capacity, and noise requirements outlined, and require no changes to the structure or configuration of adjacent assemblies or materials.
- .3 Contractor shall be fully responsible for costs for work or materials required by Subcontractor or other contractors to accommodate use of other than specified materials or equipment.

1.05 COORDINATION

- .8 Cooperate and coordinate with other trades and verify order of installation of overlapping or interconnecting services or equipment before starting Work.
- .9 Drawings and Specifications:
 - .1 Drawings and specifications are complementary each to the other, and what is called for by one shall be binding as if called for by both.
 - .2 Examine Contract Documents including drawings and specifications, and work of other trades before starting Work and verify that Work can be satisfactorily completed without changes to building.
 - .3 Consultant will provide a clarification to identified discrepancies between drawings and specifications that leave Contractor in doubt as to the true intent and meaning of the documents as follows:
 - .1 During Bid Period: A written Addendum will be issued to address a written request for clarification.
 - .2 During Construction: A Construction Communication will be issued to address a written request for information.
 - .4 Consultant will determine the requirements for clarification based only on variances contained in the documents as follows:
 - .1 Clarification will not be based on information not contained in the documents or in manufacturers written literature.
 - .2 Clarification will be based on the hierarchy of the complete document package, not just the documents provided to Subcontractor by Contractor.
 - .3 Clarification will include effects or influence of other specified products, adjacent construction, adjacent finishes and methods of construction.
 - .4 Clarification issued during Construction Phase that affects the cost of the Work will be regarded as a Change to the Work.
- .10 Coordinate installation of the Work with manufacturer's recommended installation details and procedures, supplemented by requirements of Contract Documents; provide adequate access space for maintenance and service of equipment and systems.
- .11 Coordinate location of access to cleanouts, valves, equipment and duct access doors above continuous ceilings; coordinate access panel and door requirements with Section 08 31 00.

- .12 Coordinate installation of Work with adjacent work by others, and as follows:
- .1 Install material and equipment generally in locations and routes shown, close to building structure with minimum interference with other services or free space; remove and replace improperly installed equipment as determined by Consultant.
 - .2 Refer to electrical, mechanical, structural and architectural drawings when setting out work and coordinate with other applicable components of the Work when setting out locations for ductwork, equipment, and piping so that conflicts are avoided and symmetrical even spacing is maintained.
 - .3 Provide coordination drawings showing the work of other trades and contractors involved in areas of potential conflict or congestion at no additional cost to the Contract.
 - .4 Coordinate dimensional details with applicable architectural and structural drawings.
 - .5 Full-size and detailed drawings will take precedence over scale measurements from drawings when laying out the Work.
- .13 Coordinate requirements of, and connect to, equipment specified in other Sections and to equipment supplied and installed by other contractors or by City; uncrate equipment, assemble, move in place and install complete, start-up and test.

1.06 GUARANTY/WARRANTY

- .8 Furnish a written guaranty/warranty stating that Work executed in this Contract will be free from defective workmanship and materials for a period of one (1) year starting from the date of substantial performance of work.
- .9 Guaranty/warranty shall make provision for repair or replacement of any Work that fails or becomes defective during term of the guaranty/warranty, providing the operating and maintenance instructions have been complied with.
- .10 Duration of guaranty/warranty specified shall not, in any way, supplant any other guaranties or warranties provided under the Contract for individual pieces of equipment or systems having a longer period provided by Manufacturers or as called for in the project documents.
- .11 Unless specified otherwise, the City will be responsible for routine maintenance requirements as required in the manufacturer's instructions, and will be responsible for supplying filters, grease and belts and other consumables required for routine maintenance.

1.07 DECLARATIONS

- .8 Coordinate declaration of Substantial Performance and Total Performance with requirements of the General Conditions and Supplementary Conditions of Contract.

2. PRODUCTS

2.02 NOT USED

3. EXECUTION

3.02 CUTTING AND PATCHING

- .8 Coordinate locations of mechanical penetrations and sleeves through concrete floor structure including slabs, beams, purlins and girders; coordinate sleeving locations with Section 03 31 00:
 - .1 Section 03 31 00 will prepare coordination drawings for each floor level of the building indicating requirements of all trades penetrating concrete floor construction.
 - .2 Section 03 31 00 will require sign-off from affected mechanical subtrades having penetrations and sleeves before submitting shop drawings to Consultant for review.
- .9 Provide inserts, holes and sleeves, cutting and fitting required for mechanical work; relocate improperly located holes and sleeves.
- .10 Provide inserts or drill for expansion bolts, hanger rods, brackets, and supports.
- .11 Obtain written approval from Consultant before drilling, coring, cutting or burning structural members; verify that post tensioned or pre-stressed strands are located accurately and avoid cutting or damaging these elements with an adequate margin of safety.
- .12 Provide openings and holes required in precast concrete members for mechanical work; cast holes larger than 100 mm in diameter; field-cut holes smaller than 100 mm when location is approved by Consultant.
- .13 Patch and make good building where damaged from equipment installation, improperly located holes etc. Work shall be performed by Subcontractor responsible for that type of work affected.

3.03 EXCAVATION AND BACKFILL

- .8 Confirm service invert elevations and locations prior to starting work, set grades to suit inverts.
- .9 Provide excavating to facilitate installation of mechanical work, including shoring, pumping, placement of 150 mm compacted sand bedding under and first 300 mm of compacted sand over piping and ducting.

3.04 USE OF PERMANENT SYSTEMS FOR TEMPORARY HEAT

- .8 Do not use permanent system for temporary heating purposes without written permission from Consultant.
- .9 Provide a proposed temporary heat agreement for the City to review prior to use of permanent building systems for temporary heat; agreement shall include payment schedule for utilities, spare parts listing and confirmation of warranty.

- .10 Use of permanent systems for temporary heat shall not modify terms of warranty; equipment manufacturers shall certify that equipment is in "new" condition at start of warranty period, and as follows:
 - .1 Block-off system components not required for temporary heat in accordance with manufacturer's requirement to maintain warranty.
 - .2 Thoroughly clean and overhaul permanent equipment used during construction period, replace worn or damaged parts before final inspection.
 - .3 Operate heating systems under conditions that ensure no temporary or permanent damage.
 - .4 Operate with proper safety devices and controls installed and fully operational.
 - .5 Operate systems only with treated water as specified.
 - .6 Air systems may not be used for temporary heating.
 - .7 Provide alarm indicating system failure; connect alarm to independent alarm company system.
 - .8 Replace mechanical seals, regardless of condition, with new mechanical seals where pumps are used for temporary heating prior to Total Performance of the Work.
 - .9 Avoid thermal shock to heating system during planning, construction and operation of temporary heating system.
- .11 Review temporary heating procedures with Consultant as follows:
 - .1 Obtain acceptance by Consultant for thermal insulation work and automatic control equipment associated with use of permanent heating system for temporary heat.
 - .2 Obtain approval from Provincial Boiler Protection Branch of Department of Labour before use of permanent heating system for temporary heat.

3.05 EQUIPMENT PROTECTION AND CLEAN-UP

- .8 Protect equipment and materials in storage on site during and after installation until final acceptance; leave factory covers in place; take special precautions to prevent entry of foreign material into working parts of piping and duct systems.
- .9 Protect equipment with polyethylene covers and crates.
- .10 Operate, drain and flush out bearings and refill with new change of oil, before final acceptance.
- .11 Clean piping, ducts and equipment of dirt, cuttings and other foreign substances.
- .12 Protect bearings and shafts during installation. Grease shafts and sheaves to prevent corrosion. Supply and install necessary extended nipples for lubrication purposes.

3.06 TEMPORARY OR TRIAL USAGE OF PERMANENT SYSTEMS

- .8 Temporary or trial usage requested by the City of mechanical equipment supplied under contract will not represent acceptance by the City; operate and maintain equipment and systems during trial usage in a manner that preserves the manufacturer's warranty/guaranty.
- .9 Repair or replace equipment damaged as a result of defective materials or workmanship during temporary or trial usage.
- .10 Pre-test operation of ventilation systems by running the units in a 100% fresh air, 100% exhaust air mode after distribution ductwork is installed.

3.07 SITE UTILITY SERVICES

- .8 Maintain liaison with the City to interrupt, re-route or connect to water, sewer, heating, or gas systems, with minimum interruption of services.
- .9 Confirm elevations and locations of existing services prior to and during excavation.
- .10 Provide Consultant with as-built drawings of site services; dimensioned to grid lines, building exterior walls or other permanent building component.

END OF SECTION

1. GENERAL

1.01 SUMMARY

- .1 Contents of this section apply to all Specifications contained in Divisions 20, 22, 23 and 25.

1.03

1.04 ADMINISTRATIVE REQUIREMENTS

- .1 Substitution Requests: Definitions described in Section 01 00 06 – General Requirements: Substitutions and Product Options apply to this section, with procedural requirements modified by this section to account for variations in the administration of Substitution requests required by mechanical work results described in the Specifications as follows:

- .1

- .2 Apparent Substitutions: Any Substitution found in the work or forming a part of a shop drawing or product data submittal and that has not been reviewed and accepted during the Bid Period will be denied, with instructions from the Consultant indicating removal of apparent substitution from the Work and replacement by the Contractor at no additional cost to the City, or Consultant.

1.05 SUBMITTALS

- .1 Confirmation of Products: Contractor is required to submit within 30 days from award of Prime Contract indicating name of Product manufacturer used to establish the Bid Price, and that forms a component of the Contract and as follows:
 - .1 Acceptable Product Listings: Consultant will consider that any named Acceptable Products are accounted for and included in the Work when specifically listed in the technical Specifications in accordance with requirements of Section 01 00 06 – General Requirements: Substitutions and Product Options in the event that no manufacturer names are submitted.
 - .2 Basis-of-Design Product Listings: Consultant will consider that the Basis-of-Design Products are accounted for and included in the Work in the event that no manufacturer names are submitted.
 - .3 Generic Product Listings: Consultant will consider that Products not otherwise named will be selected from the Acceptable Materials Manufacturers listed in this Section.

2. PRODUCTS

2.03 ACCEPTABLE MATERIALS MANUFACTURERS

- .1 Limitations of Listed Manufacturers: Manufacturers and suppliers listed in the Specifications are acceptable for their ability to meet the general design intent, quality and performance characteristics for the specified Products, this list does not endorse the acceptability of all Products available from the listed manufacturers and suppliers.

3. EXECUTION

3.03 INSTALLATION

- .1 Subcontractor's Responsibility for Coordinating Installation: It is the responsibility of the Subcontractor to verify that Products supplied to the Work meet the specified performance requirements indicated in the Specifications including the physical dimensions indicated on the Drawings, and that they will operate as intended once installed and as follows:

-
- .1 Subcontractor will be fully responsible for any additional work or materials necessary to accommodate the use of equipment from listed acceptable materials manufacturers and suppliers list where differences occur between manufactured Products used for the Work.
 - .2 Notify the Consultant immediately where dimensions or orientation of Products supplied to the Work require coordination with other mechanical or electrical components.
 - .3 Notify the Consultant immediately where Products supplied to the Work require modifications to structures and surrounding construction
 - .4 Notify the Consultant immediately where changes to orientation of installed Products is required to maintain accessibility for servicing.

END OF SECTION

1. GENERAL**1.01 SUMMARY**

- .1 This section includes requirements for supply and installation of pipe and pipe fittings including; but not limited to, the following:
 - .1 Sanitary Drainage and Vent System Piping
 - .2 Storm Sewer System Piping
 - .3 Domestic Water Piping
 - .4 Natural Gas Piping

1.02 RELATED REQUIREMENTS

- .1 Section 07 05 53 – Fire and Smoke Assembly Design Requirements and Identification
- .2 Section 07 84 00 – Firestopping and Smoke seals: Firestopping and smoke seal materials for piping penetrating fire rated assemblies.
- .3 Section 20 05 23 – Valves for Mechanical Systems
- .4 Section 20 05 29 – Pipe Hangers, Supports and Anchors for Mechanical Systems
- .5 Section 20 05 48 – Noise and Vibration Control
- .6 Section 20 07 00 – Piping and Equipment Insulation
- .7 Section 22 13 25 – Plumbing Specialties

1.03 REFERENCE STANDARDS

- .1 American Society for Testing and Materials (ASTM):
 - .1 ASTM A53/A53M-07, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
 - .2 ASTM A106/A106M-08, Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service
 - .3 ASTM A181/A181M-06, Standard Specification for Carbon Steel Forgings, for General-Purpose Piping
 - .4 ASTM A536-84 (2004), Standard Specification for Ductile Iron Castings
 - .5 ASTM A999/A999M-04a, Standard Specification for General Requirements for Alloy and Stainless Steel Pipe
 - .6 ASTM B88-03, Standard Specification for Seamless Copper Water Tube
 - .7 ASTM D3034-08, Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings
- .2 American Water Works Association (AWWA):
 - .1 ANSI/AWWA C606-06, Standard for Grooved and Shouldered Joints
 - .2 ANSI/AWWA C900-07, Standard for Polyvinyl Chloride (PVC) Pressure Pipe, 100 mm through 300 mm for Water Distribution
- .3 Canadian Standards Association (CSA):
 - .1 CAN/CSA A257 Series-03, Standards for Concrete Pipe
 - .2 CAN/CSA B137 Series-05, Thermoplastic Pressure Piping
 - .3 CAN/CSA B149.1-05, Natural Gas and Propane Installation Code
 - .4 CAN/CSA B242-05, Groove- and Shoulder-Type Mechanical Pipe Couplings.
 - .5 CAN/CSA B1800 Series-06, Plastic Non-pressure Pipe Compendium

.4 National Plumbing Code of Canada 2005 (NPC):

- .1 Alberta Plumbing Code Regulation, 2007

.5 Underwriters Laboratories Canada (ULC):

- .1 CAN/ULC S10207, Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies
.2 CAN/ULC S102.2-07, Standard Method of Test for Surface Burning Characteristics of Flooring

1.04 SUBMITTALS

- .1 Submit schedule as shop drawing, prior to ordering pipe and fitting material, showing materials proposed for service, size and application in accordance with Section 01 00 06 – General Requirements: Submittals.
- .2 Action Submittals: Provide the following submittals before starting any work of this Section.
- .3 Informational Submittals: Provide the following submittals when requested by the Consultant:
- .1 Certificates: Submit statement describing welding procedures proposed for the review of the Consultant before commencing work.

1.05 QUALITY ASSURANCE

- .1 Regulatory Requirements:
- .1 Fire Rated PVC Materials: PVC drainage pipe and fittings used for this project shall conform to CAN/ULC S102.2, and bear the seal of a nationally recognized listing or certifying agency acceptable to authorities having jurisdiction in accordance with Section 07 05 53.
- .2 Below Grade Work: Steel piping used below grade shall be yellow jacketed in accordance with requirements of Authority Having Jurisdiction.
- .2 Qualifications: Provide proof of qualifications when requested by Consultant:
- .1 Materials:
- .1 Use highest quality piping conforming to the referenced ASTM and CSA Standards.
- .2 Non-specified pipe joining and pipe fitting methods such as T-drill and press fit are not permitted in any piping system for this Project.
- .2 Installers: Use tradesmen licensed by the authority having jurisdiction for the particular service or component of the work.
- .3 Certifications: Provide the following during the course of the Work:
- .1 Welding Requirements: Provide proof of skill level and welding certificate having specific annotations for the following:
- .1 Use fully qualified welders licensed by the authority having jurisdiction in accordance with Section 05 05 00 – Common Work Results for Metals.
- .2 Comply with procedures of current editions of CSA W55.3, CSA W117.2 and the ASME Standard for building services piping for field welding.
- .3 Use pressure welders for work on systems containing pressures in excess of 103 kPa.

2. PRODUCTS

2.01 MANUFACTURERS

.1 Subject to compliance with the standards and properties listed in this specification, the following manufacturers are acceptable for this project:

.1 Pipe and Fittings:

- .1 Crane
- .2 Ladish
- .3 Taylor Forge

.2 Plastic Pipe and Fittings:

- .1 Building Products Orion
- .2 Canplas Industries Ltd.
- .3 Emco
- .4 Domm-X
- .5 Scepter
- .6 IPEX

.3 Vacuum Breakers:

- .1 Febco
- .2 Watts
- .3 Mifab.

.2 Materials other than the named products for the Project may be acceptable to the Consultant, submit information in accordance with Section 01 00 06 – General Requirements: Substitutions and Product Options.

2.02 PIPE

Service	Material
.1 Sanitary drainage, and vent, inside building, above ground	DWV Copper: ASTM B306 Cast Iron: CSA B70 PVC – DWV: CAN/CSA B181.2, CAN 4-S102.2, F.S.<25, S.D.>50: Except in R/A plenums, vertical shafts, highrises, and underground parking garages greater than 1 storey F.S.=0, S.D.<50: Suitable for R/A plenums and highrises. Not suitable for vertical shafts and underground parking garages greater than 1 storey
.2 Sanitary drainage, and vent, inside building, below ground	Cast iron: CSA B70 PVC – DWV: CAN/CSA B181.2, CAN 4-S102.2 PVC Sewer pipe: CAN/CSA B182.1, sizes to 150 mm PVC, SDR-35 for sizes up to 1050 mm: ASTM D3034, complete with tracer wire
.3 Sanitary drainage and vent, outside building	Cast iron: CSA B70 PVC, SDR-35 for sizes up to 1050 mm: ASTM D3034, complete with tracer wire Concrete for sizes above 300 mm (12"): CAN/CSA A257

.4	Storm drainage, inside building, above ground	Cast Iron: CSA B70 DWV Copper: ASTM B306 PVC – DWV: CAN/CSA B181.2, CAN 4-S102.2, F.S.<25, S.D.>50:Except in R/A plenums, vertical shafts, highrises, and underground parking garages greater than 1 storey F.S.=0, S.D.<50:Suitable for R/A plenums and highrises. Not suitable for vertical shafts and underground parking garages greater than 1 storey
.5	Storm drainage, inside building, below ground	Cast Iron: CSA B70 PVC – DWV: CAN/CSA B181.2, CAN 4-S102.2 PVC Sewer pipe: CAN/CSA B182.1, sizes to 150 mm PVC, SDR-35 for sizes up to 1050 mm: ASTM D3034, complete with tracer wire
.6	Storm drainage, outside building	Cast Iron: CSA B70 PVC, SDR-35 for sizes to 900 mm: ASTM D3034, complete with tracer wire PVC Ultra Rib CAN/CSA B182.4, complete with tracer wire Concrete pipe for sizes above 300 mm: CAN/CSA A257
.7	Domestic water, above ground (inside building)	Type “L” Hard Copper: ASTM B88M Schedule 40 Stainless Steel: ASTM A999
.8	Domestic water (buried inside building)	Type “K” soft copper, ASTM B88M
.9	Domestic cold water for trap seal primers only (buried inside building to trap seal primer)	Polyethylene/Aluminum/Polyethylene pipe (PE/AL/PE), to CSA B137.9-M, conform to ULC or Warnock Hershey listed, Flame spread: 5, Smoke Developed: 5, no joints Cross linked Polyethylene Pressure tubing (PEX), to CSA B137.5-M, conform to ULC or Warnock Hershey listed, Flame spread: 5, Smoke Developed: 5, no joints
.10	Domestic water service below ground	Steel, Schedule 40: ASTM A53, Grade B Type “L” Hard Copper: ASTM B88M Type “K” Soft Copper Buried: ASTM B88M PVC, Class 1200 (DR14), conforming to CSA B137.3 and AWWA C900, complete with tracer wire, size 100 mm PVC, Class 150 (DR18), conforming to CSA B137.3 and AWWA C900, complete with tracer wire, sizes 150 mm to 500 mm PE, Series 160, conforming to CSA B137.1 and AWWA C906, complete with tracer wire, working pressure rating of 1103 kPa, sizes 20 mm to 50 mm
.11	Natural Gas, Propane	Steel, Schedule 40: ASTM A53, Grade B

2.03 FITTINGS AND JOINTS

Service	Material	Joint
.1 Sanitary drainage and vent, inside building, above ground	Wrought or cast copper	50-50 Solder
	Cast iron (Hubless fitting)	Gasket & Clamp
	PVC – DWV	Solvent Weld
.2 Sanitary drainage and vent, inside building, below ground	Cast iron (Hubless fittings)	Gasket & Clamp
	PVC – DWV	Solvent Weld
.3 Sanitary drainage and vent, outside building	Cast iron	Hub & Spigot
	PVC – Gravity Sewer	Hub & Spigot with gasket
	Concrete	Hub & Spigot
.4 Storm drainage, inside building, above ground	Cast iron	Gasket & Clamp
	Wrought or cast copper	50-50 Solder
	PVC – DWV	Solvent Weld
.5 Storm drainage, inside building, below ground	Cast iron	Gasket & Clamp
	PVC – DWV	Solvent Weld
.6 Storm drainage, outside building	Cast iron	Hub & Spigot
	PVC – Gravity Sewer	Hub & Spigot with Gasket
	Concrete	Hub & Spigot
.7 Domestic water, above ground	Wrought copper, bronze	95-5 solder, brazed
	Cast bronze	Screwed
	Stainless steel	Welded,
.8 Domestic water, buried	PVC	Hub & Spigot with “O” ring
	Copper pipe	No joints permitted underground
.9 Natural gas	Banded malleable iron, 1035 kPa, for sized 40 mm and under	Screwed
	Steel, same schedule as pipe, for sizes 50 mm and larger, and for high pressure (over 1.4 kPa) – all sizes	Welded
.10	Use factory fabricated butt welded fittings for welded steel pipes.	

2.04 PIPE SIZES

Nominal Metric Size mm	Steel Pipe O.D., mm	Copper Pipe O.D., mm	Cast Iron O.D., mm
12 - 15	21.34	15.88	-
20	26.67	22.23	-
25	33.40	28.58	-
30	42.16	34.95	-
40	38.10	41.28	-
50	60.33	53.98	-
65	73.03	66.68	-
75	88.90	79.38	100.58
100	114.30	104.70	121.92
125	141.30	-	-
150	168.28	-	175.26
200	219.09	-	229.87
300	323.85	-	304.80

2.05 UNIONS AND COUPLINGS

.1 Size 50 mm and under:

.1 1034 kPa malleable iron, bronze to iron ground joint unions for threaded ferrous piping, all bronze for copper piping, cast iron 861 kPa for heating. Unions to ANSI B16.3.

.2 Sizes 65 mm and over: 1034 kPa forged steel slip-on flanges for ferrous piping, 1034 kPa bronze flanges for copper piping with gaskets 1.59 mm thick preformed synthetic rubber bonded asbestos. Flanges to ASTM A181

2.06 VACUUM BREAKER ASSEMBLIES

.1 Provide pressure type vacuum breaker assembly complete with shut-off valves before and after check valves and test cocks. Assembly shall consist of one (1) positive sealing check valve and one (1) atmospheric vent disk with stainless steel or bronze seats complete with shut-off valves before and after check valves and test cocks. Assembly shall meet AWWA requirements and CSA B64 standards. Acceptable material: Watts No. 800.

2.07 SOLDER

.1 Generally, use 95-5 solder for pressure service, 50-50 solder for gravity drainage service.

3. EXECUTION

3.01 PIPING GENERAL

.1 Install piping approximately as shown, with all lines being carried parallel to building walls close to the structure as possible, or as detailed on the drawings.

.2 Align and support all piping properly, under no circumstances may any piping load be transferred to the equipment. Make all equipment connections so as to allow disassembly of the piping for equipment removal and maintenance.

- .3 Install piping to allow for expansion and contraction without unduly stressing pipe or connected equipment.
- .4 Provide clearance for proper installation of insulation and for access to valves, air vents, drains and unions.
- .5 Install piping material specified to 1 m outside of building.
- .6 Use the following for branch connections off main:
 - .1 Mains 100 mm to 200 mm inclusive: branches under 40 mm, use factory manufactured welding fittings to accommodate the take-off either welded or threaded: branches 50 mm to 75 mm, use welding saddles. Do not use welding saddles for branches greater than ½ size of main.
 - .2 Mains 75 mm; branches under 25 mm use factory manufactured welding fittings to accommodate the take-off either welded or threaded; branches over 25 mm use standard tees.
 - .3 Mains 65 mm and under: use standard tees for all branch take-offs.
 - .4 Mains 250 mm and over: Branches up to and including 2 nominal sizes less than main, welded stub ins, tee or saddles. Branches nominal size smaller and above, use standard tees.
- .7 Use only eccentric reducing fittings. Install all reducers in steam lines with the piping in line at the bottom.
- .8 Do not use direct welded or screwed connections to valves, equipment or other apparatus. Make all connections with accessible mechanical connection of style consistent with the connecting pipe joints.
- .9 Sleeve all pipe passing through partitions, walls and floors.
- .10 Provide non-conducting type connections wherever jointing dissimilar metals. Dielectric unions are the only types acceptable.
- .11 Ensure no contact between copper and ferrous metal.
- .12 Provide drain valves at main shut off valves, low points of piping and apparatus, and at the bottom of all risers.
- .13 Keep open ends of pipe free from scale and dirt. Whenever work is suspended during construction protect the open ends by using temporary plugs, burlap or other means approved by the Consultant.
- .14 Do not run piping carrying liquids or steam over electrical switchboards, elevator controllers or electrical motor starters. Where this is unavoidable provide 1.2 mm gauge aluminum pans under piping. Each drip pan shall have drain piped to discharge over nearest available open drain.
- .15 Provide for isolation of systems by section.
- .16 Ensure piping location does not subject piping to frost damage under flow or no flow conditions.
- .17 Install and support piping so that strain and weight does not bear on cast iron fittings or apparatus.
- .18 Chrome-plate all piping exposed in food preparation areas, and dishwashing areas, central sterilizing areas and laundry areas. Stainless steel cover plates may be substituted to conceal groups of pipes.

- .19 PE pipe shall not be installed in areas contaminated or potentially contaminated with organic compounds (organic solvents or petroleum products), i.e. near buried petroleum fuel tanks, abandoned gas stations, petro storage areas, or petro refinery sites.

3.02 SCREWED CONNECTIONS

- .1 American National Taper pipe thread must be used for all screwed connections. Remove burrs and chips and ream or file the pipe ends out to size or bore. Not more than two imperfect threads exposed when joint made up.
- .2 Make screw joints metal to metal. Do not use lamp wick or other packing material in making up screwed joints.
- .3 Use teflon tape, red lead and linseed oil or other approved non- toxic joint compound applied to male threads only.
- .4 Thread chromium-plated piping and make up carefully. Do not expose more than one full turn of thread beyond any fitting.

3.03 WELDED CONNECTIONS

- .1 Prepare mating surfaces properly; at least one mating surface shall be bevelled. Longitudinally align piping carefully, set 3.2 mm space between mating surfaces and tack, using 6010 rod. Preheat the materials to be joined to at least 21°C. Make minimum of three passes; use 6010 rod for root pass, use 7018 rod for subsequent filler passes and final cover pass. Remove slag and flux after each pass by brushing or grinding. Remove voids from each pass by cutting or grinding and make good by back welding.
- .2 Ensure complete penetration by the root pass. Measured at the inner diameter of the piping, the weld shall be minimum of 1 mm thicker than the pipe thickness.
- .3 Do not caulk or peen welds.

3.04 SOLDER AND BRAZED CONNECTIONS

- .1 Remove burrs and chips and ream or file the pipe ends out to size or bore. In the case of soft copper tubing, ensure reaming restores tubing to full diameter before joining to fitting.
- .2 Assemble joints without binding. Brazing material or solder shall penetrate fully and fill the joint completely.
- .3 Braze all joints on refrigerant and medical gas piping.
- .4 Braze all piping joints on copper sprinkler piping. Use of solder to join sprinkler head to the piping only will be permitted.

3.05 SOLVENT WELDED CONNECTIONS

- .1 Prepare mating surfaces properly in accordance with manufacturers instructions. Proper primer and solvent cementing procedures must be followed at all times.

3.06 GRADING OF PIPING AND DRAINS

- .1 In all water systems, at each low point, and at all equipment connections inside the isolating valves, install hose bibb drains in accessible locations. Use 15 mm valves unless specifically noted otherwise.
- .2 Make connections from all pump casings, relief valves, system drains, air vents, overflows and all major drain points to the nearest accessible hub or funnel or floor drain. Arrange overflow drains so that drips may be readily seen.

3.07 DOMESTIC WATER PIPING INSTALLATION

- .1 Water piping shall be complete from service connection to all fixtures, equipment and outlets. Sizes of pipes shall be as shown or as specified.
- .2 Exercise care in the laying of soft copper tubing under slabs so that it does not bear or is in contact with rocks and that directional changes are gradual to ensure tubing will not be kinked or collapsed.
- .3 All brass and copper pipe and tubing shall be free from cuts, dents or other surface damage at the time of final inspection. Remove damaged pipe or tubing and replace with new pipe or tubing.
- .4 Take branches from water supply mains from the top, bottom or side, using crossover fittings where required by structural or operating conditions.

3.08 DRAINAGE AND VENT PIPE INSTALLATION

- .1 Run pipes be run in straight lines and have uniform grade between elevations noted. No branch drain shall have lesser grade than that indicated for the main drain to which it is connected. Where elevations are not given, pipes shall have uniform grade of 2%, except that where such grade on overhead pipes would reduce the headroom materially, the grade may be reduced to not less than 1%, if so directed by the Consultant. All overhead pipes must be kept as close to ceilings as possible, unless otherwise indicated or noted.
- .2 Do not use double hubs, straight crosses, double Ts or double TYs in any soil or waste pipe below any fixture. Do not install branch fitting other than the full Y and an eighth bend on any soil or waste pipe running in horizontal plane. Quarter bends placed on their sides shall not be permitted. Do not use inverted joints below any fixture.
- .3 Fire resistant PVC piping may not be painted.

3.09 VACUUM BREAKERS

- .1 Install vacuum breaker on all hose bibbs.
- .2 Install vacuum breaker on water supplies to flushometer valves, tanks with open top, water closets, urinals.
- .3 Provide air gaps on all atmospheric drains such as drains from coils, blowdowns, tanks, equipment, riser drains, relief valve discharge.

3.10 GAS DISTRIBUTION LINES INSTALLATION

- .1 Install the gas distribution lines in accordance with the policy and specifications of the Natural Gas Utility Company and CAN/CSA B149.1.
- .2 Weld all-natural gas piping in concealed inaccessible spaces regardless of size.
- .3 Paint all-natural gas piping throughout with high visibility yellow paint.

END OF SECTION

1. GENERAL

1.01 SUMMARY

- .1 Expansion fittings and loops in this Section includes the following:
 - .1 Flexible pipe connections.
 - .2 Expansion joints and compensators.
 - .3 Pipe loops, offsets, and swing joints.

1.02 REFERENCE STANDARDS

- .1 Expansion Joint Manufacturers Association (EJMA):
 - .1 8th Edition EJMA Standards-2003, including 2005 Addenda.

1.03 SUBMITTALS

- .1 Provide required information in accordance with Section 01 00 06 – General Requirements: Submittals
- .2 Flexible pipe connector shop drawing data shall include maximum allowable temperature and pressure rating, overall face-to-face length, live length, hose wall thickness, hose convolutions per 300 mm and per assembly, fundamental frequency of assembly, braid structure and total number of wires in braid.
- .3 Expansion joint shop drawings shall include maximum allowable temperature and pressure rating, and maximum expansion compensation.

1.04 DESIGN REQUIREMENTS

- .1 Conform Expansion Joint Manufacturers Association standards and manufacturer's recommendations.

1.05 INSPECTION

- .1 Provide inspection services by flexible pipe manufacturer's representative for final installation and certify installation is in accordance with manufacturer's recommendations and connectors are performing satisfactorily.

2. PRODUCTS

2.01 MANUFACTURERS

- .1 Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - .1 Flexible Pipe Connections:
 - .1 Senior Flexonics Canada
 - .2 Mason Industries
 - .2 Expansion Joints and Compensators:
 - .1 Senior Flexonics Canada
 - .2 Mason Industries

2.02 FLEXIBLE PIPE CONNECTORS

- .1 Flexible Rubber Spools: Neoprene twin sphere connector of moulded multiple plies of nylon tire cord fabric and neoprene, rated for 1035 kPa at 120°C. Union end connections for sizes 50 mm and under; floating galvanized ductile iron flanges for sizes over 50 mm.
- .2 Spherical Rubber Spools: Neoprene single sphere elbow connector, construction and service rating same noted in Item 2.02.1 above.
- .3 Braided Spools for Copper Piping: Stainless steel inner core and braid brazed to copper tube ends, suitable for 1035 kPa at 120°C.
- .4 Braided Spools for Steel Piping: Stainless steel inner core and braid welded to steel pipe nipples, threaded for pipe up to 50 mm diameter, flanged for 65 mm diameter pipe and over. Suitable for service at 1035 kPa at 120°C.

2.03 EXPANSION JOINTS

- .1 Copper piping: Laminated stainless steel bellows brazed to copper tube ends, internal guide, stainless steel external shroud. Suitable for 1035 kPa at 260°C.
- .2 Steel piping up to 100 mm: Laminated stainless steel bellows welded to steel pipe nipples. Anti-torque device and threaded ends for sizes to 50 mm, flanged ends for sizes 65 mm and over. Internal guide and carbon steel shroud suitable for 1035 kPa at 260°C.
- .3 Steel piping 100 mm and over: Guided externally pressurized laminated stainless steel bellows, flanged ends, internal guide tube and ring, external shroud and guide ring. Suitable for 1035 kPa at 260°C.

2.04 PIPE GUIDES

- .1 4 finger "spider" inside a guiding sleeve formed of two halves suitable for clamping onto pipe.
- .2 Guided sleeve formed of two parts, suitable to be bolted to supporting structure.
- .3 Guide length to be minimum 300 mm.

3. EXECUTION**3.01 APPLICATION**

- .1 Provide flexible pipe connectors on pipes connected to equipment supported by vibration isolation and where indicated on the drawing.
- .2 Provide structural work and equipment required to control expansion and contraction of piping, loops, pipe offsets, and swing joints and provide expansion joints where indicated or required.
- .3 Provide pipe guides as required to ensure correct pipe alignment for expansion joints. Minimum two guides on each side of expansion joints.

3.02 INSTALLATION

- .1 Install flexible connectors at right angles to displacement. Install one end immediately adjacent to isolated equipment and anchor other end.

- .2 Rigidly anchor pipe to building structure at points shown, and where necessary provide pipe guides so that movement takes place along axis of pipe only.
- .3 Install flexible connectors and expansion joints in accordance with manufacturer's instructions.
- .4 Do not compress or expand connector during installation.

END OF SECTION

1. GENERAL**1.01 SUMMARY**

.1 Work in this section includes, but is not limited to, the following:

- .1 Gate Valves
- .2 Globe Valves
- .3 Check Valves
- .4 Plug Valves
- .5 Ball Valves
- .6 Butterfly Valves
- .7 Radiator Valves
- .8 Drain Valves
- .9 Relief Valves
- .10 Pressure Differential Control Valves

1.02 RELATED REQUIREMENTS

- .1 Section 20 05 10 – Mechanical Systems Pipe and Pipe Fittings
- .2 Section 22 13 25 – Plumbing Specialties
- .3 Section 22 40 00 – Plumbing Fixtures and Trim
- .4 Section 25 09 00 – Instrumentation and Control Devices for Mechanical Systems

1.03 REFERENCE STANDARDS

.1 American National Standards Institute (ANSI):

- .1 ANSI/ASME B1.20.1-1983(R2001), Pipe Threads, General Purpose
- .2 ANSI/ASME B16.1-1998, Cast Iron Pipe Flanges and Flanged Fittings
- .3 ANSI/ASME B16.10-2000, Face to Face and End-to-End Dimensions of Valves
- .4 ANSI B16.18-2001, Cast Copper Alloy Solder Joint Pressure Fittings

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

- .1 ASTM A126-04, Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings
- .2 ASTM A536-84, Standard Specification for Ductile Iron Castings
- .3 ASTM B21/B21M-06, Standard Specification for Naval Brass Rod, Bar, and Shapes
- .4 ASTM B61-02, Standard Specification for Steam or Valve Bronze Castings
- .5 ASTM B62-02, Standard Specification for Composition Bronze or Ounce Metal Castings
- .6 ASTM B98/B98M-03, Standard Specification for Copper-Silicon Alloy Rod, Bar and Shapes
- .7 ASTM B139/B139M-06, Standard Specification for Phosphor Bronze Rod, Bar, and Shapes

.3 Canadian Standards Association (CSA):

- .1 CSA B149.1-05, Natural Gas and Propane Installation Code
- .2 CAN/CSA B139-04, Installation Code for Oil Burning Equipment
- .3 CAN/CSA B242-05, Groove- and Shoulder- Type Mechanical Pipe Couplings.
- .4 CSA Z305.1-1992 (R2001), Non-Flammable Medical Gas Piping Systems
- .5 National Plumbing Code 1995

1.04 SUBMITTALS

- .1 Provide required information in accordance with Section 01 00 06 – General Requirements: Submittals.
- .2 Submit shop drawings of each valve type and a valve application schedule. Indicate on the shop drawings the manufacturer, model, sizes, pressure rating, materials and intended uses.
- .3 Submit valve directories in triplicate, typed form. List valve tag number, service and location. Frame one copy under glass for wall mounting.

1.05 QUALITY ASSURANCE

- .1 Comply with the codes and standards referenced in this section; editions of codes and standards shall be those currently in effect or accepted by the Authorities Having Jurisdiction.
- .2 All valves for fire service shall be UL, ULC or FM approved.
- .3 All valves for sprinkler service shall be UL, ULC or FM approved.

1.06 PRODUCT OPTIONS

- .1 An Armstrong “Flo-trex” control valve may be substituted on pump discharge in lieu of check valve, balancing valve and isolation valve. B & G and Victaulic (for grooved piping systems) equivalents are acceptable.
- .2 An Armstrong suction guide may be substituted on pump inlet in lieu of strainer. B & G and Victaulic (for grooved piping systems) equivalents are acceptable.
- .3 Victaulic Butterfly Valves: Butterfly valves for grooved pipe mechanical coupling connections may be used on lines 50 mm and larger for, domestic water.
 - .1 Product: Victaulic 300 MasterSeal, EPDM pressure responsive seat, for sizes 50mm through 300 mm.
- .4 Furnish extended shafts on butterfly valves when valves are to be insulated.
- .5 Butterfly valve stem shall be offset from the disc centerline to provide full 360-degree circumferential seating.

2. PRODUCTS**2.01 MATERIALS**

- .1 Provide valves in accordance with the valve schedule that forms part of this Section.
- .2 Use one manufacturer only for all valves of the same type.
- .3 Equip valves with renewable seats suitable for the service intended and to provide positive shutoff.
- .4 Provide composition discs on globe and check valves that are suitable for temperature and fluid or gas encountered.
- .5 Comply with ANSI B16.18 for solder joint ends.
- .6 Comply with ANSI B1.20.1 for threaded ends.
- .7 Comply with ANSI/AWWA C606 and CSA B242 for grooved ends.

- .8 Comply with ANSI B16.1 for cast iron flanges with face-to-face distance to ANSI B16.10.
- .9 Comply with ASTM A126 Cl.B for cast iron valves; bronze valves to ASTM B61 and B62 as noted.
- .10 For threaded valve stem materials: Naval brass to ASTM B21; copper silicone alloys to ASTM B98; or phosphor bronze to ASTM B139.

2.02 VALVE APPLICATION SCHEDULE

PLUMBING (Cold Water (soft and hard), Hot Water and Hot Water Recirculation)							
STYLE		0 - 50 mm	65 - 75 mm	100 - 150 mm	150 - 200 mm	200 - 250 mm	300 - 400 mm
GATE	Connection	Solder	Screwed	Flanged	Flanged	Flanged	Flanged
	Valve Item Number	1.2	1.1	1.5	1.5	1.5	1.5
	Function	Isolation	Isolation	Isolation	Isolation	Isolation	Isolation
BUTTERFLY	Connection	--	Grooved	Grooved	Grooved	Grooved	Grooved
	Valve Item Number	--	7.1 / 7.6	7.1 / 7.6	7.1	7.1	7.5
	Function	--	Isolation	Isolation	Isolation	Isolation	Isolation
GLOBE	Connection	Solder	Screwed	Flanged	Flanged	Flanged	Flanged
	Valve Item Number	2.2	2.1	2.6	2.6	2.6	2.6
	Function	Isolation/ Throttling	Isolation/ Throttling	Isolation/ Throttling	Isolation/ Throttling	Isolation/ Throttling	Isolation/ Throttling
CHECK	Connection	Solder	Screwed/ Grooved	Flanged/ Grooved	Flanged	Flanged	Flanged
	Valve Number	3.1	3.3 / 3.7	3.4 / 3.7	3.4	3.4	3.4
	Function	Check	Check	Check	Check	Check	Check
SPRING	Connection	--	Wafer/ Grooved	Wafer/ Grooved	Wafer/ Grooved	Wafer/ Groove	Page 8
	Valve Item Number	--	4.2 / 4.4	4.2 / 4.4	4.2 / 4.4	4.2 / 4.4	
	Function	--	Check, Sewage & Sump	Check, Sewage & Sump	Check, Sewage & Sump	Check, Sewage & Sump	
BALL	Connection	VicPress	Grooved	Grooved			
	Valve Item Number	6.8	6.9	6.9			
	Function	Isolation	Isolation	Isolation			

PLUMBING (Waste Water)							
STYLE		0 - 50 mm	65 - 75 mm	100 - 150 mm	150 - 200 mm	200 - 250 mm	300 - 400 mm
	Connection	--	Flanged	Flanged	Flanged	Flanged	Flanged
	Valve Item Number	--	1.5	1.5	1.5	1.5	1.5
	Function	--	Isolation	Isolation	Isolation	Isolation	Isolation
GLOBE	Connection	--	Flanged	Flanged	Flanged	Flanged	Flanged
	Valve Item	--	2.6	2.6	2.6	2.6	2.6

	Number						
	Function	--	Isolation/ Throttling	Isolation/ Throttling	Isolation/ Throttling	Isolation/ Throttling	Isolation Throttling
CHECK	Connection	--	Flanged	Flanged	Flanged	Flanged	Flanged
	Valve Item Number	--	3.4	3.4	3.4	3.4	3.4
	Function	--	Check	Check	Check	Check	Check

NATURAL GAS (Natural Gas)							
STYLE		0 - 50 mm	55 - 75 mm	100 - 150 mm	150 - 200 mm	200 - 250 mm	300 - 400 mm
PLUG	Connection	Screwed	Screwed	Screwed	Screwed	Screwed	Screwed
	Valve Item Number	5.5	5.6	5.6	5.6	5.6	5.6
	Function	Isolation	Isolation	Isolation	Isolation	Isolation	Isolation
BALL	Connection	Screwed					
	Valve Item Number	6.6					
	Function	Isolation					

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2.03 VALVE PRODUCT SCHEDULE

VALVE TYPE	ITEM	PRODUCT	DESCRIPTION	PRESSURE RATING SERVICE (PSI)	CONNECTION	OPERATOR
1.0 GATE VALVES	1.1	Red-White/Toyo – 293	B62 Bronze Construction, Solid Wedge Disc, Union Bonnet	125 Steam 200 WOG	Threaded or Soldered	Handwheel, Rising Stem
	1.2	Kitz – 44	B62 Bronze Construction, Solid Wedge Disc, Union Bonnet	200 PSI	Solder	Handwheel, Rising Stem
	1.3	N/A	Cast Iron, Solid Wedge Disc	1380 CWP	Flanged	Handwheel, Rising Stem
	1.4	Red-White/Toyo – 415A	Bronze Construction, Solid Wedge Disc, Bolted Bonnet	125 Steam 200 WOG	Flanged	Handwheel, Non-Rising Stem
	1.5	Red-White/Toyo – 421A	Cast Iron Construction, Bronze Fitted, Solid Wedge Disc, Bolted Bonnet	125 Steam 200 WOG	Flanged	Handwheel, OS & Y
	1.6	Kitz AK200 UEM	All stainless steel gate valve	1035 CWP	Threaded	Handwheel
	1.7	Kitz 150 SCLS	Cast steel construction, Hard Facing Trim, Solid Wedge Disc, Bolted Bonnet. Bypass where specified for service HP steam	Class 150	Flanged	Handwheel, OS & Y
	1.8	Red-White/Toyo – 314	Bronze Construction, Union Bonnet, Solid Wedge Disc, Stainless Steel Seat	200 Steam 400 WOG	Screwed	Handwheel, Rising Stem
	1.9	Victaulic Series 771 (OS&Y) and 772 (NRS)	Cast ductile iron construction, EPDM coated disc, brass stem	1725 kPa CWP	Grooved	Handwheel, R N S
Approved acceptable manufacturers: Crane, Jenkins, Kitz						

VALVE TYPE	ITEM	PRODUCT	DESCRIPTION	PRESSURE RATING SERVICE (PSI)	CONNECTION	OPERATOR
2.0 GLOBE VALVES	2.1	Red-White/Toyo – 211A	Bronze Construction, Swivel Type Metal Disc, Screwed Bonnet	125 Steam 200 WOG	Screwed	Handwheel
	2.2	Red-White/Toyo – 212A	Bronze Construction, Swivel Type Metal Disc, Bonnet	125 Steam 200 WOG	Solder	Handwheel
	2.3	Red-White/Toyo – 220	Bronze Construction, Renuable Teflon Disc, Swivel Type Disc Holer, Union Bonnet	125 Steam 200 WOG	Screwed	Handwheel
	2.4	Red-White/Toyo –	Bronze Construction, Renuable Teflon Disc, Swivel Type Disc Holer, Union	125 Steam 200 WOG	Soldered	Handwheel

		222	Bonnet			
	2.5	Red-White/Toyo – 214	Bronze Construction, 420 S.S. Union Bonnet	2760 CWP	Screwed	Handwheel, Rising Stem
	2.6	Red-White/Toyo – 400A	Cast Iron Construction, Bronze trimmed, Bolted Bonnet	125 Steam 200 WOG	Flanged	Handwheel, OS & Y
	2.7	Kitz 150 SCJ	Cast steel construction, plug type disc, bolted bonnet, stellite trim	Class 150	Flanged	Handwheel, OS & Y
	2.8	Kitz AK 200 UJM	All stainless steel globe valve	1035 CWP	Threaded	Handwheel
	2.9	Red-White/Toyo – 221	Union Bonnet, Renewable Teflon Disc, Swivel Type Disc Holder, Screwed Ends	150 Steam 300 WOG	Screwed	Handwheel, Stem Rising
Approved acceptable manufacturers: Crane, Jenkins, Nibco						

VALVE TYPE	ITEM	PRODUCT	DESCRIPTION	PRESSURE RATING SERVICE (PSI)	CONNECTION	OPERATOR
3.0 CHECK VALVES	3.1	Red-White/Toyo – 237	Bronze Construction Y-Pattern, Regrind seating, Screwed Cap, Integral Disc	125 Steam 200 WOG	Solder	Swing
	3.2	Red-White/Toyo – 360	Bronze Construction, T-Pattern Regrind Seating, Screwed Cap	4140 CWP	Threaded	Swing
	3.3	Red-White/Toyo – 236	Bronze Construction Y-pattern, Regrind Seating, Screwed Cap, Integral Disc	125 Steam 200 WOG	Threaded	Swing
	3.4	Red-White/Toyo – 435A	Cast Iron Construction, Bronze Trimmed, Regrindable Disc, Bolted Cover	125 Steam 200 WOG	Flanged	Swing
	3.5	Kitz 150 SCO	Cast Steel Construction, Stellite Trim	Class 150	Flanged	Swing
	3.6	Kitz AK200UOM	All stainless steel check valve	1035 CWP	Screwed	Swing
	3.7	Victaulic Series 712	Cast ductile iron body, stainless steel trimmed, coupled cover.	2065 kPa CWP	Grooved	Swing
Approved acceptable manufacturers: Crane, Jenkins, Nibco						

VALVE TYPE	ITEM	PRODUCT	DESCRIPTION	PRESSURE RATING SERVICE (PSI)	CONNECTION	OPERATOR
4.0 SPRING LOADED CHECK VALVES	4.1	MAS 700	Ansi B1.20.1, Forced Brass, 316 Stainless Steel Spring, NBR-70SH Rubber Disc	1965 CWP	Screwed	Spring
	4.2	M & G - W12A-16V	Cast Iron Body to ASTM 48 Class 40, 316 Stainless Steel Disc, Viton Seat	125 Class	Wafer	Spring
	4.3	M & G U I515WM5B	Cast Iron Body, Viton A seat, UL approved	1725 CWP	Wafer	Inconel X Spring

	4.4	Victaulic Series 716	Ductile Iron Body, Stainless Steel Spring and Shaft	2065 kPa CWP	Grooved	Spring
	4.5	Victaulic Series W715	Ductile Iron Body, Stainless Steel Dual Disc, Spring, and Shaft, EPDM seat	1585 kPa CWP	AGS Grooved	Spring
	4.6	Victaulic Series 717	Ductile Iron Body, Stainless Steel Spring and Shaft, UL approved.	2065 kPa CWP	Grooved	Spring
	Approved acceptable manufacturers: Mueller, Nibco, Victaulic					

VALVE TYPE	ITEM	PRODUCT	DESCRIPTION	PRESSURE RATING SERVICE (PSI)	CONNECTION	OPERATOR
5.1 PLUG VALVES	5.1	DeZurik 118, S, 2, RS55, ALG	Eccentric, permanently lubricated, C1 body, resilient plug, SS Bearings, Viton/TFE U-ring seal, Isobutene – Isoprene plug facing	1200 CWP	Threaded	Lever c/w memory stop
	5.2	DeZurik 118, F/V, 2, RS55, ALG	Eccentric, Permanently Lubricated, C1 body, Resilient Plug, SS Bearings, Viton/TFE U-ring seal, Isobutene – Isoprene plug facing	1200 CWP	Flanged or Grooved	Lever c/w memory stop
	5.3	DeZurik 118, FV, 6, RS55, ANG	Eccentric, Permanently Lubricated, C1 body, Resilient Plug, SS Bearings, Buna packing, Isobutene – Isoprene plug facing	1200 CWP	Flanged or Grooved	Removable Lever c/w memory stop
	5.4	DeZurik 118 F/V, 6, RS56, ACG6, Fig. 604	Eccentric, Permanently Lubricated, C1 body, Resilient Plug, SS Bearings, Buna packing, Isobutene – Isoprene plug facing	1200 CWP	Flanged or Grooved	Geared, Handwheel c/w memory stop
	5.5	Rockwell 142	Tapered, Coated plug, C1 Body	1200 CWP	Threaded	Removable Lever
	5.6	Rockwell 143	Tapered, Coated plug, C1 Body	1200 CWP	Flanged	Removable Lever
	5.7	Victaulic Series 377	Eccentric, Ductile Iron Body, EPDM Coated Plug, Welded-in Nickel Seat, 316 SS Bearings	1200 kPa CWP	Grooved	Removable Lever or C
Approved acceptable manufacturers: Rockwell, DeZurik, Victaulic						

VALVE TYPE	ITEM	PRODUCT	DESCRIPTION	PRESSURE RATING SERVICE (PSI)	CONNECTION	OPERATOR
6.0 BALL VALVES	6.1	Red-White/Toyo – 5044A	Brass Construction, 2-piece construction, Teflon seats, Seals Buna-N O-ring, Blow out Proof stem	150 Steam 600 WOG	Screwed	Lever
	6.2	Red-White/Toyo – 5044W	Brass Construction, 2-piece construction, Teflon seats, Seals Buna-N O-ring, Blow out Proof stem	150 Steam 600 WOG	Screwed	Wing Handles

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6.3	Red-White/Toyo – 5049A	Brass Construction, 2-piece construction, Teflon seats, Seals Buna-N O-ring, Blow out Proof stem	150 Steam 600 WOG	Soldered	Lever
6.4	Red-White/Toyo – 5049W	Brass Construction, 2-piece construction, Teflon seats, Seals Buna-N O-ring, Blow out XXXX stem	150 Steam 600 WOG	Soldered	Wing Handles c/w Memory Stop
6.5	Kitz 150 UTBM (Full Bore)	ANSI 150 All stainless steel ball valve	1970 CWP Kitz 150 UTRM (Reduced Bore)	Flanged	Worm Gear
6.6	Red-White/Toyo – 5044A	Forged Brass, 2-piece Construction, Blow Out Proof Stem, Hard chrome Plated Forged Brass Ball, Teflon seats, Buna-N O- ring, CGA Approved	600 GAS	Screwed	Lever
6.7	Type – 5044A	Forged Brass, 2-piece Construction, Blow Out Proof Stem, Hard chrome Plated Forged Brass Ball, Teflon seats, Buna-N O- ring, UL Approved	600 GAS	Screwed	Lever
6.8	Victaulic Series 589	Forged Brass, 2-piece Construction, Blow Out Proof Stem, Hard chrome Plated Forged Brass Ball, Teflon seats,	2065 kPa CWP	Vic-Press	Lever
6.9	Victaulic Series 726	Cast Ductile Iron, 2-piece Construction, Blow Out Proof Stem, Hard chrome Plated Steel Ball, TFE seats.	5515 kPa CWP	Grooved	Lever or gear
6.10	Victaulic Series 728	Cast Bronze, 2-piece Construction, Blow Out Proof Stem, Hard Chrome Plated Brass Ball, TFE seats, with Supervisory Switches. UL approved.	2410 kPa CWP	Grooved / Threaded	Handwheel
Approved acceptable manufacturers: Crane, Nibco, Newman Hattersley -					

VALVE TYPE	ITEM	PRODUCT	DESCRIPTION	PRESSURE RATING SERVICE (PSI)	CONNECTION	OPERATOR
7.0 BUTTERFLY VALVES	7.1	Center Line Series 20	Cast Iron Body, EPDM Resilient Seat, Bronze Disc, 416 SS Shaft, Bronze Bushings	200	Lug	10 Position Lever
		Victaulic 300 MasterSeal	Ductile iron body, enamel coated body, EPDM pressure responsive seat.	2065 kPa CWP	Grooved	10 position lever or Gear
	7.2	Center Line Series 200	Cast Iron Body, EPDM Resilient Seat, Bronze Disc, 416 SS Shaft,	200	Lug	Infinite Position Lever c/w Memory Stop

			Bronze Bushings			
	7.3	Center Line Series 200	Cast Iron Body, EPDM Resilient Seat, Bronze Disc, 416 SS Shaft, Bronze Bushings	200	Lug	Gear Wheel c/w Flag Indicator
	7.4	Victaulic Series 705W -	DI Body, Disc, and Shaft, EPDM Disc Coating, UL approved	2065 kPa CWP	Grooved	Gear, Wheel, c/w Flag Indicator & Provision for Monitor
	7.5	Victaulic Series W706	DI Body, PPS Coated DI Disc, EPDM seal, SS Shaft	2065 kPa CWP	AGS Grooved	Gear
	7.6	Victaulic Series 608	Cast Bronze Body, EPDM Coated Disc, Copper-Tube Dimension Ends.	2065 kPa CWP	Grooved	Lever or Gear
	7.7	Victaulic Series 763	Grade CF8M Stainless Steel Body and Disc, Elastomer Seal, 316SS Stem.	2065 kPa CWP	Grooved	Lever or Gear
Approved acceptable manufacturers: Jenkins, Keystone, Crane -						

VALVE TYPE	ITEM	PRODUCT	DESCRIPTION	PRESSURE RATING SERVICE (PSI)	CONNECTION	OPERATOR
8.0 RADIATOR VALVES	8.1	Red-White/Toyo – 252	Bronze, Heavy Pattern, Composition Disc	200	Union	Handwheel
	8.2	Red-White/Toyo – 250 LS	Bronze, Heavy Pattern, Composition Disc	1380 WP @ 121°C	Union	Lockshield c/w Memory Stop
Approved acceptable manufacturers: Red-White/Toyo, Dahl						

VALVE TYPE	ITEM	PRODUCT	DESCRIPTION	PRESSURE RATING SERVICE (PSI)	CONNECTION	OPERATOR
9.0 DRAIN VALVES	9.1	Red-White/Toyo – 5046	Hard Chrome Plated Ball, Cap and Drain	1380 WP @ 121°C	Screwed X hose	Lever
	Approved acceptable manufacturers: Toyo, Kitz					

VALVE TYPE	ITEM	PRODUCT	DESCRIPTION	PRESSURE RATING SERVICE (PSI)	CONNECTION	OPERATOR
10.0 NEEDLE VALVES	10.1	Crane 88	B62 Bronze Construction	2760 CWP	Screwed	Handwheel Rising Stem
	Approved acceptable manufacturers: Jenkins, WH Bolton, Crane					

VALVE TYPE	ITEM	PRODUCT	DESCRIPTION	PRESSURE RATING SERVICE (PSI)	CONNECTION	OPERATOR
11.0 RELIEF	11.1	Watts 174A	Bronze Body, Composition Disc	Heating Water to 1100 kPa	Screwed	

VALVES	11.2	Watts 40 – 140	Bronze Body, Composition Disc	Domestic water	Screwed	Temperature and Pressure
	11.3	Watts X15	Brass or Bronze Body, Teflon Disc, SS Spring	LP Steam	Screwed	Pressure
	Approved acceptable manufacturers: Sarco, Lunkenheimer					

VALVE TYPE	ITEM	PRODUCT	DESCRIPTION	PRESSURE RATING SERVICE (PSI)	CONNECTION	OPERATOR
12.0 DIFFERENTIAL PRESSURE RELIEF VALVES	12.1	Braukman DU 146	Brass Body, SS Spring, EP Disc Seat, sizes to 30 mm	300 kPa	Screwed	
	12.2	Watts ACV116E	Cast iron body, coated S.S. seal, viton diaphragm, seat, O-rings, sizes to 38 mm	1379 kPa	Screwed	24 VAC solenoid, normally closed
	12.3	Watts ACV116E	Cast iron body, coated S.S. seal, viton diaphragm, seat, O-rings, sizes >= 50 mm	1379 kPa	Flanged	24 VAC solenoid, normally closed

3. EXECUTION

3.01 INSTALLATION

- .1 Use line size valves throughout with the exception of control valve by passes. Size control valve bypass valves equal to control valve.
- .2 Install valves with stems upright or horizontal. Under no circumstances install inverted.
- .3 Align valves for easy access and identification when several service lines are installed together.
- .4 Provide chain operators on valves installed at high level in equipment rooms that cannot be reached by an operator standing on the floor or fixed service platform.
- .5 Provide one lever handle per 10 plug valves where handles are removable.

3.02 APPLICATION

- .1 Install gate or butterfly valves to isolate equipment, sections of systems, at the base of each vertical pressure riser and elsewhere as indicated.
- .2 Install gate or butterfly valves on all branch connections to the main.
- .3 Use globe valves for throttling service, meter bypass and control valve bypass.
- .4 Provide shutoffs to groups of plumbing fixtures.

3.03 DRAINS

- .1 Provide drain valves at main shutoff valves, low points of piping circuits including base of all risers and at apparatus other than room heat transfer units.
- .2 Provide drain valves on strainers size 100 mm and over and larger.

END OF SECTION

1. GENERAL

1.01 SUMMARY

- .1 This Section covers generally the requirements for pipe hangers and supports, pipe anchors and sleeving for mechanical components specified in Divisions 20, 21, 22, 23 and 25.

1.02 RELATED REQUIREMENTS

- .1 Section 20 05 10 – Mechanical Systems Pipe and Pipe Fittings
- .2 Section 20 05 48 – Noise and Vibration Control

1.03 REFERENCE STANDARDS

- .1 American National Standards Institute (ANSI):
 - .1 ANSI/ASME B31.1-2004, Power Piping

1.04 SUBMITTALS

- .1 Provide required information in accordance with Section 01 00 06 – General Requirements: Submittals.
- .2 Submit shop drawings of each factory fabricated component.
- .3 Submit samples of hangers and supports with shop drawing submittal.

1.05 DESIGN REQUIREMENTS

- .1 Provide hangers and supports to secure equipment in place, prevent vibration, maintain grade, provide for expansion and contraction.
- .2 Install supports of strength and rigidity to suit loading without unduly stressing building; locate adjacent to equipment to prevent undue stresses in piping and equipment.
- .3 Select hangers and supports for the service and in accordance with manufacturer's recommended maximum loading. Hangers shall have a safety factor of 5 to 1.
- .4 Fasten hangers and supports to building structure or inserts in concrete construction.
- .5 Provide and set sleeves or block-outs required for equipment, including openings required for placing equipment.
- .6 Provide sleeves for all pipe, and duct penetrations through walls, ceilings, floors and footings. Provide locations and dimensions for block-outs or imbedded material if provided or installed by others.
- .7 Do not weld piping, ductwork or equipment supports to building metal decking or building structural steel supports unless prior written approval has been obtained from the structural Consultant.
- .8 Obtain approval prior to drilling for inserts and supports for piping system. Discuss and obtain approval for hanging systems and methods with Structural Consultant.
- .9 Obtain approval prior to using percussion type fastenings.

- .10 Use of piping or equipment for hanger supports and use of perforated band iron, wire or chain as hangers is not permitted.

2. PRODUCTS

2.01 INSERTS

- .1 Inserts shall be galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms.
- .2 Size inserts to suit threaded hanger rods.

2.02 PIPE HANGERS AND SUPPORTS

- .1 Hangers, Pipe Sizes 15 mm to 40 mm: Adjustable wrought steel ring or steel clevis.
- .2 Hangers, Pipe Sizes 50 mm and Over: Adjustable wrought steel clevis or steel clevis.
- .3 Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods. Cast iron roll and stand for hot pipe sizes 150 mm and over. Cup washers for hot piping below 150 mm.
- .4 Wall Support, Pipe Sizes to 80 mm: Cast iron hook.
- .5 Wall Support, Pipe Sizes 100 mm and Over: Welded steel bracket and wrought steel clamp, adjustable steel yoke and cast iron roll for hot pipe sizes 150 mm and over.
- .6 Vertical Support: Steel riser clamp.
- .7 Floor Support, Pipe Sizes to 100 mm and All Cold Pipe Sizes: Cast iron adjustable pipe saddle, locknut nipple, floor flange and concrete pier or steel support.
- .8 Floor Support, Hot Pipe Sizes 125 mm and Over: Adjustable cast iron roll and stand, steel screws and concrete pier to steel support.
- .9 Design hangers so they cannot become disengaged by movements of supported pipe.
- .10 Provide copper plated hangers and supports for copper piping.
- .11 Provide galvanized hangers and supports for galvanized piping.
- .12 Support all piping below structural floor slabs in 3.416 mm (10 gauge) continuous epoxy coated channel. Support channel with epoxy coated clevis hangers and rods. Install supports on centres as specified in 3.2. Extend epoxy coated hanger rods 450 mm above slab rebar and bend back over rebar so as to provide a minimum of 450 mm of support in slab. Do not stress rod when bending.
 - .1 Acceptable material: Scotchkote Fusion Bonded epoxy powder, or acceptable substitution.

2.03 HANGER RODS

- .1 Provide steel rods, threaded both ends, threaded one end, or continuous threaded.

2.04 SLEEVES

- .1 Pipes through Floors: Form with steel pipe or approved PVC sleeves.
- .2 Pipes through Beams, Walls, Fire Proofing, Footings, Potentially Wet Floor: Form with steel pipe.

- .3 Ducts: Form with galvanized steel.
- .4 Size large enough to allow for movement due to expansion and to provide for continuous insulation.

3. EXECUTION

3.01 INSERTS

- .1 Use inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams wherever practicable.
- .2 Set inserts in position in advance of concrete work. Provide reinforcement rod in concrete for inserts carrying pipe over 100 mm or ducts over 1500 mm wide.
- .3 Where inserts are omitted, drill through concrete slab from below and provide rod with recessed 100 mm minimum square steel plate and nut above slab.

3.02 PIPE HANGERS AND SUPPORTS

- .1 Support horizontal steel and copper piping as follows:

Nominal Pipe Size	Distance Between Supports		Hanger Rod Dia.
	Steel	Copper	
15 mm to 20 mm	1800 mm	1500 mm	10 mm
25 mm to 40 mm	2100 mm	1800 mm	10 mm
50 mm to 65 mm	3000 mm	2400 mm	10 mm
80 mm to 100 mm	3600 mm	3000 mm	16 mm
150 mm to 300 mm	4200 mm	4000 mm	22 mm
350 mm to 450 mm	6000 mm		25 mm

- .2 Install hangers to provide minimum 15 mm clear space between finished covering and adjacent work.
- .3 Use oversize hangers to accommodate pipe insulation thickness. For pipes up to 50 mm use high density rigid pipe insulation at hanger location, with an insulation protection shield. For pipes 65 mm and over use insulation protection saddle.
- .4 Place a hanger within 305 mm of each horizontal elbow.
- .5 Use hangers which are vertically adjustable 40 mm minimum after piping is erected.
- .6 Support cast iron horizontal drainage pipe near each hub and on each side of gasket and clamp joints, with 1500 mm maximum spacing between hangers.
- .7 Support vertical piping at every other floor. Support vertical soil pipe at each floor at hub.
- .8 Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
- .9 Where practical, support riser piping independently of connected horizontal piping.

3.03 EQUIPMENT BASES AND SUPPORTS

- .1 Provide reinforced concrete housekeeping bases poured directly on structural floor slab 100 mm thick minimum, extended 100 mm minimum beyond machinery bedplates for equipment. Provide templates, anchor bolts and accessories required for mounting and anchoring equipment.
- .2 Construct supports of structural steel members or steel pipe and fittings. Brace and fasten with flanges bolted to structure.
- .3 Provide rigid anchors for ducts and pipes immediately after vibration isolation connections to equipment unless spring hangers are specified.

3.04 PRIMING

- .1 Prime coat exposed steel hangers and supports.

3.05 SLEEVES

- .1 Set sleeves in position in advance of concrete work. Provide suitable reinforcing around sleeve.
- .2 Extend sleeves through potentially wet floors 25 mm above finished floor level. Caulk sleeves full depth and provide floor plate.
- .3 Piping and duct work passing through floor, ceiling or wall, close off space between duct and sleeve with non-combustible insulation. Provide tight fitting metal caps on both sides and caulk.
- .4 Piping passing through perimeter walls below grade, mechanical room floor, roof or wall, close off space between pipe and sleeve with synthetic rubber compound mechanical type seals.
- .5 Sleeves provided through walls or floors where liquids could potentially pass from one side to the other, provide sleeves with a 25 mm 'flange' welded to the external face of the sleeve at the mid point of the thickness of the structure to provide a water stop.
- .6 Install chrome plated escutcheons where piping passes through finished surfaces.

END OF SECTION

1. GENERAL**1.01 SUMMARY**

- .1 This Section covers the identification of various mechanical pipe and duct distribution systems using:
 - .1 Pipe and Duct Markers
 - .2 Stencils
 - .3 Valve Tags
 - .4 Valve Chart Frames
- .2 Paint identification of systems, pipes, ducts, and equipment will be completed by painting contractor responsible for work specified in Section 09 91 00 – Painting.
- .3 Application of identification labels and stencils to systems, pipes and ducts, and equipment will be completed by trade contractor responsible for scope of work specified in this section.
- .4 This section will identify and label the systems, pipes, ducts, and equipment to the painting contractor that require painting in the specified colour schemes.

1.02 DEFINITIONS

- .1 The following definitions apply to the Mechanical Systems Identification specification:
- .2 Inherently Hazardous Materials:
 - .1 Flammable or Explosive: Materials that can be easily ignited, provide fuel as primary fire producer or create an explosive atmosphere.
 - .2 Chemically Active or Toxic: Materials that are corrosive or are in themselves toxic or produce poisonous gases.
 - .3 High Temperature or Pressure: Materials that when released from piping have the potential to inflict injury or property damage by burns, impingement or flashing to vapour state.
- .3 Inherently Low Hazardous Materials: Materials that are not hazardous by nature, and that are near enough to ambient pressure and temperature so that personnel working on systems carrying these materials are at low risk through the release of these materials.

1.03 RELATED REQUIREMENTS

- .1 Section 09 91 00 – Painting: Identification painting of mechanical and electrical distribution systems.

1.04 REFERENCE STANDARDS

- .1 American Society of Mechanical Engineers ([ASME](#)):
 - .1 ASME A13.1-2007, Scheme for the Identification of Piping Systems

1.05 ADMINISTRATIVE REQUIREMENTS

- .1 Scheduling and Coordination: Coordinate painted colour coding of piping and equipment with work specified in Section 09 91 00; provide lengths of pipe or duct runs, quantities of equipment, hangers and supports, and additional information required by Section 09 91 00 in sufficient time to allow accurate pricing.

1.06 SUBMITTALS

- .1 Provide required information in accordance with Section 01 00 06 – General Requirements: Submittals.
- .2 Action Submittals: Provide the following submittals before starting any work of this Section:
 - .1 Product Data: Submit manufacturer's catalogue literature for each product specified, identifying use for interior, exterior or high temperature installations, and as follows:
 - .1 Pipe Identification: Submit list of wording, symbols, letter size, and colour coding for piping identification.
 - .2 Valve Identification: Submit list of wording, symbols, letter size, and colour coding for valve identification.
 - .2 Schedules: Submit a complete schedule of all equipment to have identification complete with symbol and description engraved on the lamacoid plates or stamped brass tags.
 - .3 Samples: Submit two labels, indicating type and quality of installed products.
- .3 Informational Submittals: Provide the following submittals when requested by the Consultant:
 - .1 Installation Instructions: Submit manufacturer's installation instructions indicating special procedures, and installation methods.

1.07 PROJECT CLOSEOUT SUBMISSIONS

- .1 Provide copies of directories and legends for inclusion in the operating and maintenance manuals in accordance with Section 01 00 06 – General Requirements: Closeout Submissions.

2. PRODUCTS**2.01 MANUFACTURERS**

- .1 Subject to compliance with requirements of this section, Pre-Printed Pipe Marking Systems that may be incorporated into the Work include, but are not limited to, the following:
 - .1 Pre-Printed Pipe Marking Systems:
 - .1 [Brady Signmark](#)
 - .2 [Graphic Products](#)
 - .3 Seton Safety and Identification
 - .2 Site Printed Identification Labels: Portable label printer and tapes as follows:
 - .1 [Brady Handimark](#)
 - .2 [Brother PT1800](#)
 - .3 [Graphic Products](#), Duralabel 4TTP
 - .4 Kroy K2500

2.02 DESIGN CRITERIA

- .1 Design wording for tags and labels, and submit schedule of proposed wording for review and acceptance by Consultant prior to manufacture.
- .2 Provide nameplates for terminal cabinets and junction boxes indicating system and voltage characteristics.

2.03 MATERIALS

- .1 Select identification materials to suit surfaces to which they are being applied including but not limited to:
 - .1 Interior Building Surfaces

- .2 Insulated or Non-Insulated Surfaces
- .3 Surfaces Exposed to High Temperature or Cryogenic Conditions
- .4 Surfaces Exposed to High Humidity Conditions
- .5 Surfaces Subject to Wear or Abrasion

2.04 TAGS, LABELS AND BANDING

- .1 Valve Tags: Tags having 13 mm high lettering and #16 brass jack chain for fastening to valve fabricated from one of the following materials at Contractors choice:
 - .1 Brass tags: 38 mm Ø
 - .2 Fibreglass tags: 50 mm x 50 mm
 - .3 Anodized aluminum tags: 38 mm Ø
 - .4 Stainless steel tags: 38 mm Ø
- .2 Laminated Plastic Nameplate (Lamacoid): Self-adhesive, composite laminated plastic nameplates, 3 mm thick with one smooth white surface and core of black plastic, designed to leave black lettering on a white background when engraved, fabricated as follows:
 - .1 Mechanical Equipment: Engraved lettering 19 mm high
- .3 Colour Banding Tape: Adhesive backed plastic tape, integrally coloured, minimum 25 mm wide in accordance with ASME A13.1 pipe marking standards.
- .4 Duct or Pipe Mounted Identification Labels: Pre-printed, adhesive backed plasticized labels having lettering and flow arrows of sizes listed in 3.12.4 below, background colour and colour of directional arrows and letters as scheduled for interior, exterior and hot temperature installations.
- .5 Site Printed Identification Labels: Site-printed, machine-printed, adhesive backed plasticized minimum 13 mm high strip labels colours as indicated in 3.11 below.
- .6 Stencils: Factory-cut stencils ready for paint applied 50 mm high lettering and flow arrows, colour of letters and directional arrows as scheduled.

2.05 DIRECTORIES

- .1 Provide a typewritten directory for each system identified, minimum size 215 mm x 280 mm, or larger as required to accommodate information requirements.
- .2 Mount each directory in an individual metal frame and protect with clear, unbreakable acrylic sheet, permanently mounted.
- .3 Provide additional copies for inclusion in each Operating and Maintenance Manual.
- .4 Pipe and Duct Directory shall include the following information:
 - .1 Abbreviations used for identification
 - .2 Definitions of abbreviations
 - .3 Colour code identification for hazardous and non-hazardous materials
- .5 Valve Tag Directory shall include the following information:
 - .1 Valve number
 - .2 Location
 - .3 Service
 - .4 Make/model size
 - .5 With/without hand wheel
 - .6 Type of control

3. EXECUTION**3.01 PREPARATION, PROTECTION AND CLEAN-UP**

- .1 Degrease and clean surfaces to receive identification materials.
- .2 Prepare surfaces in accordance with Section 09 91 00 for stencil painting.
- .3 Cover new equipment and surfaces with clean tarps or heavy-duty plastic.
- .4 Completely remove spills or spatter from finishes and equipment immediately using cleaning methods that will not harm the finish.

3.02 INSTALLATION

- .1 Install pipe markers in accordance with accepted shop drawings and manufacturer's instructions.
- .2 Install valve tags in accordance with accepted shop drawings and manufacturer's instructions.
- .3 Install pipe and duct identification at the following locations:
 - .1 At each branch or riser take off on piping systems.
 - .2 At each pipe passage through walls, floors or ceilings, both sides.
 - .3 On all straight pipe or duct runs evenly spaced to a maximum of 15 metres o/c.
 - .4 Identify on both sides of obscuring items where pipes or ducts are partially obscured by other pipes, ducts or equipment.
 - .5 Identify pipes and ducts at points of entry and leaving, and at each access opening where piping is concealed in pipe chase or other confined space.
 - .6 Identify pipes and ducts at starting and end points of runs and at each piece of equipment.
 - .7 Identify pipes at major manual and automatic valves immediately upstream of valves.
- .4 Apply stencil lettering only after final finish has been applied.

3.03 MANUFACTURER'S NAME PLATES

- .1 Provide a factory-applied nameplate on each piece of manufactured equipment indicating size, equipment name, manufacturers name, serial number, electrical characteristics, and performance characteristics.
- .2 Provide registration plates such as pressure vessel, cUL_{US}, ULC and CSA approval plates as required by respective agency or authority having jurisdiction, and as required by the specifications.
- .3 Nameplates of non-Canadian made equipment shall include the name and address of the Canadian agent providing the product, and equivalent Canadian labelling criteria acceptable to the authorities having jurisdiction.
- .4 Fasten nameplates securely in a conspicuous and easily read location.
- .5 Do not apply insulation or paint over nameplates.

3.04 EQUIPMENT IDENTIFICATION

- .1 Provide each piece of equipment with a neatly stamped brass tag giving equipment name, system identification and number.
- .2 Provide a separate lamacoid plate describing the function of the piece of equipment having lettering no smaller than 15 mm high, in addition to identification described above.

.3 Identify each piece of equipment with the symbol and number provided by the City.

.4 Equipment that is electrically driven and is identified at motor starter shall have identical nameplates as on the starter.

3.05 DUCTWORK IDENTIFICATION

.1 Identify both system number and type of air (e.g. AIR SYSTEM #1 – SUPPLY) where applicable using 50 mm high black-stencilled letters with arrows indicating flow.

3.06 PIPING IDENTIFICATION

.1 Apply identification colour bands on all exposed or concealed piping except drainage piping and vent piping outside mechanical rooms in the primary colours listed in this Section.

.2 Colour bands shall completely encircle the pipe for a length of 150 mm in primary colour. Neatly arrange all bands in straight lines across groups of pipes.

3.07 VALVE IDENTIFICATION

.1 Provide brass tags with 15 mm stamped code lettering.

.2 Secure tags to items with brass hooks and non-ferrous chains.

.3 Affix a tag to all valves not adjacent to the equipment they serve.

.4 Provide lamacoid plates giving instructions on opening, closing, throttling and setting.

.5 Provide neat, type written valve location identification charts giving valve tag numbers, valve service and valve location; frame one copy under glass and mount in equipment room.

3.08 CONTROLLER IDENTIFICATION

.1 Identify each controller (e.g.: freezestats, humidistats, discharge temperature controllers) with embossed metal bands secured to each controller.

3.09 PRE-PAINTED EQUIPMENT

.1 Repair finish on all pre-painted equipment that is damaged or faded.

3.10 MECHANICAL EQUIPMENT SITE PAINTING

.1 Refer to Section 09 91 00 for extent of site painting of mechanical equipment, pipes and ducts.

3.11 MISCELLANEOUS IDENTIFICATION

.1 Identify electric starting switches, thermostats controlling motors, remote push button stations, and controls equipment supplies under this division with lamacoid plates having 6 mm high minimum letter size.

.2 Identification shall state equipment controlled and be matched to control shop drawing identification numbers.

- .3 Identify the purpose of duct access panels with self adhesive stick-on coloured labels with colours conforming to the following schedule:

	Abbreviation	Field Colour	Letter Colour
Cleaning and service access	C.A.	Yellow	Black
Controls, including heat sensors	C	Black	White
Dampers (back draft, balance and control)	D	Blue	White
Fire dampers	F.D.	Red	White

- .4 Identify the location of the following items of equipment using site printed labels, which are concealed above a suspended unit ceiling by applying to grid adjacent to panel to be removed; or behind a wall or ceiling access door by applying to frame with colours conforming to the following schedule:

	Field Colour	Letter Colour
Concealed equipment and cleaning access	Yellow	Black
Control equipment, including control dampers and valves, and heat sensors	Black	White
Fire, smoke, and sprinkler equipment	Red	White
Pipe mounted equipment with the exception of fire, smoke, sprinkler and control equipment	Green	White

3.12 COLOUR CODE SCHEDULE

- .1 Paint pipes, services, equipment and other items in areas requiring full colour coding in primary banding colour in accordance with Section 09 91 00.
- .2 Natural gas piping shall be yellow coloured in concealed, semi-concealed and exposed location, and shall not have any other colour applied to it, except as stated for banding identification only.
- .3 Paint colours and labels shall conform to the following schedule based on ASME A13.1 colour code identification system, except as modified by identification table following:

Contents	Banding	Label	
	Primary Colour	Field Colour	Letter Colour
INHERENTLY HAZARDOUS MATERIALS			
Flammable or Explosive	Yellow	Yellow	Black
Natural Gas	Yellow	Yellow	Black
Non-Potable Water	Yellow	White	Black
Extreme Temperature or Pressure	Yellow	White	Black

- .4 Size of letters on labels shall conform to the following schedule based on ASME A13.1 identification system:

Outside Diameter of Pipe or Covering	Length of Field Colour	Size of Letters
19 mm to 32 mm	200 mm	13 mm
38 mm to 50 mm	200 mm	19 mm
65 mm to 150 mm	305 mm	32 mm
200 mm to 250 mm	610 mm	65 mm
Over 250 mm	800 mm	89 mm

- .5 Identification symbols and abbreviations for piping and equipment, complete with directional arrows where applicable:

Description	Pipe Colour	Stripe Colour	Symbol
Domestic Cold Water	Light Blue	None	COLD WAT.
Domestic Cold Water Recirculation	Light Blue	None	DCWR
Domestic Hot Water	Green	Orange	DHW 60°C
Hangers, Brackets and Hanger Rods	Black	None	None
Hot Water Storage Tanks (Uninsulated)	Aluminum	Red	None
Hot Water Storage Tanks (Insulated)	Green	Orange	None
Natural Gas	Yellow	None	NAT. GAS
Vent	Aluminum	Red or Orange	None

- .6 Mechanical Control Systems:

- .1 Conduit banding, pull boxes, terminal boxes and junction boxes; Grey Covers, Grey Bands with black 'C'.
.2 Main and secondary control panels, factory finish acceptable; control contractor shall install company label to identify controlled equipment.

- .7 Duct Work:

- .1 Identify duct work as follows, complete with directional arrows:

Description	Symbol
Combustion Air	COMB. AIR
Exhaust Air	EXH. AIR
Mixed Air	M.A.
Relief Air	RELIEF AIR
Return Air	R.A.
Supply Air	S.A.

- .8 Equipment Bases and Housekeeping Pads: Grey, with 100 mm wide strip on face and top, 50 mm wide yellow and black angled bands around edges.

END OF SECTION

1. GENERAL

1.01 SUMMARY

- .1 This Section covers generally the requirements for bases, supports and vibration isolation for all equipment specified in Divisions 20, 21, 22, 23 and 25.

1.02 RELATED REQUIREMENTS

- .1 Section 20 05 29 – Pipe Hangers, Supports and Anchors for Mechanical Systems.
- .2 Section 23 72 13 – Indoor Air-to-Air Recovery Ventilators
- .3 Section 23 34 00 – HVAC Fans

1.03 SUBMITTALS

- .2 Provide required information in accordance with Section 01 00 06 – General Requirements: Submittals
- .3 Submit vibration isolation schedule indicating the tag number of the equipment isolated, the type of base selected, the type of isolator selected, and the isolator static deflection chosen.
- .4 Submit shop drawing for all mounted mechanical equipment that reflects the dimensional and installation requirements of the approved piece of equipment submitted under different sections. Include electrical motor isolation.
- .5 Submit proposed mounting detail drawings for approval by the Consultant if manufacturer's drawings are not available or suitable.
- .6 Submit report prepared by the isolation supplier that certifies that the installation has been checked and corrected as necessary.
- .7 Provide inspection services by vibration isolation equipment and materials manufacturer's representative for final installation.

1.04 QUALITY ASSURANCE

- .2 Mount mechanical equipment in accordance with approved drawings and literature provided by the manufacturer and with the electric motor on the same base or frame as the driven equipment. Equipment to be mounted true and level so that operation will not be affected by weight.
- .3 Mount mechanical equipment on vibration isolators to minimize the transmission of vibrations to building structure.
- .4 All vibration control equipment shall be the product of one manufacturer. An exception to this is the vibration isolation supplied as an integral part of packaged equipment.
- .5 When all equipment is in operation, the vibration isolator system shall be checked by the product supplier for effectiveness and proper installation. Any isolation which is not performing as intended or which is not properly installed shall be replaced at no additional cost.
- .6 Provide isolation that will maintain stability during starting and stopping of equipment without any traverse and eccentric movement of equipment that would damage or adversely affect the equipment or attachments.
- .7 Isolators shall be selected and located to produce uniform loading and deflection even when equipment weight is not evenly distributed.

2. PRODUCTS**2.02 MANUFACTURERS**

.2 Basis-of-Design materials are based on products supplied by Vibro-Acoustics; other manufacturers products may be acceptable for work of this Section subject to compliance with specified requirements; manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

- .1 Vibro-Acoustics
- .2 Amber/Booth Company Inc.
- .3 Kinetics Noise Control/Vibron Products Group
- .4 Korfund Dynamics
- .5 Lo-Rez Vibration Control Ltd.
- .6 Mason Industries

2.03 INERTIA BASES

.2 Base Type 5: No base. Isolator is fixed directly to equipment.

.3 Base Type 6: Sling rail style structural steel base frame with gusset reinforced isolator flanges to allow spring isolator to be situated within the vertical space occupied by the inertia base.

.4 Base Type 7: Integral structural steel base frame to support rotating equipment. Spring isolators shall mount below base. Base frame shall be complete with affixed motor slide rails.

.5 Base Type 8: Concrete filled, structural steel inertia base all welded construction complete with steel reinforcing rods. Height saving gusset reinforced isolator flanges.

2.04 FLEXIBLE PIPE CONNECTIONS

.2 Flexible connections shall be the following types:

- .1 For 65 mm pipe size and under – Provide standard Type 321 stainless steel bellows type inner core with Type 312 braided stainless steel sheath. Screwed ends with union nut and nipped at one end.
- .2 For pipe size 76 mm and larger – Provide Type 321 stainless steel bellows type inner core with Type 321 standard braided stainless steel with ANSI 300 flanged ends.

.3 Design flexible connections for an operating temperature of 10°C above the maximum system design temperature and for working pressure of not less than 862 kPa or 1 1/2 times system operating pressure whichever is greater. Support either side of the flexible connection. Select the flexible connector length to manufacturer's requirements.

3. EXECUTION**3.02 GENERAL**

.2 Provide vibration isolation for all rotating equipment.

.3 Isolator type shall be as indicated in the attached schedule.

3.03 CONCRETE BASES

.2 Provide concrete bases or housekeeping pads under all floor mounted equipment and components unless specific instructions are given not to install these bases.

.3 All housekeeping bases are to be minimum of 100 mm thick and to extend minimum of 100 mm beyond the largest outside dimensions of the equipment. Bases to have 25 mm chamfered edge.

.4 Correct location and size of concrete bases shall be the responsibility of Divisions 20, 21, 22, 23 and 25. Concrete will be provided under Division 03.

3.04 ANCHOR BOLTS

.2 Provide and set anchor bolts, sleeves, washers, nuts and provide templates to locate the positions of the bolts. Set sleeves so that they are flush with or slightly above the top surface or rough concrete. Use anchor bolts with adequate right-angled bends or hooks, or with square plate washers, threads and nuts for anchoring. Do not use expansion shields or similar devices for anchoring mechanical equipment to concrete bases.

3.05 GROUTING AND LEVELLING

.2 Grout all machines having bed plates and flexible or solid couplings under the full area of the bed plate with non-shrinking premixed grout. After grout has set, remove all wedges, shims and jack bolts, and fill the spaces with grout.

.3 Carefully level equipment on rough bases using metal leveling wedges and properly sized pieces of steel plate or steel sections. Allow maximum of 25 mm for grouting.

3.06 FLEXIBLE CONNECTIONS

.2 Provide flexible pipe connections where shown.

.3 Flexible connections for rotating equipment where possible shall be installed in horizontal position, parallel to shafts of equipment. For reciprocating equipment install in pairs, one at right angles to the other. Install connecting all with resilient support. Install anchor adjacent to the flexible connectors. Install in accordance with manufacturer's recommendations.

.4 Flexible connections are not required to isolate in-line pipe mounted pumps. If after operation pump noise is evident, correct to satisfaction of the Consultant.

3.07 METAL SUPPORTS

.2 Design, construct and install metal supports, stands, platforms, and other metal structures including maintenance platforms required for and associated with the mechanical equipment. Ensure that structures are designed so that loads and impact loads are properly distributed into building structure.

.3 Where equipment is indicated or specified to be floor mounted on stands or legs, fabricate these from structural steel section and/or steel pipe with adequate bracing and steel plate flanges for bolting to the concrete base or floor.

.4 Where ceiling or wall mounting is indicated or specified, use suspended platform, bracket or shelf, whichever is most suitable for the equipment and its location. Fabricate from standard structural steel sections and plate and/or steel pipe. Ensure that these structures are adequately fastened to the building structure.

.5 Supports must be large enough to support the equipment along the entire length and width. Adequate provision must be made to install isolators if necessary either below the support or between support and the equipment.

.6 If necessary to provide continuous and rigid support for equipment components, mount all components on channel or 'I' beams before mounting on isolators.

- .7 Vertical tanks are to be supported by adjustable jack-legs and horizontal tanks by saddles with correct curvature for tank shell.

3.08 VIBRATION CONTROL INSTALLATION

- .2 Care must be taken to ensure that no ducts or piping transmit vibration to the walls and floors through which they pass. Pipe sleeves shall be tightly packed with low density fibreglass and sealed with non-hardening mastic on both sides. Provide minimum 25 mm thick packing around the perimeter of the isolated penetration.
- .3 Manufacturer is to supervise the installation of vibration control equipment and issue certified report that the units have been properly installed and are performing with maximum efficiency.
- .4 Supply to the Vibration Isolation Manufacturer approved drawings of all equipment to be isolated.
- .5 All equipment shall be adequately isolated to maintain acceptable noise levels in the occupied areas of the building.
- .6 When all equipment is in operation, the vibration isolation system shall be checked for efficiency and installation. Replace at no additional cost any isolation which is not performing as intended or that is not properly installed.
- .7 All piping, electrical conduits and ductwork connecting isolating equipment shall not reduce the flexibility of the system.
- .8 Resiliently support all piping connected to isolated equipment for the following distances or to the nearest flexible pipe connector.

Pipe Size	Distance
25 mm	120 diameters
50 mm	90 diameters
75 mm	80 diameters
100 mm	75 diameters
150 mm	60 diameters
200 mm	60 diameters
250 mm	54 diameters
300 mm	50 diameters
400 mm	45 diameters
610 mm	38 diameters

- .9 For resiliently supported pipe, select the three closest hangers to the vibration source with static deflection equal to the static deflection of the isolated machine. Select the remaining isolators for the lesser of 25 mm static deflection or one half of the static deflection of the isolated equipment.
- .10 Provide isolators and inertia bases in accordance with the vibration isolation schedule on Drawings.

END OF SECTION

1. GENERAL

1.01 SUMMARY

.1 This Section includes requirements for testing of the following:

- .1 Test domestic water piping.
- .2 Test sanitary sewer piping.
- .3 Test storm sewer piping.
- .4 Test sewer vent piping.
- .5 Test low velocity ducts.
- .6 Test natural gas piping.

1.02 QUALITY ASSURANCE

- .1 Test equipment and material where required by specification or authority having jurisdiction to demonstrate its proper and safe operation.
- .2 Test procedures in accordance with applicable portions of ASME, ASHRAE, SMACNA, N.F.P.A. and other recognized test codes.
- .3 Perform tests on site to the satisfaction of the Consultant.
- .4 Piping, fixtures or equipment shall not be concealed or covered until installation is inspected and approved by the Consultant. Provide written notice to the Consultant at least three (3) days in advance of tests or concealing of piping.
- .5 Coordinate with Consultant at start of the project, those tests that will require witnessing by the Consultant.
- .6 Submit sample test certificate forms for review two (2) weeks prior to any testing on site.

1.03 SUBMITTALS

- .1 Provide required information in accordance with Section 01 00 06 – General Requirements: Submittals.
- .2 Obtain certificates of approval and acceptance, complying with rules and regulations from authorities having jurisdiction. Submit copies to be included in Operating and Maintenance Manuals.
- .3 Perform tests as specified. Include test certificates in Operating and Maintenance Manuals.

1.04 LIABILITY

- .1 Take charge of plant during tests, assume responsibility for damages in the event of injury to personnel, building or equipment and bear costs for liability, repairs and restoration in this connection.

2. PRODUCTS

2.01 NOT USED.

3. EXECUTION**3.01 PRESSURE TESTS**

- .1 Provide equipment, materials and labour for tests and pay expenses. Use test instruments from approved laboratory or manufacturer and furnish certificate showing degree of accuracy and date of calibration. Install permanent gauges and thermometers used for tests just prior to tests to avoid possible changes in calibration.
- .2 Carry out tests for 8 hour period and maintain pressure with no appreciable pressure drop. Where leakage occurs, repair and re-test and pay necessary costs for re-witnessing.
- .3 Drainage systems: Test by filling with water to produce water pressure to 30 kPa minimum and 62 kPa maximum.
- .4 Water piping: Test to 1-1/2 times maximum working pressure or 1035 kPa, whichever is greater, water pressure measured at system low point.
- .5 Ducts: Check for audible leaks at 500 Pa WG above associated fan external static pressure.
- .6 Check systems during application of test pressure including visual check for leakage of water test medium, soap bubble test for air.
- .7 When using water as test medium for system not using water, evacuate and dehydrate the piping and certify the lines are dry. Use agency specializing in this type of work.
- .8 Check systems during application of test pressure including visual check for leakage of water test medium, soap bubbler test for air or nitrogen test medium.
- .9 Should tests indicate defective work or variance with specified requirements, make changes immediately to correct the defects. Correct leaks by re-making joints in screwed fittings, cutting out and re-welding welded joints, re-making joints in copper lines. Do not caulk.

END OF SECTION

1. GENERAL

1.01 SUMMARY

.1 Work in this section includes, but is not limited to, the following:

- .1 Performance testing of equipment.
- .2 Manufacturer's start-up of equipment.

1.02 REFERENCE STANDARDS

- .1 American Society for Testing and Materials (ASTM)
- .2 American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE)
- .3 American Society of Mechanical Engineers (ASME)
- .4 American Society of Plumbing Engineers (ASPE)
- .5 Canadian Standards Association (CSA)
- .6 Sheet Metal and Air Conditioning Contractors National Association (SMACNA)

1.03 QUALITY ASSURANCE

- .1 Use factory trained representatives and submit manufacturer's check sheets for starting all systems and equipment.
- .2 Testing and certification of each backflow prevention device shall be by an "Approved Cross Connection Installation Specialist". One copy of the certificate to be submitted to respective municipal authority, and one copy is to be inserted in each O & M manual.
- .3 Prior to starting, testing, balancing, adjusting, and cleaning processes, verify with Consultant any tests required to be witnessed. Provide sufficient notice to Consultant prior to commencement of procedures.
- .4 Consultant shall be allowed to witness any testing, adjusting, starting, balancing, and cleaning procedures.
- .5 Assume all costs associated with starting and testing, including the supply of testing or cleaning medium.
- .6 Prior to starting equipment or systems, secure and review manufacturer's installation, operation, and starting instructions. Read in conjunction with procedures defined herein.
- .7 Use manufacturer's or supplier's starting personnel where required to ensure integrity of manufacturer's warranty.
- .8 Compare installations to published manufacturer's data and record discrepancies. Items potentially detrimental to equipment performance shall be corrected prior to equipment starting.
- .9 Some processes involved in starting procedures defined in this section may be duplications of authority's verification. To facilitate expedient completion of project, arrange for authorities to assist or witness these procedures.
- .10 All starting, testing, and procedures shall be in accordance with applicable portions of ASME, ASHRAE, AABC, CSA, NFPA, SMACNA, ASTM, ASPE and as required and outlined in these specifications. In particular note the testing requirements of NFPA-20 fire pumps, and of the authorities having jurisdiction.

.11 Personnel involved in starting, testing, balancing and adjusting procedures shall be experienced in the design and operation of mechanical equipment and systems being checked and shall be able to interpret results of the readings and tests.

.12 Assume all liabilities associated with starting, testing and balancing procedures.

2. PRODUCTS

2.01 NOT USED

3. EXECUTION

3.01 GENERAL

.1 Conduct performance tests to demonstrate equipment and systems meet specified requirements after mechanical installations are completed and pressure tested. Conduct tests as soon as conditions permit. Make changes, repairs, and adjustments required prior to operating tests.

.2 Gas fired appliances rated in excess of 117 kW shall be subjected to an operational test established by the Gas Protection Branch and shall pass this test before being approved for operation.

.3 Meet with Division 26 manufacturers, suppliers, and other specialists as required to ensure all phases of work are properly coordinated prior to commencement of each particular testing procedure. Establish all necessary manpower requirements.

.4 Operate and test motors and speed switches for correct wiring and sequences and direction of rotation. Check and record overload heaters in motor starters.

.5 Confirm voltages and operating amperages at full load.

.6 Failure to follow instructions pertaining to correct starting procedures may result in re-evaluation of equipment by an Independent Testing Agency selected by City at Contractor's expense. Should results reveal equipment has not been properly started, equipment may be rejected, removed from site, and replaced. Replacement equipment shall also be subject to full starting procedures, using same procedures specified on the originally installed equipment.

3.02 PROCEDURES

.1 Procedure shall be identified in the following five (5) distinct phases:

.1 Pre-Starting: Visual inspection.

.2 Starting: Actual starting procedure.

.3 Post-Starting: Operational testing, adjusting or balancing, and equipment run-in phase.

.4 Pre-Interim Acceptance of the Work: Final cleaning, re-testing, balancing and adjusting, and necessary maintenance.

.5 Post-Interim Acceptance of the Work: Repeat tests and fine-tuning resulting from corrective action of deficiency clean-up.

.2 Check specified and shop drawing data against installed data.

.3 Check the installation is as defined by contract documents and as per manufacturer's recommendations including manufacturer's installation check sheets.

.4 Include for the costs of an independent testing agency, selected by the City, to take samples of all chemically treated hydronic systems, perform lab analysis of the chemical treatment levels, and submit a written report of their findings to the City. Should chemical treatment levels not meet the requirements of the specifications, the Contractor shall adjust treatment levels accordingly and cover the costs of the independent testing agency to take additional samples and tests.

3.03 CONTRACTOR TESTING RESPONSIBILITIES

- .1 The contractor shall be required to provide the following tests as part of his construction contract. For each test, a test form is to be filled out, witnessed, kept on site for the Consultant to verify at any time during construction and then they are to be included in the final submission of the contractor O&M manuals.

.1 Air Systems

.1 Fans

- Check radiated and discharge sound power levels
- Determine rpm, air flow rates, static pressure and record on the fan curves
- Conduct fan performance test for total system volume on main air supply and exhaust units
- Conduct smoke control test to meet occupancy requirements

.2 Air Outlets

- Take sound readings at specified air flows at outlets

.3 Fire Dampers

- Test each damper to ensure proper blade movement and damper closure
- Verify damper accessibility for changing of the fusible links

.4 Ductwork

- Low pressure supply, return and exhaust ductwork is to be tested by sound and feel for leakage
- Medium and High pressure supply, return and exhaust ductwork is to be pressure tested as per requirements of Section 23 31 00 – Ductwork

.5 Gas Burner

- Verify controls and modulation
- Verify safety checks

.6 Pressure test of welds

.7 Sound testing on the discharge side of the fans

.2 Plumbing Systems

.1 Domestic Cold Water

- Piping to be tested to 1035 kPa for eight (8) hours
- Conduct pipe flushing and cleaning program with all fixtures in place
- Conduct a water analysis after shock treatment of piping system

.2 Drainage System

- Conduct a standing water test 30 kPa to 75 kPa over eight (8) hour period

.3 Glycol Heating System:

.1 Boilers:

- Start up boilers per manufacturers recommendations.
- Set up and adjust burner operation through all firing rates, and record efficiencies.

.2 Control Valves:

- Record pressure drops across each valve.

.3 Pumps:

- Run for 12 hours (ensure parallel pumps are equally balanced).
- Record motor power consumption.
- Calculate pump efficiency.
- Measure specific gravity of fluid.

.4 Tanks:

- Verify expansion tank level at 20°C and 93°C.

.5 Verify glycol concentration levels.

.6 Chemical Treatment System:

- Acceptance tests by independent lab to provide performance guarantee.
- Plot pump operating curve.

.4 DDC Control System:

.1 General:

- Conduct system 7 day performance test to prove communication, loop tuning and control sequences.

END OF SECTION

1. GENERAL

1.01 SUMMARY

.1 Work in this section includes, but is not limited to, the following:

- .1 Allow for work to assist Balancing Agency in completion of the balancing process.
- .2 Prepare the Facility for Balancing.

1.02 RELATED REQUIREMENTS

- .1 Section 20 05 23 – Valves for Mechanical Systems
- .2 Section 20 05 93.19 – Balancing of Mechanical Systems
- .3 Section 22 08 13 – Cleaning and Start-Up of Piping Systems

2. PRODUCTS

2.01 NOT USED

3. EXECUTION

3.01 INSTALLATION

.1 Bring the work to an operating state and ready for balancing, including:

- .1 Clean equipment and ductwork.
- .2 Provide temporary filters in air handling equipment and carry out a rough air balance to ensure all equipment performs required function.
- .3 Replace filters with specified filters prior to balancing.
- .4 Verify lubrication of equipment.
- .5 Install permanent instrumentation.
- .6 Clean piping systems in accordance with Section 22 08 13, drain and fill with clean treated heat exchange fluid.
- .7 Complete the “start-up” of equipment.
- .8 Adjust stuffing boxes and packing glands on pumps and valves.
- .9 Remove temporary strainers and install permanent strainers prior to fluid system balancing. Refer to Section 20 05 23.
- .10 Check rotation and alignment of rotating equipment and tension of belted drives.
- .11 Verify ratings of overload heaters in motor starters.
- .12 Set control points of automatic apparatus, check-out sequence of operation.
- .13 Make available control diagrams and sequence of operation.
- .14 Clean work, remove temporary tags, stickers, and coverings.
- .15 Make available one (1) copy of Maintenance Manuals especially for use in balancing.
- .16 Provide Balancing Agency a complete set of mechanical drawings and specifications.

.2 Cooperate with the Balancing Agency as follows:

- .1 Make corrections as required by Balancing Agency.
- .2 Allow Balancing Agency free access to site during construction phase. Inform Balancing Agency of any major changes made to systems during construction and provide a complete set of record drawings for their use.
- .3 Provide and install any additional balancing valves, dampers, and other materials requested by the balancing agency and/or necessary to properly adjust or correct the systems to design flows.

- .4 Provide and install revised pulleys and sheaves for rotating equipment as required to properly balance the systems to design flows. Obtain requirements from balancing agency. Refer to Section 20 05 93.19.
- .5 Operate automatic control system and verify set points during Balancing.

END OF SECTION

1. GENERAL

1.01 SUMMARY

- .1 Balance, adjust, and test air and liquid systems and equipment and submit reports using identical units to those shown on contract documents.

1.02 RELATED REQUIREMENTS

- .1 Section 20 05 93.18 – Coordination with Balancing Agency.

1.03 REFERENCE STANDARDS

- .1 National Environmental Balancing Bureau (NEBB)
- .2 Sheet Metal and Air Conditioning Contractors National Association (SMACNA)
- .3 American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE)

1.04 QUALITY ASSURANCE

- .1 Work specified in this section shall be performed by an Independent Agency specializing in this type of work.
- .2 Balancing (of both air and liquid systems) and sound level readings shall be performed by the same agency.
- .3 During the one year warranty period, the City may request re-check or re-setting of outlets or fans as listed in test report. Provide technicians and equipment required during visits for seasonal adjustments.

1.05 SITE VISITS

- .1 Total of 1 site visit shall be made to correspond with the general monthly site meetings held by the Contractor. After each site visit, a written report shall be submitted to the Contractor and Consultant. Site visits shall commence after the start of air and liquid distribution work and be spread over the construction period to the start of the balancing work.
- .2 A review of the installation and access to all valves, dampers, and equipment shall be made at the specified site visits and any additional dampers or valves required for proper balancing shall be forwarded in writing to be reviewed by the Consultant.
- .3 Allow for 4 visits of 1 day to site to adjust systems for seasonal changes during warranty. Coordinate time of visits with the City. Submit reports to Consultant.
- .4 Begin balancing after equipment start-up and testing and after systems have been completed and are in full working order. Place systems and equipment into full operation and continue operation during each working day of balancing.

1.06 SUBMITTALS

- .1 Provide required information in accordance with Section 01 00 06 – General Requirements: Submittals.

.2 Balancing Agenda:

- .1 General: Submit balancing agenda to the Consultant and commissioning contractor for review at least sixty (60) days prior to the start of balancing work. Start balancing work only after agenda has been approved. Include descriptive data, procedure data, and sample forms in agenda.
- .2 Descriptive Data: General description of each system including associated equipment and different operation cycles, listing of flow and terminal measurements to be performed.
- .3 Procedure Data: Procedures for converting test measurements to establish compliance with requirements, specify type of instrument to be used, method of instrument application (by sketch) and correction factors.
- .4 Sample Forms: Form showing application of procedures to typical systems.

.3 Balance Report

- .1 Submit (2) copies of rough balancing reports to the Consultant for review, prior to on-site verification and acceptance of Project.
- .2 Provide four (4) copies of final reports to contractor for inserting in City's Operating and Maintenance Manuals as described in Section 01 00 06 – General Requirements: Project Closeout Procedures.
- .3 Include types, serial number, and dates of calibration of instruments in the reports.

1.07 SYSTEM DATA

.1 Air Handling Equipment

Design Data:

Total air flow rate;
Fan total static pressure;
System static pressure;
Motor kW, r/min, amps, Volts, Phase;
Outside air flow rate L/s;
Fan r/min;
Fan/kW;
Inlet and outlet, dry and wet bulb temperatures.

Installation Data:

Manufacturer and model;
Size;
Arrangement discharge and class;
Motor type, kW, r/min, voltage, phase, cycles, and load amperage;
Location and local identification data.

Recorded Data:

Supply Air Fan

◆ Fan 100% Outside Air

Air flow rate;
Fan total static pressure;
System static pressure;

◆ Fan Full Return/Min O/A

Air flow rate;
Fan total static pressure;
System static pressure;

Fan r/min;

For Axial Fans, note blade pitch angle;
Motor operating amperage;

Inlet and outlet, dry and wet bulb temperatures.

- .2 Duct Air Quantities – All mains supplying more than 10% of Volume, outside air and exhaust (maximum and minimum) major return air openings back to duct shafts.

Duct sizes;
Number of pressure readings;
Sum of velocity measurements;
Average velocity;
Duct recorded air flow rate;
Duct design air flow rate.

- .3 Air Inlet and Outlets:

Outlet identification location and designation;
Manufacturers catalogue identification and type;
*Application factors;
Design and recorded velocities;
Design and recorded air flow rates;
Deflector vane or diffuser cone settings.
* (Refer to 3.1.3 for supporting information)

- .4 Heating Equipment (Radiant Tube Heaters)

Design Data:

Heat transfer rate;

Installation Data:

Manufacturer, model, type;
Capacity.

Recorded Data:

Element type and identification (location and designation);

- .5 Heating Equipment (Baseboard, Boilers, Unit heaters, etc.)

Design Data:

Heat transfer rate;
Fluid flow rate;
Entering and leaving fluid temperatures;
Fluid pressure drop.

Installation Data:

Manufacturer, Model, Type;
Entering and leaving fluid temperatures;
Capacity;
Pressure drops;
Flow rates.

Recorded Data:

Element type and identification (location and designation);
Entering and leaving fluid temperature (for varying outdoor temperatures);
Fluid pressure drop;
Fluid flow rate;
Pressure relief valve setting.

- .6 Air Heating Equipment

Design Data:

Heat transfer rate;
Air flow rates;
Air static pressure drop;
Entering and leaving air dry and wet bulb temperatures.

Manufacturer, model, type;
Entering and leaving air flow and temperatures;
Fluid and air side pressure drops.

Recorded Data:

Element type and identification (location and designation);
Entering and leaving air dry and wet bulb temperatures;
Air static pressure drop;
Air and rates;
Adjusted temperature rise or drop.

.7 Sound Level Data

Diagram or description of relationship of sound source and measuring instrument;
scale reading;
Graph readings at each octave band frequency;
Calculate room N.C. levels.

2. PRODUCTS**2.01 MANUFACTURERS**

.1 Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include; but are not limited to, the following:

- .1 Aztec
- .2 Chalet
- .3 Thermo

2.02 INSTRUMENTS

.1 Provide calibration histories for each instrument. Recalibration or use of other instruments may be requested when accuracy of readings is questionable.

3. EXECUTION**3.01 GENERAL PROCEDURE**

- .1 Permanently mark, by stick-on labels and/or fluorescent paint, settings on valves, splitters, dampers, and other adjustment devices.
- .2 Subsequent to correctional work, take measurements to verify balance has not been disrupted or that any such disruption has been rectified.
- .3 Where vane anemometer is used to measure supply, return or exhaust air grilles, AK factors shall be determined as follows:
 - .1 Determine and tabulate similar sized grilles being balanced for AK schedule.
 - .2 Traverse all ducts serving grilles (outlined in AK schedule) to verify AK factors.
 - .3 AK factor from schedule, must be approved by Consultant during initial review with balancer on site. (Balancer shall include written procedure for determination of AK factors).

- .4 No flow hoods are to be used for measurement of exhaust or return air grilles.
 - .4 Balancing shall be performed to the following accuracies:
 - .1 Air - terminal outlets $\pm 10\%$ (outlets less than 200 l/s)
 - .2 Air - terminal outlets $\pm 5\%$ (outlets greater than 200 l/s)
 - .3 Air - central equipment $\pm 5\%$
 - .5 Balancing contractor shall advise mechanical contractor of required revised pulleys, sheaves and impellor shavings to allow proper balancing of systems (Refer to Section 20 05 93.18).
 - .6 Where axial fans require blade pitch changes, this shall be the responsibility of the balancing contractor.
- 3.02 AIR SYSTEM PROCEDURE
- .1 Perform balancing, adjusting, and testing with building doors and windows in their normal operation position.
 - .2 The following procedure shall be adopted for central systems:
 - .1 Ensure dampers or volume control devices are in fully open position.
 - .2 Balance central apparatus to $\pm 5\%$ air flow.
 - .3 Balance branches and mains in accordance with 3.1.4.
 - .4 Recheck central apparatus.
 - .5 Balance all terminal air outlets in accordance with 3.1.4.
 - .6 Re-balance central apparatus to $\pm 5\%$.
 - .7 Recheck all air outlets.
 - .8 Perform acoustical measurements.
 - .3 When balancing air outlets:
 - .1 Rough balance furthest outlets and then balance sequentially back to source.
 - .2 Fine balance furthest outlet back to source.
 - .4 Take static pressure readings and air supply temperature readings at 10 points on the system.
 - .5 Make air quantity measurements in ducts by "Pitot Tube" traverse of entire cross-sectional area. Take minimum of 16 for rectangular ducts, and 10 on each vertical and horizontal axis for round ducts, traverse readings. If readings are inconsistent across duct, try to obtain straight run of six (6) diameters widths upstream and re-do traverse.
 - .6 Use volume control devices to regulate air quantities only to extent that adjustments do not create objectionable air motion or sound levels. Effect volume control only by duct internal devices such as dampers and splitters.
 - .7 Vary total system air quantities by adjustment of fan speeds. Vary branch air quantities by damper regulation.
 - .8 The final balanced condition of each area shall include testing and adjusting of pressure conditions. Test and record building pressurization levels throughout full range of fan delivery rates, under both heating and cooling conditions. Front doors, exits, elevator shafts, should be checked for air flow so that exterior conditions do not cause excessive or abnormal pressure conditions. Document abnormal building leakage conditions noted.
 - .9 Complete balancing to achieve positive building pressure unless otherwise instructed. A positive pressure relative to outside of 10 Pa minimum and 20 Pa maximum shall be achieved, measured with negligible outside wind velocity.

3.03 FIRE DAMPER/FIRE STOP FLAP VERIFICATION

- .1 Visually inspect all fire dampers and fire stop flaps:
 - .1 Installation is straight.
 - .2 Wall angles properly installed.
 - .3 Duct has break away connection.
 - .4 Fire stopping material where used is properly installed.
 - .5 Adequate access.
 - .6 Clearance between sleeve and wall.
- .2 Inspect all fire damper blades and tracks prior to test firing. Sheet metal trade to clean all dirty dampers and tracks to satisfaction of balancer.
- .3 Manually remove each fusible link to ensure damper blade drops properly, then reset damper. Mark dropped fire damper with black felt marker.
- .4 Testing of 10% of the fusible links shall be performed with a suitable heat source capable of generating sufficient heat to detonate fusible link without burning or generating carbon deposits on the blades, frame or adjacent ductwork. Selection of links to be test dropped to be as directed by Consultant. Retesting and resetting shall be witnessed by Consultant.
- .5 If fire damper does not close properly, sheet metal trade to repair installation and balancing agency to retest.
- .6 All fire damper tests shall be witnessed by two parties, certified by Contractor and endorsed by the testing personnel.
- .7 Contact Alberta Building Code enforcement authorities in writing prior to testing each damper and have authorities witness tests as required.

3.04 BALANCING OF HYDRONIC SYSTEMS

- .1 Open all (excepting pressure bypass must be closed) valves to fully open position including balancing valves, isolation valves, and control valves.
- .2 Execute air balance prior to initiating hydronic balance (if coils are provided).
- .3 Remove temporary strainers and install permanent sheaves prior to commencing balancing of hydronic systems (Refer to Section 20 05 93.18). Set pumps to deliver 10% excess flow if possible.
- .4 Adjust flows through each boiler or chiller to ensure equal flow.
- .5 Check and adjust flows and temperatures at inlet side of coils.
- .6 Position and mark all automatic valves, hand valves and balancing cocks for design flow through all coils, connectors, and all items in system requiring circulation of liquid.
- .7 Upon completion of flow readings and coil adjustments, mark setting and record data.
- .8 Coordinate with the mechanical contractor shaving of impellor to operating condition on pumps larger than 1.5 kW.
- .9 Ensure all bypass valves are tightly closed.
- .10 After making all terminal unit adjustments, re-check settings at pumps. Re-adjust as required.
- .11 Calibrate all pressure and temperatures gauges.

- .12 For all parallel pumping systems, check all flows through boilers, chillers, heat exchangers, and pumps under the following situations:
 - .1 With two pumps operating.
 - .2 With one pump operating – repeat for each pump.
 - .3 With controls demanding no heating or cooling.
- .13 For each pump, plot maximum and minimum flows on curve.
- .14 Verify pressure drops and flows through 3-way pressure control bypass valves at full operating range.

3.05 BALANCING REPORT

- .1 Submit draft copies of rough balancing reports prior to final acceptance of project.
- .2 Include types, serial number and dates of calibration of instruments.
- .3 Record test data on a sepiia made from the latest available revised set of mechanical drawings and submit three (3) copies upon completion of the balancing contract for inclusion in equipment and maintenance manuals.
- .4 Submit with report, fan and pump curves with operating conditions plotted. Submit grille and diffuser shop drawings and diffusion factors.
- .5 Report shall be indexed as follows:

Air

Summary
Procedure
Instrumentation
Drawings
Equipment Summary
Fan Sheets
Fan Curves
Fan Profile Data
Static Data
Air Monitoring Station Data
Traverse Data and Schedule
Terminal Unit Summary
Outlet Data Summary and Schematics (per system)
Building Schematic
Building Pressurization Data
Weather Conditions at Time of Test
Diagnostic
Millwright Reports

Liquid

Summary
Procedure
Instrumentation
Drawings
Equipment Data
Element Data Summary and Schematics (per system)
Diagnostic
Millwright Reports

END OF SECTION

1. GENERAL

1.01 SUMMARY

- .1 Work in this section includes, but is not limited to, the following:
- .1 Operating and Maintenance Manuals.

1.02 OPERATING AND MAINTENANCE MANUALS

- .1 Coordinate with Section 01 00 06 – General Requirements: Closeout Submissions for submission requirements details.
- .2 Secure and assemble all necessary literature describing the operation and maintenance of all equipment provided. Complete and transmit documentation for review to Consultant at project milestones.

1.03 BINDERS

- .1 Provide sets of Operations and Maintenance Manuals in binders of size, colour and type as listed in Section 01 00 06 – General Requirements: Closeout Submissions.

1.04 TABS

- .1 The divider tabs shall be laminated mylar plastic and coloured according to division and section.
- .2 Plastic tabs with typewritten card inserts will not be accepted.
- .3 Each tab to include tab number and title printed on the tab.
- .4 The colouring for tabs for individual sections is as follows:

Colour	System
Green	Air Systems
Brown	Control Systems
Orange	Heating Systems
Yellow	Miscellaneous Systems
Purple	Plumbing Systems

1.05 MANUAL DIVISIONS

- .1 Organize each manual into the following divisions:
- .1 Operation Division
- .2 Maintenance Division
- .3 Contract Documentation Division

1.06 OPERATIONS DIVISION

- .1 The operations division shall have all data organized into sections according to the system category with individual divider tabs as follows:
- .1 AIR Air Systems
- .2 CTL Control Systems
- .3 HTG Heating Systems
- .4 MIS Miscellaneous Systems
- .5 PLG Plumbing Systems

- .2 Organize data for each system category (section) into individual sub-systems. Provide an index for each system category and a divider tab for each individual system.
- .3 For each individual sub-system include the following:
 - .1 System Description – Provide details of system type, composition, areas served, location in the building, design criteria and function of major components. All equipment arranged to operate together as one system shall be considered part of that system description. Design criteria shall, at minimum, include the following:
 - .1 Occupied space conditions
 - .2 Outdoor ambient conditions
 - .3 Air circulation rate
 - .4 Exhaust air rate
 - .5 Minimum outside air
 - .6 Building pressurization
 - .7 Future load allowances
 - .8 Standby capabilities
 - .9 Calculated load and design capacity of domestic water supply mains
 - .10 Calculated load and design capacity of drainage mains
 - .2 Operating Instructions – Provide, in “operator” layman language, the specific instructions for start-up, shutdown and seasonal change over of each system component. Include exact type and specific location of each switch and device to be used in the system operation. Identify safety devices and interlocks that must be satisfied in order for the equipment to start. Also, list conditions to be fulfilled before attempting equipment start-up, i.e. valves position correct, glycol mixture concentration proper, piping filled with fluid, filters/strainers in place, etc.

1.07 MAINTENANCE DIVISION

- .1 Organize data into the following sections with divider tabs:
 - .1 Maintenance Tasks and Schedules
 - .2 Spare Parts
 - .3 Suppliers and Contractors
 - .4 Tags and Directories
- .2 Maintenance Tasks and Schedules: Organize data according to the system category, with further breakdown into individual systems as used in the operations division of the manual. Provide section index and divider tabs for each system category. Summarize maintenance tasks from manufacturers maintenance brochures, for each component of each system in the following format:
 - .1 Daily
 - .2 Weekly
 - .3 Monthly
 - .4 Semi-Annually
 - .5 Annually
 - .6 When Required
- .3 Spare Part List:
 - .1 Organize data according to the system category, with further breakdown into individual systems as used in the operations division of the manual.
 - .2 Provide section index and divider tabs for each system category.
 - .3 Summarize from manufacturers maintenance brochures the recommended spare parts for each component of each system.

- .4 Suppliers and Contractor List – Provide summary of Suppliers and Contractors for each components of each system. List name, address and telephone number of each.
- .5 Tags and Directories – Provide a copy of the Mechanical Drawing, List, Valve Tag List, Piping Identification Schedule and all other directories as specified in the contract documents.

1.08 CONTRACT DOCUMENTATION DIVISION

- .1 Organize all data required by the construction contract into sections, with divider tabs, as follows:
 - .1 Drawings List
 - .2 Shop Drawings and Product Data
 - .3 Certifications
 - .4 Warranties and Bonds
 - .5 Maintenance Brochures
 - .6 Reports
- .2 Shop Drawings and Product Data: Provide final copies of all shop drawings and product data required by the contract documents. Include section index and divider tabs. Maximum of twenty-five (25) sheets or one (1) system shop drawing per tab.
- .3 Certifications: Provide copies of Contractor Certifications for the performance of product and systems. Include copies of all pressure tests for piping and ductwork systems, equipment alignment certificates, local authority inspection reviews, backflow prevention certification, and fire protection certifications. Include section index and divider tabs with maximum of twenty-five sheets (25) or one report per tab.
- .4 Warranties and Bonds: Include one copy each of the Contractor's, warranty, manufacturers' warranties longer than one year, the bond, and any service contract provided by the contractor. Provided section index.
- .5 Maintenance Brochures: Include copies of all manufacturers' printed maintenance brochures pertaining to each product, equipment or system. Provide section index and divider tabs. Maximum of twenty-five (25) sheets or one system brochure per tab.
- .6 Reports: Include copies of all reports relating to the testing, adjusting and balancing of equipment and systems, as required by the contract specification sections. Also include all Water Treatment Reports and Manufacturers Start-Up Reports. Include section index and divider tab for each report.
- .7 Submissions and Approvals.

2. PRODUCTS

2.01 NOT USED.

3. EXECUTION

3.01 ASSEMBLY

- .1 Submit documents to the Consultant for approval prior to transmitting to the City.
- .2 Final edition shall include all outstanding project information and conform to all requirements specified.

END OF SECTION

1. GENERAL**1.01 SUMMARY**

.1 This Section includes materials and methods for:

- .1 Pipe and equipment insulation
- .2 Radiant Tube Insulation
- .3 Adhesives, tie wires, and tapes
- .4 Recovery jackets for interior and exterior piping and equipment

1.02 RELATED REQUIREMENTS

- .1 Section 07 84 00 – Firestopping: Coordinate insulation type with penetration classification and firestopping systems.
- .2 Section 07 92 00 – Joint Sealants
- .3 Section 20 05 10 – Mechanical Systems Pipe and Pipe Fittings

1.03 REFERENCE STANDARDS

- .1 American Society for Testing and Materials (ASTM):
 - .2 ASTM A666-03, Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar
 - .3 ASTM B209/B209M-01, Specification for Aluminum and Aluminum Alloy Sheet and Plate
 - .4 ASTM C449/C449M-00, Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement
 - .5 ASTM C547-03, Standard Specification for Mineral Fiber Pipe Insulation
 - .6 ASTM C553-02, Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications
 - .7 ASTM C612-00a, Standard Specification for Mineral Fiber Block and Board Thermal Insulation
 - .8 ASTM C921-03a, Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation
 - .9 ASTM C1136-03a, Standard specification for Flexible, Low Permeance Vapour Retarders for Thermal Insulation
 - .10 ASTM C1393-00a, Specification for Perpendicularly Oriented Mineral Fiber Roll and Sheet Thermal Insulation for Pipes and Tanks
- .2 Canadian General Standards Board (CGSB):
 - .1 CGSB 51-GP-52MA, Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation
 - .2 CAN/CGSB 51.53-95Poly (Vinyl Chloride) Jacketing Sheet, for Insulated Pipes, Vessels and Round Ducts
- .3 Manufacturer's Trade Associations:
 - .1 Thermal Insulation Association of Canada (TIAC): National Insulation Standards (Revised 1999).
- .4 Underwriters Laboratories of Canada (ULC):
 - .1 CAN/ULC S102-03, Method of Test for Surface Burning Characteristics of Building Materials and Assemblies
 - .2 CAN/ULC-S702-03, Thermal Insulation, Mineral Fibre, for Buildings, Part 1 and Part 2

- .3 CAN/ULC S704-03, Standard for Thermal Insulation, Polyurethane and Polyisocyanurate, Boards, Faced
- .4 CAN/ULC S770-03, Standard Test Method for Determination of Long Term Thermal Resistance of Closed-Cell Thermal Insulating Foams

1.04 DEFINITIONS

- .1 The following definitions apply to the Piping and Equipment Insulation specification:
- .2 Concealed: Insulated mechanical services in suspended ceilings and non-accessible chases and furred-in spaces such as crawl spaces and pipe shafts.
- .3 Exposed: Insulated mechanical services in all other areas visible after final construction will be considered as exposed.

1.05 SUBSTITUTIONS

- .1 Materials other than the named products for the Project may be acceptable to the Consultant.
- .2 Substitutions for materials of this section will be considered after the close of bids in accordance with Section 01 00 06 – General Requirements: Product Options and Substitutions provided that proposed materials have a thermal resistance within 5% at normal conditions as material specified and meet other properties required for specified installation.

1.06 SUBMITTALS

- .1 Provide information requested in this section in accordance with Section 01 00 06 – General Requirements: Submittals.
- .2 Submit shop drawings indicating complete material data, K value, temperature rating, density, finish, and recovery jacket of materials proposed for this project and indicate thickness of material for individual services.

1.07 QUALITY ASSURANCE

- .1 Installer for insulation work listed in this Section shall be specialist in performing work of this Section, and have minimum 3 years successful experience in this size and type of project.
- .2 Insulation provided by this Section shall not be produced with, or contain, any regulated CFC compounds listed in the Montreal Protocol adopted by the United Nations Environmental Program.
- .3 Materials used in this section shall meet or exceed flame spread rating of 25 or less and smoke developed classification of 50 or less in accordance with applicable building codes including, but not limited to, insulation materials, recovery jackets, vapour barrier facings, tapes and adhesives.
- .4 Insulation materials shall meet or exceed the requirements of the building code; label packages or containers indicating compliance of packaged materials.

1.08 PROJECT CONDITIONS

- .1 Deliver material to job site in original non-broken factory packaging, labelled with manufacturer's density and thickness.
- .2 Perform work at ambient and equipment temperatures as recommended by the adhesive manufacturer.
- .3 Make good separation of joints or cracking of insulation due to thermal movement or poor workmanship.

2. PRODUCTS**2.01 MANUFACTURERS**

.1 Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

- .1 Fibrex Insulations, Inc.
- .2 Isolation Manson Inc.
- .3 Johns Manville
- .4 Knauf Fiberglass
- .5 Owens-Corning
- .6 Roxul Inc.

2.02 MATERIALS, GENERAL

- .1 Manufacture insulation shall to meet or exceed the requirements of listed standards for sizes required by piece of equipment, pipe configuration or duct shape.
- .2 Material shall be of a type suitable for installation on equipment systems, pipes and ducts to meet listed requirements.
- .3 Insulate fittings and valve bodies with preformed insulated fittings.
- .4 Mineral fibre specified includes glass fibre, rock wool, or slag wool meeting the maximum K values listed at the choice of manufacturer.

2.03 PIPING INSULATION**.1 Cold Piping:**

- .1 Formed fine fibrous glass or formed mineral fibre pipe insulation, with factory applied vapour barrier jacket, factory moulded to conform to piping, K value maximum 0.035 W/m.°C at 24°C.
- .2 Service temperature: 4°C to 100°C.

.2 Hot Piping:

- .1 Formed fine fibrous glass or mineral fibre pipe insulation, with factory applied general purpose jacket, factory moulded to conform to piping, K value maximum 0.035 W/m.°C, at 24°C.
- .2 Service temperature up to 150°C.

.3 Roof Drains and Vents:

- .1 Flexible fibrous glass or mineral fibre insulation, K value maximum 0.035 W/m.°C at 24°C with factory applied reinforced aluminium foil vapour barrier.
- .2 Service temperature -14°C to 50°C.

2.04 EQUIPMENT INSULATION**.1 Hot Equipment:**

- .1 Rigid fibrous glass, or mineral fibre insulation.
- .2 K value maximum 0.035 W/m.°C, at 24°C.
- .3 Service temperature -14°C to 260°C.

.2 Cold Equipment:

- .1 Rigid fibrous glass, or mineral fibre insulation, with factory applied reinforced aluminum foil vapour barrier.
- .2 K value maximum 0.035 W/m. °C, at 24° C.
- .3 Service temperature -10° C to 100° C.

2.05 INSULATION SECUREMENT

- .1 Tape: Self-adhesive, aluminum, reinforced, 50 mm wide minimum.
- .2 Contact adhesive: Quick setting.
- .3 Canvas adhesive: Washable.
- .4 Tie wire: 1.5 mm diameter stainless steel.
- .5 Bands: Stainless steel, 19 mm wide, 0.607 mm thick.

2.06 CEMENT

- .1 Thermal insulating and finishing cement:
 - .1 Hydraulic setting or Air drying on mineral wool, to ASTM C449/C449M.

2.07 VAPOUR RETARDER LAP ADHESIVE

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

2.08 INDOOR VAPOUR RETARDER FINISH

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

2.09 OUTDOOR VAPOUR RETARDER FINISH

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

2.10 RECOVERY JACKETS

.1 Canvas:

- .1 220 and 120 gm/m² cotton, plain weave, treated with dilute fire-retardant lagging adhesive to ASTM C921.
- .2 Lagging adhesive: Compatible with insulation compliant and with requirements for ULC listed dilute fire-retardant lagging adhesive.

.2 Aluminum:

- .1 In accordance with ASTM B209.
- .2 Thickness:
 - .1 Piping Recovery Jacket: 0.508 mm.
 - .2 Equipment, Valves and Fittings, and Engine Exhaust Recovery Jacket: 0.813 mm.
 - .3 Installations in Close Proximity to Occupied Areas: 0.813 mm
- .3 Finish: Smooth.
- .4 Joining: Longitudinal and circumferential slip joints with 50 mm laps.

- .5 Fittings: 0.508 mm thick die shaped fitting covers with factory attached protective liner.
- .6 Metal jacket banding and mechanical seals: stainless steel, 19 mm wide, 0.508 mm thick at 305 mm spacing.
- .7 Special requirements:
 - .1 Exterior Installations: Include integral moisture barrier and weatherproof lap seals and fastenings.
- .3 Stainless Steel:
 - .1 In accordance with ASTM A666, Type: 304.
 - .2 Thickness:
 - .1 Piping Recovery Jacket: 0.250 mm.
 - .2 Equipment, Valves and Fittings, and Engine Exhaust Recovery Jacket: 0.455 mm.
 - .3 Installations in Close Proximity to Occupied Areas: 0.455 mm.
 - .3 Finish: Smooth.
 - .4 Joining: Longitudinal and circumferential slip joints with 50 mm laps.
 - .5 Fittings: 0.455 mm thick die-shaped fitting covers with factory attached protective liner.
 - .6 Metal jacket banding and mechanical seals: stainless steel, 19 mm wide, 0.455 mm thick at 305 mm spacing.
 - .7 Special requirements:
 - .1 Exterior Installations: Include integral moisture barrier and weatherproof lap seals and fastenings.
- .4 Polyvinyl Chloride (PVC):
 - .1 One-piece moulded type to CAN/CGSB-51.53 with pre-formed shapes as required.
 - .2 Colours: as selected by Consultant.
 - .3 Minimum service temperatures: -20°C.
 - .4 Maximum service temperature: 65°C.
 - .5 Moisture vapour transmission: 0.02 perm.
 - .6 Thickness: 0.350 mm.
 - .7 Fastenings:
 - .1 Solvent weld adhesive compatible with insulation for lap and joint seals.
 - .2 Tacks.
 - .3 Pressure sensitive vinyl tape of matching colour.
 - .8 Special requirements:
 - .1 Indoor: UV rated materials in areas exposed to fluorescent fixtures.
 - .2 Outdoor: UV rated material minimum 0.508 mm thick.
- .5 ABS Plastic:
 - .1 One-piece moulded type with pre-formed shapes as required.
 - .2 Colours: as selected by the Consultant.
 - .3 Minimum service temperatures: -40°C.
 - .4 Maximum service temperature: 82°C.
 - .5 Moisture vapour transmission: 0.012 perm.
 - .6 Thickness: 0.750 mm.
 - .7 Fastenings:
 - .1 Solvent weld adhesive compatible with insulation for lap and joint seals.

.2 Tacks.

.8 Locations:

.1 For outdoor use only.

2.11 SEALANTS

.1 Joint and weatherproofing sealants of type compatible with adjacent materials and as specified in Section 07 92 00.

3. EXECUTION

3.01 PREPARATION

.1 Test and verify that piping and equipment are functioning correctly before installing recovery jacket materials.

.2 Verify that surface is clean and dry prior to installation.

.3 Verify that insulation is dry before and during application.

.4 Finish with systems at operating conditions.

3.02 INSTALLATION

.1 Install insulation and recovery jacket in accordance with TIAC National Standards, manufacturers written instructions and requirements of this specification.

.2 Install insulation so that it is continuous through inside walls; pack around pipes with fireproof self-supporting insulation material, properly sealed in accordance with Section 07 84 00.

.3 Use two layers with staggered joints when required nominal wall thickness exceeds 76 mm.

.4 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes; hangers and supports shall be outside vapour retarder jacket.

.5 Apply high compressive strength insulation, suitable for service, at oversized saddles and shoes where insulation saddles have not been provided at supports and hanger locations.

.6 Insulate complete system including, but not limited to: piping; fittings; valves; unions; flanges; and strainers, except for flexible connections and expansion joints; terminate insulation neatly with plastic material trowelled on a bevel.

.7 Insulate piping fittings and valves except for unions, flanges (except on flanged valves), strainers (except on chilled water lines), flexible connections and expansion joints; terminate insulation neatly with plastic material trowelled on a bevel.

.8 Cold Piping:

.1 Seal lap joints with 100% coverage of vapour barrier adhesive; seal butt joints with 50 mm wide strips of vapour barrier sealed with vapour barrier adhesive

.2 Apply hydraulic insulating cement for fittings and valves; or apply factory fabricated insulation half shells, seal all laps and joints.

.9 Hot Piping:

.1 For fittings and valves, apply hydraulic insulating cement; or apply factory fabricated insulation half shells;

- .2 Flare-out staples may be used to secure jacket laps on hot systems applied on 100 mm centres.
- .10 Roof Drains and Vents:
 - .1 Adhere flexible insulation with adhesive applied to all laps.
 - .2 Provide annealed tie wire tied at 400 mm centers for securing insulation.
 - .3 Butt insulation and seal joints and breaks with 50 mm of foil tape adhered over joint.
 - .4 Use pre-formed pipe covering insulation with aluminum recovery jacket if exposed.
- .11 Equipment:
 - .1 Apply insulation with edges tightly butted, joints staggered and secured in place by metal bands.
 - .2 Weld on suitable anchors where necessary.
 - .3 Provide sufficient clearance around openings for normal operation of equipment.
 - .4 Finish surface of cold equipment insulation with vapour barrier jacket sealed with vapour barrier adhesive.
 - .5 Make uneven surfaces smooth with insulating cement.
- .12 Radiant Tube
 - .1 Tightly butt insulation with staggered joints secured with metal bands or wires.
 - .2 Cover fitting with equivalent thickness of insulation.
- 3.03 FINISHING
 - .1 Finish insulation neatly at hangers, supports and other protrusions.
 - .2 Provide recovering jackets on exposed insulation throughout, including equipment rooms:
 - .3 Indoor Exposed Finishing Applications, in accordance with TIAC CPF/1:
 - .1 Apply factory integral service jacket to receive treated fabric jacket applied using recommended fabric adhesive.
 - .2 Cover fittings, valves and strainers not finished with PVC covers with a hard coat cement and finished with treated fitting fabric applied with using recommended fabric adhesive.
 - .3 Locate insulation seams in least visible locations.
 - .4 Finish fabric with one (1) coat of fabric coating.
 - .4 Indoor Concealed Finishing Applications in accordance with TIAC CPF/2:
 - .1 Leave insulation on concealed piping left as factory finished with no further finish required.
 - .2 Apply pipe insulation with an integral all service jacket.
 - .3 Secure jacket using appropriate fastenings on 100 mm centres.
 - .4 Locate insulation seams on piping on side of the pipe visible to access point of concealed space, i.e.: underside of pipe in concealed ceiling applications.
 - .5 Cover longitudinal and circumferential joints with jacket finishing tape neatly applied or secure jacketing using integral self-sealing lap and self-sealing circumferential joint strips depending on system used.
 - .6 Cover fittings, valves and strainers not finished with PVC covers with a hard coat cement and finish with treated fitting fabric applied with fabric adhesive.
 - .5 Indoor/Outdoor Exposed Finishing Applications (Metal Recovery Jacket), in accordance with TIAC CPF/3:
 - .1 Apply aluminum or stainless steel jacket over the pipe insulation using necessary fastenings on 150 mm centres.

- .2 Apply metal jacket or preformed metal fittings over insulated fittings, valve bodies, valve bonnets, strainers and flanges to provide a complete jacket system.
 - .3 Lap circumferential joints 50 mm minimum and seal with compatible waterproof lap cement
 - .4 Lock form longitudinal joints and seal.
 - .5 Locate metal jacket seams in least visible locations.
 - .6 Secure with recommended fastenings.
- .6 Indoor/Outdoor Exposed Finishing Applications (PVC Recovery Jacket), in accordance with TIAC CPF/4:
- .1 Apply PVC Jacket over the pipe insulation using necessary fastenings on 100 mm centres.
 - .2 Cover longitudinal and circumferential joints with finishing tape neatly applied.
 - .3 Apply PVC jacket or preformed PVC fitting covers over insulated fittings, valve bodies, valve bonnets, strainers and flanges to provide a complete jacket system.
 - .4 Locate PVC jacket seams in least visible locations.
 - .5 Secure with appropriate fastenings and jacket finishing tape.
- .7 Outdoor Concealed, in accordance with TIAC CPF/5:
- .1 Apply 2 ply weatherproof coating to insulated surfaces:
 - .1 First Ply: apply minimum 1 litre per 1.5 m length of pipe weatherproof coating applied to insulated surfaces, increase application rate based on pipe diameter and manufacture's recommendations.
 - .2 Embed a layer of reinforcing membrane while still wet
 - .3 Second Ply: apply minimum 1 litre per 1.5 m length of pipe weatherproof coating applied to insulated surfaces, increase application rate based on pipe diameter and manufacture's recommendations.

3.04 INSULATION INSTALLATION THICKNESS SCHEDULE

Piping or Equipment	Pipe Sizes mm	Insulation Thickness mm	Recovery Jacket
Domestic Cold Water Piping	13 to 40 50 and over	13 25	PVC
Domestic Hot Water Supply	13 to 40 50 and over	13 25	PVC
Roof Drains, Vertical Connections Below Roof Drains and 3 m of Horizontal Piping.	All sizes	25	PVC
Vents within 3 m of Roof Outlet	All sizes	25	PVC
Glycol Heating Piping	13 to 30 40 and Over	25 50	PVC

- .1 Install insulation to thickness specified for piping outside the wall cavity.

END OF SECTION

1. GENERAL**1.01 SUMMARY**

- .1 Tanks specified in this Section include, but are not limited to, the following:
 - .1 Expansion tanks
 - .2 Glycol systems feeder and tank
 - .3 Accessories and connections
 - .4 Saddles and supports

1.02 RELATED REQUIREMENTS

- .1 Section 20 05 23 – Valves for Mechanical Systems
- .2 Section 20 07 00 – Piping and Equipment Insulation
- .3 Section 20 30 00 – Pumps for Mechanical Systems
- .4 Section 22 08 13 – Cleaning and Start-Up of Piping Systems

1.03 REFERENCE STANDARDS

- .1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE):
 - .1 ANSI/ASHRAE 90.1-2010 (I-P), Energy Standard for Buildings Except Low-Rise Residential Buildings
- .2 American Society of Mechanical Engineers (ASME):
 - .1 ASME 2010 Boiler and Pressure Vessel Code
- .3 American Society for Testing and Materials (ASTM):
 - .1 ASTM A515/A515M-10, Standard Specification for Pressure Vessel Plates, Carbon Steel, for Intermediate- and Higher-Temperature Service

1.04 SUBMITTALS

- .1 Provide required information in accordance with Section 01 00 06 – General Requirements: Submittals.
- .2 Submit shop drawings for tanks including specifications and installation instructions for tank lining method, incorporating all details of construction and mountings on same plan or a separate sheet of the same size.

1.05 QUALITY ASSURANCE

- .1 Construct pressure tanks to ASME Code for unfired pressure vessels.
- .2 Obtain inspection certificates of approval for pressure vessel tanks installation from Authority Having Jurisdiction.
- .3 Comply with Provincial Government Regulations.

2. PRODUCTS**2.01 MANUFACTURERS**

- .1 Basis-of-Design Materials: Products named in this Section were used as the basis-of-design for the project; manufacturers listed as additional acceptable materials and that offer similar products may be incorporated into the work of this Section provided they meet the performance requirements established by the named products.
- .2 Additional Acceptable Materials Manufacturers: Subject to compliance with performance requirements specified in this Section; as established by the Basis-of-Design Materials, use any of the listed manufacturers' products in accordance with Section 20 05 03; following manufacturer's do not require submission of a request for substitutions provided required shop drawing and product data submissions are submitted before starting any work of Section:
 - .1 Glycol Fill Tanks: Axiom
 - .2 Expansion Tanks, Diaphragm Type: Bell and Gossett, Armstrong, Hamlet and Garneau, X-Trol, FloFab

2.02 EXPANSION TANKS, DIAPHRAGM TYPE

- .1 Welded steel, rated for working pressure, supplied with steel support structure.
- .2 Precharged air chamber, heavy duty butyl diaphragm bonded with polypropylene liner to steel shell separating air chamber from water.
- .3 Provide with air side charge connection and water side inlet connection.
- .4 Provide glass long enough to cover the tank from 50 mm above the bottom to 50 mm below the top. Maximum length of each glass must be 600 mm.
- .5 Provide quick connect air inlet of automotive tire valve type, pipe from top of tank to accessible location on wall, and tank drain hose bibb on bottom of tank.

2.03 GLYCOL SYSTEM FEEDER AND TANK

- .1 25 L Storage/mixing tank with molded-in level gauge,
- .2 125 mm fill/access opening and cover
- .3 Pump suction hose with inlet strainer and check valve
- .4 Pressure pump with fuse protection
- .5 Low fluid level pump cut-out float switch
- .6 Manual diverter valve for purging air and agitating contents of storage tank
- .7 UL Listed and fused power supply adapter with LED power indicator light, 115/60/1 to 24VDC, 50 watts AC, supplied loose for field installation.
- .8 Compatible with glycol solutions up to 50% concentration.

3. EXECUTION

3.01 INSTALLATION

- .1 Support tanks inside building from building structure as indicated on drawings.

3.02 PERFORMANCE

- .1 Provide tanks of dimensions and capacities indicated on the Tank Schedule on Drawing.

END OF SECTION

1. GENERAL

1.01 SUMMARY

- .1 Provide meters and gauges and taps where shown on drawings and as specified in this Section.

1.02 SUBMITTALS

- .1 Provide required information in accordance with Section 01 00 06 – General Requirements: Submittals.
- .2 Submit shop drawings of proposed products to the Consultant for review.
- .3 Submit data sheets on thermometers and pressure gauges indicating service, and temperature or pressure ranges, to the Consultant for review.
- .4 Submit list of all meters, including location, service, flow and corresponding reading for flow.

2. PRODUCTS

2.01 MANUFACTURERS

- .1 Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

- .1 Static Pressure Gauges:

- .1 Dwyer Instruments Inc./Magnehelic®

- .2 Positive Displacement Meters:

- .1 Badger Meter Inc.
 - .2 Neptune Technology Group
 - .3 Sensus Metering Systems

2.02 THERMOMETERS

- .1 Dial Thermometers: 100 mm diameter dial in drawn steel case, bimetallic helix actuated, brass separable socket or flange and bushing, glass cover, adjustable pointer.
- .2 Spirit (Organic) Thermometer: Red reading spirit (organic) filled, 2 graduations, plastic or aluminum case, 230 mm scale, straight shank, separable socket, adjustable angle.

2.03 STATIC PRESSURE GAUGES

- .1 Dial Gauge: 100 mm dial, diaphragm actuated, suitable for positive, negative, or differential pressure measurement. Accuracy within $\pm 2\%$ of full scale, complete with static pressure tips and mounting accessories.
- .2 Inclined Vertical Manometer: molded plastic manometer, accuracy within $\pm 3\%$ of full scale, suitable for positive, negative or differential pressure measurement, complete with static pressure tips, and mounting accessories.

2.04 POSITIVE DISPLACEMENT METERS

- .1 Nutating disc measuring chamber, disc material to suit fluid encountered, odometer-type direct reading totalizer counter with 6 numerical wheels for cumulative readings.

3. EXECUTION

3.01 INSTALLATION

- .1 Install positive displacement meters with isolating valves. Provide valve bypass for liquid service meters.
- .2 Install flow meters in uninterrupted straight pipe, minimum 2 pipe diameters downstream and 5 pipe diameters upstream, or according to manufacturers recommendations.
- .3 Select gauges so that normal operating point is approximately mid-point of instrument range.
- .4 On pipes 65 mm and smaller, place well in tee used in lieu of an elbow to accommodate well.

3.02 METERS AND GAUGES INSTALLATION SCHEDULE

- .1 Positive Displacement Meter:
 - .1 Domestic Cold Water.
- .2 Static Pressure Gauges:
 - .1 Across built-up filter banks
 - .2 Across supply and return fans
- .3 Static Pressure Taps:
 - .1 Across all major dampers

END OF SECTION

1. GENERAL**1.01 SUMMARY**

- .1 This section includes requirements for supply and installation of the following:
 - .1 In-line circulators
 - .2 Glycol injection pumps
 - .3 Pump controls where self-contained
 - .4 Pump seals

1.02 RELATED REQUIREMENTS

- .1 Section 20 05 00 – Common Work Results for Mechanical
- .2 Section 20 05 03 – Mechanical Product Options and Substitution Procedures
- .3 Section 20 05 93.19 – Balancing of Mechanical Systems
- .4 Section 20 13 13 – Tanks for Mechanical Systems

1.03 SUBMITTALS

- .1 Provide required information in accordance with Section 20 05 03.
- .2 Action Submittals: Provide the following submittals before starting any work of this Section:
 - .1 Product Data: Submit manufacturer's product data showing pump materials, dimensional data and ratings and the following:
 - .1 Details of pump drive motor
 - .2 Details of drive assembly, including the rated capacity of the drive at the specified r/min
 - .3 Details of bearings including manufacturers ratings of full load operating hours
 - .4 Details of pump seals, listing maximum operating temperatures and material limitations
 - .2 Shop Drawings: Submit shop drawings of all pumps specified complete with certified pump curves showing performance characteristics, including NSPH curve where applicable and seal types.
 - .1 For pumps operating in parallel, provide pump curves for pumps operating individually and in parallel.
- .3 Informational Submittals: Provide the following submittals during the course of the work:
 - .1 Certificates: Provide factory certified performance curve for fire pumps specified in this Section.

1.04 QUALITY ASSURANCE

- .1 Regulatory Requirements: Provide fire pumps that are CSA and ULC approved and bear a ULC label, and that are equipped with controllers meeting requirements of NFPA 20.

- .2 Qualifications: Provide proof of qualifications during the course of the work of this Section:
 - .1 Materials: Provide pumps that operate at specified system fluid temperatures without vapour binding and cavitation, are non-overloading in parallel or individual operation, and operate within 25% of midpoint of published maximum efficiency curve.

2. PRODUCTS

2.01 MANUFACTURERS

- .1 Acceptable Materials Manufacturers: Subject to compliance with requirements specified in this Section; where multiple listings of manufacturers occur, use any of the following listed manufacturers' products in accordance with Section 20 05 03 including the following:
 - .1 In-line Circulator :
 - .1 Grundfos
 - .2 Wilo
 - .3 Taco

2.02 MANUFACTURED MATERIALS

- .1 Provide manufactured pumps as described in this Section that have statically and dynamically balance rotating parts; manufactured to permit complete servicing without breaking piping or motor connections and as follows:
 - .1 Pumps Operating Speed: 1750 RPM unless different rating is reviewed and accepted by Consultant
 - .2 Pump Connections: Flanged, and having pressure gauge tapings
- .2 Vertical In-Line End Suction Pumps: Centrifugal in-line single or double suction as specified; direct coupled for up to 5.6 kW and split spacer coupling for 7.5 kW and over and as follows:
 - .1 Volute of cast iron rated for 1225 kPa or ductile iron for 2500 kPa. Provide the following casing accessories: drain plug, flanged inlet and outlet, separate tapped flush line and gauge connections.
 - .2 Bronze dynamically balanced impeller or equivalent alloy, keyed to shaft, held in place by self-locking bronze cap screw.
 - .3 Equip direct coupled pumps with steel shaft with bronze shaft sleeve; equip spacer coupling pumps with stainless steel shaft.
 - .4 Equip direct coupled pumps with carbon/ni-resist or tungsten carbide mechanical seal; equip spacer coupling pumps with Durametallc Type RA outside mechanical seal.
 - .5 Equip all pumps with flush lines piped from pump discharge to mechanical seals.

3. EXECUTION

3.01 INSTALLATION

- .1 Provide drains for bases and stuffing boxes piped to and discharging into floor drains.
- .2 Support vertical in-line pumps from piping, provide pipe supports outboard of pump flanges.
- .3 Provide air cock and drain connections on horizontal pump casings.
- .4 Provide line sized gate valve and strainer on suction line and line sized check valve and globe valve on discharge line unless otherwise shown.

- .5 Decrease from line size, with long radius reducing elbows or reducers. Support piping adjacent to pump such that no weight is carried on pump casings. Provide supports under elbows on pump suction and discharge line sizes 100 mm and over.
- .6 Make seal re-circulation connections from the pump casing or flange on the discharge of the pump, with external piping to the seal flushing connection. Install the flushing connection complete with regulating valve suitable for service and working pressure of pump served.

3.02 SCHEDULED PUMP PERFORMANCE

- .1 Refer to pump schedule on Drawings.

END OF SECTION

1. GENERAL**1.01 SUMMARY**

- .1 Supply and install fire protection specialties including, but is not limited to, the following:
 - .1 Portable fire extinguishers.
 - .2 Mounting brackets for fire extinguishers.

1.02 RELATED SECTIONS

- .1 Section 07 84 00 – Firestopping: Through penetration firestop materials for firestopping sealants at fire rated cabinets.

1.03 REFERENCES

- .1 American Society for Testing and Materials (ASTM):
 - .1 ASTM E814-02 Standard Test Method for Fire Tests of Through-Penetration Fire Stops
- .2 National Fire Protection Association (NFPA):
 - .1 NFPA 10-2002, Standard for Portable Fire Extinguishers
- .3 Underwriters Laboratories Canada (ULC):
 - .1 CAN/ULC S508-02, Rating and Testing of Fire Extinguishers and Extinguishing Agents
 - .2 CAN/ULC S522-M86, Standard for Fire Extinguishers and Booster Hose

1.04 SUBMITTALS

- .1 Provide requested information in accordance with Section 01 00 06 – General Requirements: Submittals.
- .2 Submit product data including, but not limited to, construction details, material descriptions, dimensions of individual components and profiles, and finishes for fire protection specialties, and as follows:
 - .1 Fire Extinguishers: Include rating and classification.
 - .2 Cabinets: Include roughing-in dimensions, details showing mounting methods, relationships of box and trim to surrounding construction, door hardware, cabinet type, trim style, and panel style.

1.05 PROJECT CLOSEOUT SUBMISSIONS

- .1 Submit maintenance data for fire extinguishers to include in maintenance manuals in accordance with Section 01 00 06 – General Requirements: Closeout Submissions.

1.06 QUALITY ASSURANCE

- .1 Obtain fire extinguishers and cabinets through one source from a single manufacturer.
- .2 Fabricate and label fire extinguishers in accordance with NFPA 10, ULC S522 and ULC S508, and meeting the requirements of the local Authority Having Jurisdiction.
- .3 Fire extinguishers shall be listed and labelled for type, rating, and classification by an independent testing agency acceptable to Authority Having Jurisdiction.

1.07 WARRANTY

- .1 Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of portable fire extinguishers that fail in materials or workmanship within specified warranty period.
- .2 Failures include, but are not limited to, the following:
 - .1 Failure of hydrostatic test according to NFPA 10.
 - .2 Faulty operation of valves or release levers.
- .3 Warranty Period: Six (6) years from date of Substantial Performance.

2. PRODUCTS**2.01 MANUFACTURERS**

- .1 Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - .1 Ansul Incorporated, Simplex-Grinnell
 - .2 Pyro-Chem/Flag Fire, National Fire Equipment Ltd.

2.02 PORTABLE FIRE EXTINGUISHERS

- .1 Multi-Purpose Dry Chemical:
 - .1 Operation: Stored pressure rechargeable type with hose and shut-off nozzle.
 - .2 Construction: Manufacturer's standard tank construction; with manufacturer's heavy duty wall bracket.
 - .3 Size: 2.25 kg and 4.5 kg
 - .4 ULC Label: Class A B C Protection.
 - .5 ULC Classification Rating: 4-A:60-B:C.

2.03 FIRE EXTINGUISHER BRACKETS

- .1 Mounting Brackets:
 - .1 Manufacturer's heavy duty, galvanized steel, designed to secure fire extinguisher to wall or structure.
 - .2 Sizes required for types and capacities of fire extinguishers indicated, with plated or baked-enamel finish.
- .2 Identification:
 - .1 Identify extinguishers in accordance with recommendations of ULC S508.
 - .2 Attach tag or label to extinguishers, indicating month and year of installation; include space for service dates.
 - .3 Location: As directed by the Consultant.
 - .4 Identify bracket-mounted fire extinguishers with the words FIRE EXTINGUISHER in red letter decals applied to mounting surface.
 - .5 Orientation: Vertical.

3. EXECUTION**3.01 EXAMINATION**

- .1 Examine fire extinguishers for proper charging and tagging; remove and replace damaged, defective, or undercharged units.

- .2 Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION, GENERAL

- .1 Install extinguishers in accordance with manufacturer's written instructions and to meet specified standards and requirements of the Authorities Having Jurisdiction.
- .2 Install extinguishers so that the top of extinguisher is no more than 1530 mm with the bottom of the extinguisher mounted a minimum of 100 mm above floor in accordance with NFPA 10.
- .3 Mounting Brackets: Fasten mounting brackets to surfaces, square and plumb, at locations indicated.
- .4 Identification: Apply decals at locations indicated.

3.03 ADJUSTING AND CLEANING

- .1 Remove temporary protective coverings and strippable films as fire protection specialties are installed, unless otherwise indicated in manufacturer's written installation instructions.
- .2 Touch up marred finishes or replace cabinets that cannot be restored to factory-finished appearance; use only materials and procedures recommended or furnished by manufacturer.

3.04 SCHEDULE

- .1 Provide extinguishers (FE) in locations and of size(s) as indicated on the Contract Documents.

END OF SECTION

1. GENERAL

1.01 SUMMARY

- .1 This Section includes procedures and cleaning solutions for cleaning mechanical piping systems including, but not limited to, the following:
- .1 Provide for flushing and disinfection of domestic water systems.
 - .2 Isolate and bypass equipment as required to complete work of this Section.

1.02 SUBMITTALS

- .1 Provide required information in accordance with Section 01 00 06 – General Requirements: Submittals.
- .2 Submit literature having complete description of proposed chemicals, quantities, calculations, procedures, test kits and equipment supplied, and copies of data sheets, procedure instructions and analysis reports proposed for use in the Work.; submit within 10 working days of the award of Contract.
- .3 Provide written reports containing procedure of system cleaning and degreasing, giving times, dates, conditions of water and problems and actions encountered.
- .4 Submit written reports to the Contractor, Consultant and Mechanical Trade Contractor containing results of tests taken every seven days after completion of chemical treatment; perform tests every seven days for a minimum time period of 35 days.
- .5 Provide written reports to the City after each visit with a copy to the Consultant.

1.03 QUALITY ASSURANCE

- .1 Perform the cleaning and degreasing operation on site in conjunction with the mechanical contractor and submit written reports on all situations found, actions taken and final results. Reports shall be signed by the contractor, chemical treatment agency.
- .2 Provide chemical treatment as specified herein and provide written reports. Reports shall be signed by the chemical treatment agency, mechanical contractor and commissioning agency.
- .3 Chemical treatment agency shall provide directive and assistance to the mechanical contractor in the degreasing, cleaning and chemical treatment of all piping systems. Use of the permanent mechanical systems for pumping or heating of cleaning and dilution solutions is not permitted. Permanent systems shall be isolated and portable pumps and boilers utilized for the duration of the cleaning process. Permanent equipment shall be flushed, degreased and chemically treated independent of the piping systems.
- .4 Include for the costs of an independent testing agency, selected by the City, to take samples of all chemically treated hydronic systems, perform lab analysis of the chemical treatment levels, and submit a written report of their findings to the City. Should chemical treatment levels not meet the requirements of the specifications, the Contractor shall adjust treatment levels accordingly and cover the costs of the independent testing agency to take additional samples and tests.

2. PRODUCTS

2.01 MATERIALS

- .1 Provide sufficient chemicals to treat and test the systems from the time of activation and acceptance of the building for the first year of operation by the City.

.2 Materials which may contact finished areas shall be colorless and non-staining. Chemicals used must comply with environmental and health standards applicable to the usage on this project.

.3 System Cleaner: Alkaline compound which in solution removes grease and petroleum products.

2.02 TEST KITS

.1 Test methods shall be titration type utilizing automatic burettes capable of determining 0.1 ppm, where this type of method may be used.

.2 All test kits shall be provided with adequate chemicals and reagents for one year of testing.

.3 Provide test kits for hardness and chlorides in addition to those listed above.

.4 Provide a PH meter complete with three different calibration standard solutions.

3. EXECUTION

3.01 ACCEPTABLE AGENCIES

.1 Chemical treatment agencies will be responsible for providing all equipment, chemicals and site supervision to fully comply with all requirements and their intent contained within this specification section.

.2 Chemical treatment agencies offering products that may be incorporated into the Work include, but are not limited to, the following:

- .1 SAI Engineering Labs
- .2 G.E. Betz Ltd.
- .3 Sumco Technologies Ltd.

3.02 MANUFACTURER'S INSTRUCTIONS

.1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

3.03 SYSTEM CLEANING

.1 Ensure reasonable care is exercised to prevent debris, dirt and other foreign material from entering the pipe during construction. This is to include proper protection of piping on site prior to installation, temporary caps on partial systems, and complete evacuation of moisture within systems being hydrostatically pressure tested.

.2 Chemical treatment agency shall, in conjunction with the mechanical contractor, review connections for complete draining and venting of the systems. The mechanical contractor shall provide adequate drain connections to completely drain the systems within one hour. Utilize water meter to record capacity within each system.

.3 Protect and/or remove control devices from systems during cleaning. All terminal control valves shall be in open position during cleaning. Particular attention is to be made to control valves which have a normally closed position. Isolate and bypass the following equipment during flushing and chemical treating: Cooling towers, plate and frame heat exchangers.

.4 Make systems completely operational, totally filled, thoroughly vented, and completely started.

.5 Add system cleaner and degreasant to flow systems at the following concentrations:

- .1 Hot Systems: 1 kg/1000L of water contained in systems.
- .2 Cold Systems: 1 kg/500L of water contained in systems.

-
- .6 For open systems clean, degrease and flush in the same methods utilized for closed systems of same temperature. Drain completely and refill.
 - .7 Inspect, clean of sludge and flush all low points with clean water after cleaning and degreasing process is completed. Include disassembly of components as required. All cleaning and flushing of low points, coils and boilers shall be done prior to final fill and chemical treatment.
 - .8 All domestic hot, cold and domestic recirculation water systems will be required to be flushed and disinfected. Add chlorine to water in system to 50 milligrams per litre (50 ppm) and let stand for 24 hours. Check chlorine content after 24 hours and insure the content is not less than 20 milligrams per litre (20 ppm). If less than 20 milligrams per litre (20 ppm) repeat process. Flush system until the chlorine content of water being drained is equal to the chlorine content of the make-up water. Utilize plumbing fixtures (i.e. lav, sinks, flushometers, etc.) for drainage.

END OF SECTION

1. GENERAL

1.01 SUMMARY

- .1 Plumbing specialties in this Section includes the following:
 - .1 Roof Drains
 - .2 Floor Drains
 - .3 Cleanouts
 - .4 Backwater Valves
 - .5 Sump Pits
 - .6 Water Hammer Arrestors
 - .7 Backflow Preventers

1.02 RELATED REQUIREMENTS

- .1 Section 03 31 00 – Cast-In-Place Concrete: Coordination with placement of cleanouts, floor drains.
- .2 Section 05 50 00 – Metal Fabrications
- .3 Section 20 05 10 – Mechanical Systems Pipe and Pipe Fittings
- .4 Section 20 05 23 – Valves for Mechanical Systems

1.03 QUALITY ASSURANCE

- .1 Provide materials, equipment and labour to install plumbing as required by Provincial and Local Codes as specified herein.
- .2 Provide water and drainage connections to equipment furnished in other sections of this specification and by the City.

1.04 SUBMITTALS

- .1 Provide required information in accordance with Section 01 00 06 – General Requirements: Submittals.
- .2 Submit shop drawings of all devices listed in this section.

1.05 PROJECT CLOSEOUT SUBMISSIONS

- .1 Provide required information in accordance with Section 01 00 06 – General Requirements: Closeout Submissions.
- .2 Submit certification sheets for inclusion in the operations and maintenance manuals.

2. PRODUCTS

2.01 MANUFACTURERS

- .1 Subject to compliance with the standards and properties listed in this specification, the following manufacturers are acceptable for this project:
 - .1 Cleanouts:
 - .1 Jay R. Smith
 - .2 Zurn
 - .3 Watts

- .4 Mifab.
- .2 Water Hammer Arrestors:
 - .1 Jay R. Smith
 - .2 Zurn
 - .3 Watts
 - .4 Mifab.
- .3 Roof and Floor Drains:
 - .1 Jay R. Smith
 - .2 Zurn
 - .3 Watts
 - .4 Mifab.
- .4 Backflow Preventers:
 - .1 Febco
 - .2 Watts
 - .3 Hersey
 - .4 Singer
 - .5 Mifab.
- .5 Backwater Valves:
 - .1 Jay R. Smith
 - .2 Zurn
 - .3 Mifab.

- .2 Materials other than the named products for the Project may be acceptable to the Consultant, submit information in accordance with Section 01 00 06 – General Requirements: Substitutions and Product Options.

2.02 CLEANOUTS AND CLEANOUT ACCESS COVERS

- .1 Provide caulked or threaded type extended to finished floor or wall surface. Provide bolted cover-plate cleanouts on vertical rainwater leaders only. Ensure ample clearance at cleanout for rodding of drainage system.
- .2 Floor cleanout access covers in unfinished areas shall be round with nickel bronze scoriated frames and plates. Provide round access covers in finished areas with depressed centre section to accommodate floor finish. Wall cleanouts to have chrome plated caps.

2.03 WATER HAMMER ARRESTORS

- .1 Fit water supply to each fixture or group of fixtures with an air chamber. Provide air chambers same size as supply line or 19 mm minimum, and minimum 450 mm long.
- .2 Install stainless steel bellows type water hammer arrestors complete, with accessible isolation valve, on water lines connected to solenoid valves (including flush-valves). Water hammer arresting devices, conforming to ASSE 1010 and WH-201 and as follows:
 - .1 Bodies: Hard drawn copper with internal mirror finish.
 - .2 Piston: Delrin PL.
 - .3 Seals: Here (3) "O" ring seal 70D, Buna N.
 - .4 Seal Lubricant: Dow Corning Silicone compound #111 FDA approved for use in potable water systems.
 - .5 Operating Pressure: Designed to operate on all domestic and commercial lines at 1.034 MPa.

- .6 Temperature range: 0.5°C to 120°C.
- .7 Connection Size: 13 mm, 19 mm or 25 mm.
- .8 Acceptable material: Ancon Shok-Gard.

2.04 ROOF DRAINS

- .1 Flow Characteristics: Full open flow.
- .2 Roof drains shall have lacquered cast iron body with large gravel sump, removable cast metal mushroom dome (or deck) strainer, flashing flange and flashing clamp with integral gravel stop, perforated extension for inverted roof.
- .3 Parapet drains shall have polished brass sloping grate.
- .4 De-icing Cabling: Coordinate supply and installation of de-icing cable for freeze protection of roof drain bodies and associated interior rain water leaders with Section 26 05 19 and Electrical Drawings.

2.05 FLOOR DRAINS

- .1 Floor drains shall have lacquered cast iron body with double drainage flange, weep holes, trap seal primer connection, combined two-piece body reversible clamping device and 13 mm thick adjustable nickel-bronze strainer. Washroom floor drains shall have a removable perforated sediment bucket.
- .2 Floor drains in equipment rooms shall have 100 mm x 225 mm epoxy coated funnel type strainer and extension for floating floor if applicable. No hub drains are allowed.

2.06 EQUIPMENT DRAINS

- .1 Provide a sloped connection from packaged equipment drain pans to nearest sanitary sewer trapped connection. Slope at minimum of 0.5% grade. Drain size to be 25 mm. Trap at unit is to be deep enough to ensure a 50 mm water seal at the maximum total pressure of the fan system.

2.07 BACKWATER VALVE ASSEMBLIES

- .1 Provide complete assembly, epoxy coated, cast-iron body, bronze flapper check valve, bolted access cover with neoprene gasket extended floor access and neoprene gasketed heavy-duty nickel-bronze.

2.08 TRAP SEAL PRIMERS

- .1 Bronze manually drop activated trap primer complete with sediment strainer, union and access door for concealed installations with 15 mm PEX tubing connection between primer valve and floor drain.

2.09 PRESSURE REDUCING VALVES

- .1 25 mm and Smaller:
 - .1 Bronze body, SS integral strainer, renewable SS seat, high temperature rated diaphragm suitable for hot or cold water. Rated at maximum inlet pressure of 2100 kPa, minimum reduced pressure 175 kPa, maximum temperature 90°C.
- .2 30 mm and Larger:
 - .1 Pilot operated, cast iron body, modified globe design, threaded ends to 50 mm flanged ends 65 mm and larger. Maximum inlet pressure 1225 kPa Maximum temperature 90°C. Bronze trim. Pilot control system: bronze with SS trim, hydraulically operated, diaphragm actuated.

- .3 Size to suit flow capacities and service.
- .4 Provide with gate valve and union on inlet and outlet, globe valve bypass, pressure gauge on inlet and outlet and pressure relief valve on reduced pressure side.

3. EXECUTION

3.01 INSTALLATION

- .1 Bury outside water and drainage pipe minimum 2400 mm.
- .2 Plumbing lines installed outside the building shall be separated by a minimum of 1 m horizontally between the outside surface of the lines. The lines are not permitted to be stacked.
- .3 Lubricate cleanout plugs with mixture of graphite and linseed oil. Prior to building turnover, remove cleanout plugs, re-lubricate and re-install using only enough force to ensure permanent leakproof joint.
- .4 Install backflow preventer or vacuum breaker assemblies on water lines where contamination of domestic water may occur. Generally necessary on, hose bibbs and flush valves and where required by the authority having jurisdiction.
- .5 Install gas piping in open or ventilated spaces. Pitch lines and provide drip legs for condensation collection points. Where gas piping is run in a concealed space, provide ventilation grilles as required.
- .6 Floor drains located in floating floors with no membrane provide lead flashing pan 900 mm x 900 mm at 39 kg/m². Flash membrane or lead into flashing clamp on drain body.
- .7 Install trap primers on all interior floor drains.
- .8 Drainage lines shall grade 2% per foot unless otherwise noted on drawings.
- .9 Install roof drains with 800 mm x 800 mm at 39 kg/m² sheet lead.
- .10 Install pressure reducing valves to limit maximum static pressure at plumbing fixtures to 550 kPa or to the rated maximum operating pressure of the devices downstream, whichever is lower.
- .11 Plumbing vents shall be located minimum 5 m from air intakes.
- .12 Reduced pressure backflow preventers shall be mounted in easily serviceable locations within reach from a 1830 mm ladder. (i.e. in mechanical room. Not in ceiling spaces.)
- .13 Reduced pressure backflow preventers to be mounted in the horizontal position. Double checks can be in horizontal or vertical, depending on manufacturers installation instructions.
- .14 Provide individual isolation valve for each hose bibb.

3.02 BACKFLOW PREVENTER ASSEMBLIES

- .1 Install line size reduced pressure backflow preventer on each water supply to the project.
- .2 Provide an air gap funnel floor drain under each reduced pressure backflow preventer. Pipe drain to sanitary sewer.
- .3 Test and verify all backflow preventer assemblies in accordance with the requirements of authorities having jurisdiction. Provide certification sheets for insertion in O & M manuals.

END OF SECTION

1. GENERAL

1.01 SUMMARY

- .1 Work in this section includes, but is not limited to, the following:
 - .1 Electric domestic water heaters.

1.02 RELATED SECTIONS

- .1 Section 20 05 23 – Valves for Mechanical Systems
- .2 Section 25 09 00 – Instrumentation and Control Devices for Mechanical Systems

1.03 REFERENCES

- .1 Underwriters Laboratories Canada (ULC)
- .2 National Sanitation Foundation (NSF)
- .3 Canadian Standards Association (CSA):
 - .1 CAN/CSA C22.2 NO. 110-94 (R2004), Construction and Test of Electric Storage-Tank Water Heaters
- .4 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE):
 - .1 ANSI/ASHRAE 90.1-2004 (SI), Energy Standard for Buildings Except Low-Rise Residential Buildings, SI Edition

1.04 QUALITY ASSURANCE

- .1 Completely pre-assemble and test water heaters at factory.
- .2 Rated for 1 MPa working pressure.
- .3 Construct electric domestic hot water heaters to CSA C22.2 NO. 110-94 and CSA C191.
- .4 Heater shall be listed with ULC and approved by National Sanitation Foundation.
- .5 Heaters must meet all applicable energy codes. The water heater will comply with the thermal efficiency, standby loss, insulation, and all other requirements of the latest version of ASHRAE 90.1 and the Model National Energy Code.

1.05 SUBMITTALS

- .1 Provide required information in accordance with Section 01 00 06 – General Requirements: Submittals.
- .2 Submit shop drawings including all trim and control wiring drawings.

2. PRODUCTS

2.01 MANUFACTURERS

- .1 Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include; but are not limited to, the following:
 - .1 Bradford White
 - .2 A.O. Smith

- .3 Ace
- .4 John Wood
- .5 State
- .6 PVI

2.02 ELECTRIC DOMESTIC WATER HEATERS

- .1 The heater(s) shall be a glass-lined commercial electric model, 60 cycle AC and constructed in accordance with ASME Code, shall bear appropriate symbol and be listed with the National Board as required.
- .2 All internal surfaces of the tank shall be glass-lined with an alkaline borosilicate composition that has been fused-to-steel by firing at a temperature of 871 °C.
- .3 Tank shall be cathodically protected with adequate extruded magnesium rod. The entire vessel is to be enclosed in a round steel enclosure with baked enamel finish.
- .4 Control compartment to be hinged and shall house 120 volts control circuit transformer, transformer fusing, magnetic contactor(s), immersion style operating thermostat(s), high limit thermostat(s), element fusing per N.E.C., and commercial grade incoloy sheathed flange mounted elements with prewired terminal leads. Temperature controls include limiting switch which will require resetting manually in the event the temperature reaches 88 °C.

3. EXECUTION

3.01 INSTALLATION

- .1 Install heaters where indicated on the drawings.

3.02 PERFORMANCE

- .1 Performance data shall include Energy Factor and indicate compliance with the latest version of ASHRAE 90.1.
- .2 Refer to Domestic Water Heaters Schedule on Drawings.

END OF SECTION

1. GENERAL

1.01 SUMMARY

.1 This Section includes requirements for supply and installation of the following:

- .1 Plumbing fixtures and trim
- .2 Fixture carriers

1.02 RELATED REQUIREMENTS

.1 Section 06 40 00 – Shop Fabricated Architectural Woodwork: Sinks installed in countertops plumbed by this Section and installed by related requirement.

1.03 GENERAL REQUIREMENTS

- .1 Provide new fixtures, CSA approved, free from flaws and blemishes with finished surfaces clear, smooth and bright.
- .2 Provide CSA approved plumbing fittings. Visible parts of fixture brass and accessories shall be heavily chrome plated.
- .3 Fixtures shall be product of one manufacturer. Fittings of same type shall be product of one manufacturer.
- .4 Protect fixtures against use and damage during construction.

1.04 JOB CONDITIONS

.1 Check millwork shop drawings. Confirm location and size of fixtures and openings before rough-in and installation.

1.05 SUBMITTALS

- .1 Provide required information in accordance with Section 01 00 06 – General Requirements: Submittals.
- .2 Submit shop drawings for review.

2. PRODUCTS

2.01 MANUFACTURERS

- .1 Subject to compliance with requirements, manufacturers offering Metering Valves that may be incorporated into the Work include; but are not limited to, the following:
 - .1 Cambridge Brass
 - .2 Delta
 - .3 Symmons
 - .4 Chicago Faucet
- .2 Subject to compliance with requirements, manufacturers offering Flush Valves that may be incorporated into the Work include; but are not limited to, the following:
 - .1 Sloan
 - .2 Presto
 - .3 Cambridge Brass
 - .4 Zurn
 - .5 Toto
- .3 Subject to compliance with requirements, manufacturers offering Plumbing Brass that may be incorporated into the Work include; but are not limited to, the following:
 - .1 Crane
 - .2 Symmons
 - .3 American Standard
 - .4 Cambridge Brass
 - .5 Delta
 - .6 Waltec
 - .7 Kohler
 - .8 Chicago Faucet
- .4 Subject to compliance with requirements, manufacturers offering Mop Sinks that may be incorporated into the Work include; but are not limited to, the following:
 - .1 Fiat
 - .2 Crane
 - .3 American Standard
 - .4 Cambridge Brass

PLUMBING FIXTURES AND TRIM

- .5 Subject to compliance with requirements, manufacturers offering Water Closets, Lavatories, and Urinal Baths that may be incorporated into the Work include; but are not limited to, the following:
- .1 American Standard
 - .2 Crane
 - .3 Kohler
 - .4 Toto
- .6 Subject to compliance with requirements, manufacturers offering Toilet Seats that may be incorporated into the Work include; but are not limited to, the following:
- .1 Olsonite
 - .2 Centoco
 - .3 Moldex
- .7 Subject to compliance with requirements, manufacturers offering Electric Flush Valves that may be incorporated into the Work include; but are not limited to, the following:
- .1 Sloan
 - .2 Delta
 - .3 Toto
- .8 Subject to compliance with requirements, manufacturers offering Electric Faucets that may be incorporated into the Work include; but are not limited to, the following:
- .1 Sloan
 - .2 Chicago Faucet
 - .3 Delta
 - .4 Toto.

3. EXECUTION**3.01 INSTALLATION**

- .1 Install each fixture with its own trap, easily removable for servicing and cleaning. At completion, thoroughly clean plumbing fixtures and equipment.
- .2 Provide chrome plated rigid or flexible supplies to fixtures with screw driver stops, reducers and escutcheons.
- .3 Install wall mounted lavatories and urinals and water closets with approved wall carriers.
- .4 Caulk gap between mop sink, urinal and water closet, and wall or floor with silicone sealant.

PLUMBING FIXTURES AND TRIM

- .5 Provide pressure reducing valves on water lines to fixtures which are not rated for the system operating pressures.

3.02 FIXTURES ROUGH-IN SCHEDULE

- .1 Rough-in fixture piping connections in accordance with the following table of minimum sizes.

	<u>Hot Water</u>	<u>Cold Water</u>	<u>Waste</u>	<u>Vent</u>
Lavatories	15 mm	15 mm	40 mm	30 mm
Service Sink	15 mm	15 mm	50 mm	40 mm
Kitchen Sink	15 mm	15 mm	40 mm	30 mm
Floor Drains	–	–	100 mm	40 mm
Water Closet (Tank Type)	–	15 mm	100 mm	50 mm
Mop Sink	15 mm	15 mm	50 mm	40 mm

- .2 Mount fixtures the following heights above finished floor:

Water Closets

Standard 375 mm to top of bowl rim

Barrier Free 450 mm to top of seat

Urinal

Standard 550 mm to top of bowl

Barrier Free 500 mm to top of bowl

Lavatory

Standard 775 mm to top of basin rim

Barrier Free 800 mm to top of basin rim

3.03 PERFORMANCE

- .1 Refer to Plumbing Fixtures and Trim Schedule on Drawings.

END OF SECTION

1. GENERAL

1.01 SUMMARY

- .1 This Section includes requirements for general duct cleaning.

1.02 RELATED SECTIONS

- .1 Section 23 31 00 – Ductwork
- .2 Section 23 33 00 – Air Duct Accessories: Access doors through duct construction.
- .3 Section 23 34 00 – HVAC Fans

1.03 SUBMITTALS

- .1 Provide required information in accordance with Section 01 00 06 – General Requirements: Submittals.
- .2 Submit list of five (5) projects undertaken in the last two (2) years of similar size and scope as this project when requested by the Consultant.
- .3 Submit letter certifying that all systems have been completely cleaned and are ready for review by the Consultant.

1.04 QUALITY ASSURANCE

- .1 Only companies having a minimum of two (2) years of experience and who have experience with projects of similar size and scope will be acceptable for this Project.

1.05 PROTECTION

- .1 Protect furniture, equipment and flooring in close proximity to the work area with clean protective coverings.
- .2 Take precautions to ensure that dust and debris do not spread outside of duct system during the cleaning process.

2. PRODUCTS

2.01 MATERIALS

- .1 Access Doors: Minimum 450 mm x 350 mm door, hinge and frame type, positive latching and locking mechanism as specified in Section 23 33 00.
- .2 Cleaning Equipment:
 - .1 Use vacuum cleaning equipment having a nominal 5.0 kPa suction capacity and 12,000 L/s minimum extraction capacity.
 - .2 Use brushes and sweepers as necessary to remove construction dust and debris from HVAC system.
 - .3 Use non-corrosive cleansers and fungicides as necessary to complete cleaning of duct system.

3. EXECUTION**3.01 ACCEPTABLE CLEANERS**

- .1 Subject to compliance with requirements, cleaning companies that may be complete work of this Section include, but are not limited to, the following:
 - .1 Don's Pow-R Vac (Edmonton)

3.02 PREPARATION

- .1 Isolate items being cleaned so as not to contaminate unprotected work.
- .2 Equip vacuum equipment with HEPA filters to prevent airborne contamination.

3.03 INSTALLING ACCESS DOORS

- .1 Locate access doors and install as follows:
 - .1 Confirm location of all access doors in Architectural shroud with Architectural.
 - .2 Base of all duct risers.
 - .3 Each fire damper location.
 - .4 Each side of all coils except where an access is provided.
 - .5 All locations of internally duct mounted equipment or devices including balancing dampers, automatic dampers, damper motors, duct mounted smoke detectors and heat detectors, and controls, except where access is provided.

3.04 CLEANING

- .1 Clean all ductwork, plenums, coils, unit heaters, fan coil units and air handling equipment by compressed air and suction equipment when the duct systems are completely installed and before any systems are operated.
- .2 Cleaning is not required for exhaust ductwork systems that convey air directly to the outside exclusively without recirculation.
- .3 Seal all ductwork outlets after ductwork has been cleaned.
- .4 Seal all plenums after cleaning.

3.05 FIELD QUALITY CONTROL

- .1 Ductwork cleanliness will be reviewed using a periscope built of 75 mm diameter tube, mirrors and flashlight.
- .2 Clean ductwork that is found dirty at no additional cost to the Contract.

END OF SECTION

1. GENERAL**1.01 SUMMARY**

- .1 This Section includes requirements for supply and installation of the following:
 - .1 Duct hangers and supports.
 - .2 Flashing for mechanical equipment.
 - .3 Sleeving required for mechanical ducting.

1.02 RELATED REQUIREMENTS

- .1 Section 03 31 00 – Structural Concrete: Coordination of placement of inserts, sleeves and block-outs for equipment and openings; concrete for housekeeping pads.
- .2 Section 05 12 00 – Structural Steel Framing: Structural grade steel required for equipment supports.
- .3 Section 05 31 00 – Steel Decking: Coordination of placement of openings for equipment and ductwork.
- .4 Section 05 50 00 – Metal Fabrications: Platforms and ladders required for access to HVAC piping and equipment.
- .5 Section 07 62 00 – Sheet Metal Flashing and Trim: Coordinate flashing materials with project requirements for flashings and sheet metals.
- .6 Section 07 92 00 – Joint Sealants: Through wall caulking requirements.
- .7 Section 09 91 00 – Painting: Priming of hangers and supports ready for site finishing.
- .8 Section 23 31 00 – Ductwork

1.03 REFERENCE STANDARDS

- .1 American Society for Testing and Materials (ASTM):
 - .1 ASTM A36/A36M-05, Standard Specification for Carbon Structural Steel.
 - .2 ASTM A125-96(2001), Standard Specification for Steel Springs, Helical, Heat-Treated.
 - .3 ASTM A307-04, Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength.
 - .4 ASTM A563-04a, Standard Specification for Carbon and Alloy Steel Nuts.
 - .5 ASTM A653-05, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - .6 ASTM B749-03, Standard Specification for Lead and Lead Alloy Strip, Sheet, and Plate Products.
- .2 Manufacturer's Standardization Society of the Valves and Fittings Industry (MSS)
 - .1 MSS SP-58-2002, Pipe Hangers and Supports: Materials, Design and Manufacture.
 - .2 MSS SP-69-2003, Pipe Hangers and Supports: Selection and Application.
 - .3 MSS SP-89-2003, Pipe Hangers and Supports: Fabrication and Installation Practices.
- .3 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA):
 - .1 SMACNA HVAC Systems - Duct Design, 1990.
 - .2 SMACNA HVAC Duct Construction Standards – Metal and Flexible, 1995, 2nd Edition and Addendum No. 1, 1997.

1.04 DESIGN REQUIREMENTS

- .1 Provide hangers and supports to secure equipment in place, prevent vibration, prevent excessive heat transmission to structure, maintain grade, and allow for expansion and contraction using manufacturer's regular production components, parts and assemblies.
- .2 Install supports of strength and rigidity to suit loading without unduly stressing building; locate adjacent to equipment to prevent undue stresses in equipment.
- .3 Select hangers and supports for the service indicated in accordance with maximum load ratings on allowable stresses prescribed by MSS SP-58, and in accordance with manufacturer's recommended maximum loading to sustain without failure a load equal to a load:
 - .1 Equal to six times the load imposed when installed in unit masonry.
 - .2 Equal to four times the load imposed when installed in concrete.
 - .3 Equal to five times the load imposed when installed in other types of materials.
- .4 Fasten hangers and supports to building structure or inserts in concrete construction; discuss proposed hanging systems and methods with structural Consultant and obtain acceptance as follows:
 - .1 Prior to drilling for inserts and supports for duct system.
 - .2 Prior to welding ductwork and equipment supports to building metal decking or building structural steel.
 - .3 Use of piping or equipment for hanger supports and use of perforated band iron, wire or chain as hangers will not be permitted.
- .5 Provide and set sleeves or block-outs required for equipment, including openings required for placing equipment; provide sleeves for duct penetrations through walls, ceilings, floors and footings; provide locations and dimensions for block-outs or embedded material if provided or installed by others.

1.05 SUBMITTALS

- .1 Provide required information in accordance with Section 01 00 06 – General Requirements: Submittals.
- .2 Submit shop drawings and product data for each factory fabricated component including, but not limited to, the following:
 - .1 Bases, hangers and supports.
 - .2 Connections to equipment and structure.

2. PRODUCTS**2.01 SHEET METAL FLASHINGS**

- .1 Zinc Galvanized Sheet Steel Flashing: Tension levelled, Commercial Steel (CS) designation, Type A, Grade 230 (33) in accordance with ASTM A653 and as follows:
 - .1 Thickness:
 - .1 Flashing: Minimum 0.455 mm base metal thickness.
 - .2 Caps: 0.759 mm base metal thickness.
 - .3 Fire Resistant Construction 1.519 mm base metal thickness.
 - .2 Galvanizing Designation: Z275 (G90) applied evenly to both sides.
 - .3 Surface Texture: Smooth.
 - .4 Finish: Natural finish ready for field painting.

- .2 Lead Sheet Flashing: Copper bearing lead sheet in accordance with ASTM B749, Type L51121 and as follows:
- .1 Waterproofing: 24.4 kg/m² nominal weight.
 - .2 Soundproofing: 4.88 kg/m² nominal weight.
 - .3 Safes: 24.4 kg/m² nominal weight or 0.5 mm thickness neoprene.

2.02 SLEEVES

- .1 Size sleeves large enough to allow for movement due to expansion and to provide for continuous insulation, and fabricate as follows:
- .1 Pipes through Floors: Form with steel pipe or approved PVC sleeves.
 - .2 Pipes through Beams, Walls, Fire Proofing, Footings, Potentially Wet Floor: Form using steel pipe.
 - .3 Ducts: Form with galvanized steel.

2.03 INSERTS

.1 Pre-Installation Inserts:

- .1 Galvanized steel shell and expander plug, internally threaded having lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.
- .1 Basis of design materials:
 - Steel Deck: Hilti HCI MD
 - Cast-In-Place Concrete: Hilti HCI WF

.2 Post-installation Inserts:

- .1 Expansion Inserts: Zinc coated carbon or Stainless steel, internally threaded inserts, sized to suit supported loads and threaded rod diameter, having expansion section that adapts to the base material:
- .1 Basis of design materials: Hilti HDI Drop-In Anchor System.

2.04 HANGER RODS AND STRAPS

- .1 Provide Stainless steel hanger rods, threaded both ends, threaded one end, or continuous threaded as required for the equipment being supported.
- .2 Straps and Rod Sizes: In accordance with SMACNA HVAC Duct Construction manual and MSS SP-58 for sheet steel width and thickness and for steel rod diameters.

2.05 HANGERS AND SUPPORTS

.1 Ducts: In accordance with SMACNA HVAC Duct Construction manuals and as follows:

- .1 Band Type Hangers: Same material as duct.
- .2 Rod Type Hangers:
 - .1 Material Mild low carbon steel fully threaded or threaded each end, with two removable nuts each end for positioning and locking rod in place.
 - .2 Finish: Galvanized Shop

- .2 Pipes: In accordance with MSS SP-58, SP-69 and SP-89 Pipe Hangers and Support manuals.

2.06 TRAPEZE AND RISER SUPPORTS

- .1 Steel shapes in accordance with ASTM A36/A36M.
- .2 Supports for Galvanized Steel Ducts: Galvanized steel shapes and plates.

2.07 FASTENERS AND ACCESSORIES

- .1 Equipment Anchor Bolts and Templates: Provide templates to ensure accurate location of anchor bolts.
- .2 Miscellaneous Fasteners and Upper Hanger Attachments:
 - .1 Sheet Metal Screws: Same material as duct.
 - .2 Machine Bolts and Nuts: Galvanized or cadmium plated steel.
 - .3 C Clamps: Locking nut and retaining strap assembly.
 - .4 Welding Studs: Capacitor discharge, low carbon steel, copper flashed.
 - .5 Structural Steel Shapes and Plates: ASTM A36, shop primed.
- .3 Expansion Anchors: Anchor bolt and sleeve assembly with capability to sustain, without failure, a load equal to six times the load imposed when installed in unit masonry and equal to four times the load imposed when installed in concrete, as determined by testing in accordance with ASTM E488.
- .4 Percussion Type Fastenings: Are not permissible for this project
- .5 Bolts: In accordance with ASTM A307.
- .6 Nuts: In accordance with ASTM A563.

2.08 FABRICATION

- .1 Fabricate hangers, supports and sway braces in accordance with MSS SP-58 and SMACNA HVAC Duct Construction manuals.
- .2 Use components for intended design purpose only; do not use for rigging or erection purposes.

3. EXECUTION**3.01 INSERTS**

- .1 Use inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams wherever practicable.
- .2 Set inserts in position in advance of concrete work wherever practicable; provide reinforcement rod in concrete for inserts carrying ducts over 1525 mm wide.
 - .1 Drill through concrete slab from below and provide rod with recessed 100 mm minimum square steel plate and nut above slab where inserts are omitted.
 - .2 Use expansion anchors where found acceptable by Consultant.
- .3 Finish inserts flush with slab surface where concrete slabs form finished ceiling.

3.02 DUCT HANGERS AND SUPPORTS

.1 Support duct work in accordance with SMACNA, and as a minimum as follows:

.1 Low Pressure Duct Hangers and Supports:

.1 Hanger Minimum Sizes:

- Less than or equal to 750 mm: 25 mm x 1.5 mm at 3 m spacing;
- 775 mm to 1220 mm: 38 mm x 1.5 mm at 3 m spacing;
- Greater than or equal to 1220 mm: 38 mm x 1.5 mm at 3.4 m spacing.

.2 Horizontal Duct on Wall Supports Minimum Sizes:

- Less than or equal to 450 mm wide: 38 mm x 1.5 mm or 25 mm x 3 mm at 2.4 m spacing;
- 475 mm to 1000 mm wide: 38 mm x 38 mm x 3 mm at 1.2 m spacing.

.3 Vertical Duct on Wall Supports Minimum Sizes:

- At 3.6 m spacing;
- Less than or equal to 610 mm: 38 mm x 1.5 mm;
- 625 mm to 915 mm: 25 mm x 25 mm x 3 mm;
- 925 mm to 1220 mm: 30 mm x 30 mm x 3 mm.

.4 Vertical Duct Floor Supports Minimum Sizes:

- Riveted or screwed to duct;
- Less or equal to 1500 mm: 38 mm x 38 mm x 3 mm;
- Greater than 1500 mm: 50 mm x 50 mm x 3 mm.

.2 Medium and High Pressure Duct Hangers and Supports:

.1 Rectangular Duct Hangers Minimum Sizes:

- Less than or equal to 915 mm: 2 at 25 mm x 1.5 mm at 3 m spacing;
- 925 mm to 1500 mm: 2 at 25 mm x 1.5 mm at 2.4 m spacing and 50 mm x 50 mm x 6 mm trapeze;
- 1525 mm to 3000 mm wide: 2 at 38 mm x 3 mm, at 2.4 m spacing and 50 mm x 50 mm x 6 mm trapeze;
- 3200 mm to 6000 mm: 3 at 10 mm diameter at 1.2 m spacing and 65 mm x 65 mm x 6 mm trapeze.

.2 Round Duct Hangers Minimum Sizes:

- At 3 m spacing;
- Less than or equal to 450 mm diameter: 25 mm x 1.5 mm;
- 475 mm to 915 mm diameter: 25 mm x 3 mm;
- 925 mm to 1250 mm diameter: 38 mm x 3 mm;
- 1300 mm to 2000 mm diameter: 2 at 38 mm x 3 mm from girth reinforcing angle.

.3 Vertical Duct Floor Supports Minimum Sizes:

- Rivet to duct and tie angles together with rod, angles or "band iron".

- Less than or equal to 1220 mm: 38 mm x 38 mm x 3 mm;
- Greater than 1220 mm: 50 mm x 50 mm x 5 mm.
- Angle reinforcing may be used for support omitting trapeze.

3.03 EQUIPMENT BASES AND SUPPORTS

- .1 Provide reinforced concrete housekeeping bases poured directly on structural floor slab; provide templates, anchor bolts and accessories required for mounting and anchoring equipment.
- .2 Construct supports of structural steel members or steel pipe and fittings; brace and fasten with flanges bolted to structure.
- .3 Provide rigid anchors for ducts and pipes immediately after vibration isolation connections to equipment unless spring hangers are specified.

3.04 PRIMING

- .1 Prime coat exposed steel hangers and support in accordance with Section 09 91 00

3.05 FLASHING

- .1 Flash and counterflash where mechanical equipment passes through weather or waterproofed walls, floors and roofs.
- .2 Flash vent and soil pipes projecting 80 mm minimum above finished roof surface with lead worked 25 mm minimum into hub, 200 mm minimum clear on sides with minimum 610 mm x 610 mm sheet size; turn flange back into wall and caulk in accordance with Section 07 92 00 for pipes extending through outside walls.
- .3 Flash floor drains over finished areas with lead 250 mm clear on sides with minimum 900 mm x 900 mm sheet size; fasten flashing to drain clamp device.
- .4 Provide curbs for mechanical roof installations 200 mm minimum high; flash and counterflash with galvanized steel, soldered and made waterproof.
- .5 Provide continuous lead or neoprene safes below air supply casings, built-up mop sinks; solder at joints, flash into floor drains and turn up 150 mm into walls or to top of curbs and caulk into joints.
- .6 Provide lead acoustic flashing around duct and pipes passing from equipment rooms, installed according to manufacturer's data for sound control.

3.06 SLEEVES

- .1 Set sleeves in position in advance of concrete work; provide suitable reinforcing around sleeve.
- .2 Extend sleeves through potentially wet floors 25 mm above finished floor level; caulk sleeves full depth in accordance with Section 07 92 00 and provide floor plate.
- .3 Ductwork passing through floor, ceiling or wall, close off space between duct and sleeve with non-combustible insulation; provide tight fitting metal caps on both sides and caulk in accordance with Section 07 92 00.

3.07 FINAL ADJUSTMENT

- .1 Adjust hangers and supports:
 - .1 Verify that rod is vertical under operating conditions.
 - .2 Equalize loads.

.2 Adjustable clevis:

- .1 Tighten hanger load nut securely to ensure proper hanger performance.
- .2 Tighten upper nut after adjustment.

.3 C-clamps:

- .1 Follow manufacturer's recommended written instructions and torque values when tightening C-clamps to bottom flange of beam.

.4 Beam clamps:

- .1 Hammer jaw firmly against underside of beam.

END OF SECTION

1. GENERAL**1.01 SUMMARY**

- .1 This Section includes materials and methods for:
 - .1 Duct thermal insulation.
 - .2 Duct acoustic insulation.
 - .3 Breeching insulation.
 - .4 Adhesives, tie wires, and tapes.
 - .5 Recovery jackets for interior and exterior ductwork.

1.02 RELATED REQUIREMENTS

- .1 Section 07 84 00 – Firestopping: Coordinate insulation type with penetration classification and firestopping systems.
- .2 Section 07 92 00 – Joint Sealants
- .3 Section 23 31 00 – Ductwork

1.03 REFERENCE STANDARDS

- .1 American Society for Testing and Materials (ASTM):
 - .1 ASTM A666-03, Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar
 - .2 ASTM B209/B209M-01, Specification for Aluminum and Aluminum Alloy Sheet and Plate
 - .3 ASTM C449/C449M-00, Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement
 - .4 ASTM C547-03, Standard Specification for Mineral Fiber Pipe Insulation
 - .5 ASTM C553-02, Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications
 - .6 ASTM C612-00a, Standard Specification for Mineral Fiber Block and Board Thermal Insulation
 - .7 ASTM C795-03, Specification for Thermal Insulation for Use with Austenitic Stainless Steel
 - .8 ASTM C921-03a, Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation
 - .9 ASTM C1136-03a, Standard specification for Flexible, Low Permeance Vapour Retarders for Thermal Insulation
- .2 Canadian General Standards Board (CGSB):
 - .1 CGSB 51-GP-52MA, Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation
 - .2 CAN/CGSB 51.53-95Poly (Vinyl Chloride) Jacketing Sheet, for Insulated Pipes, Vessels and Round Ducts
- .3 Manufacturer's Trade Associations:
 - .1 Thermal Insulation Association of Canada (TIAC): National Insulation Standards (Revised 1999)
- .4 Underwriters Laboratories of Canada (ULC):
 - .1 CAN/ULC S102-03, Method of Test for Surface Burning Characteristics of Building Materials and Assemblies

- .2 CAN/ULC-S702-03, Thermal Insulation, Mineral Fibre, for Buildings, Part 1 and Part 2
- .3 CAN/ULC S704-03, Standard for Thermal Insulation, Polyurethane and Polyisocyanurate, Boards, Faced
- .4 CAN/ULC S770-03, Standard Test Method for Determination of Long Term Thermal Resistance of Closed-Cell Thermal Insulating Foams

1.04 DEFINITIONS

- .1 The following definitions apply to the Duct Insulation specification:
- .2 Concealed: Insulated mechanical services in suspended ceilings and non-accessible chases and furred-in spaces such as crawl spaces and duct shafts.
- .3 Exposed: Insulated mechanical services in all other areas visible after final construction will be considered as exposed.

1.05 SUBSTITUTIONS

- .1 Materials other than the named products for the Project may be acceptable to the Consultant.
- .2 Substitutions for materials of this section will be considered after the close of bids in accordance with Section 01 00 06 – General Requirements: Substitutions and Product Options provided that proposed materials have a thermal resistance within 5% at normal conditions as material specified and meet other properties required for specified installation.

1.06 SUBMITTALS

- .1 Provide required information in accordance with Section 01 00 06 – General Requirements: Submittals.
- .2 Submit shop drawings indicating complete material data, K value, temperature rating, density, finish, and recovery jacket of materials proposed for this project and indicate thickness of material for individual services.

1.07 QUALITY ASSURANCE

- .1 Installer for insulation work listed in this Section shall be specialist in performing work of this Section, and have minimum 3 years successful experience in this size and type of project.
- .2 Insulation provided by this Section shall not be produced with, or contain any regulated CFC compounds listed in the Montreal Protocol adopted by the United Nations Environmental Program.
- .3 Materials used in this section shall meet or exceed flame spread rating of 25 or less and smoke developed classification of 50 or less in accordance with applicable building codes including, but not limited to, insulation materials, recovery jackets, vapour barrier facings, tapes and adhesives.
- .4 Insulation materials shall meet or exceed the requirements of the building code; label packages or containers indicating compliance of packaged materials.

1.08 PROJECT CONDITIONS

- .1 Deliver material to job site in original non-broken factory packaging, labelled with manufacturer's density and thickness.
- .2 Perform work at ambient and equipment temperatures as recommended by the adhesive manufacturer.

- .3 Make good separation of joints or cracking of insulation due to thermal movement or poor workmanship.

2. PRODUCTS

2.01 MANUFACTURERS

- .1 Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

- .1 Fibrex Insulations, Inc.
- .2 Isolation Manson Inc.
- .3 Johns Manville
- .4 Knauf Fiberglass
- .5 Owens-Corning
- .6 Roxul Inc.

2.02 MATERIALS, GENERAL

- .1 Insulation Material, Recovery Jackets, Vapour Barrier Facings, Tapes and Adhesives: Composite fire and smoke hazard ratings shall not exceed 25 for flame spread and 50 for smoke developed.
- .2 Insulating materials and accessories shall withstand service temperatures without smouldering, glowing, smoking or flaming.
- .3 Mineral fibre specified includes glass fibre, rock wool, or slag wool meeting the maximum K values listed at the choice of manufacturer.

2.03 DUCT INSULATION

- .1 Exposed Rectangular Ducts:

- .1 Rigid fibrous glass or mineral fibreboard insulation.
- .2 K value maximum 0.035 W/m/°C at 24°C.
- .3 Factory applied reinforced aluminum foil vapour barrier for cold ducts.
- .4 Service Temperature:
 - .1 Hot Duct Service Temperature: 20°C to 65°C.
 - .2 Cold Duct Service Temperature: -40°C to 65°C.

- .2 Round Ducts and Concealed Rectangular Ducts:

- .1 Flexible fibrous glass or mineral fibre insulation.
- .2 K value maximum 0.035 W/m/°C at 24°C.
- .3 Factory applied reinforced aluminum foil vapour barrier for cold ducts.
- .4 Service Temperature:
 - .1 Hot Duct Service Temperature: 20°C to 65°C.
 - .2 Cold Duct Service Temperature: -40°C to 65°C.

2.04 BREECHING INSULATION

- .1 Breeching Insulation:

- .1 Semi-rigid mineral fibre insulation with glass mat.
- .2 K value 0.035 W/m/°C maximum at 24°C.
- .3 Service temperature 65°C to 450°C.

- .2 Aluminum:
 - .1 To ASTM B209 with moisture barrier.
 - .2 Thickness: 25mm
 - .1 Ductwork: 0.508 mm sheet.
 - .2 Breeching: 1.016 mm sheet.
 - .3 Finish: Smooth
 - .4 Jacket banding and mechanical seals: 13 mm wide, 0.508 mm thick stainless steel.

2.05 ACCESSORIES

- .1 Vapour retarder lap adhesive:
 - .1 Water based, fire retardant type, compatible with insulation.
- .2 Indoor Vapour Retarder Finish:
 - .1 Vinyl emulsion type acrylic, compatible with insulation.
- .3 Insulating Cement: hydraulic setting on mineral wool, to ASTM C449.
- .4 Outdoor Vapour Retarder Mastic:
 - .1 Vinyl emulsion type acrylic, compatible with insulation.
 - .2 Reinforcing fabric: Fibrous glass, untreated 305 g/m².
- .5 Tape: self-adhesive, aluminum, reinforced, 50 mm wide minimum.
- .6 Contact adhesive: quick-setting.
- .7 Canvas adhesive: washable.
- .8 Tie wire: 1.5 mm stainless steel.
- .9 Banding: 13 mm wide, 0.508 mm thick stainless steel.
- .10 Facing: 25 mm stainless galvanized steel hexagonal wire mesh stitched on one face of insulation.
- .11 Fasteners: 4 mm diameter pins with 35 mm diameter square clips, length to suit thickness of insulation.

3. EXECUTION

3.01 PREPARATION

- .1 Do not install covering before ductwork and equipment has been tested and approved.
- .2 Verify that surface is clean and dry prior to installation.
- .3 Verify that insulation is dry before and during application.
- .4 Finish with systems at operating conditions, where possible.

3.02 INSTALLATION

- .1 Install insulation and recovery jacket in accordance with TIAC National Standards, manufacturers written instructions and requirements of this specification.

- .2 Install insulation so that it is continuous through inside walls; pack around ducts with fireproof self-supporting insulation material, properly sealed in accordance with Section 07 84 00.
- .3 Finish insulation neatly at hangers, supports and other protrusions.
- .4 Do not insulate ductwork with external thermal insulation where acoustic duct insulation is specified or indicated.
- .5 Locate insulation or cover seams in least visible locations; locate seams on ductwork in ceiling spaces on the underside of the duct.
- .6 Provide recovery jackets on exposed insulation throughout, including equipment rooms:
 - .1 Insulation located in crawl spaces, shafts and suspended ceiling spaces is not considered exposed.
 - .2 Make smooth any uneven insulated surface before recovery jacket installation.
- .7 Cover insulation exposed to outdoors with stainless steel jacket secured with stainless steel bands on 200 mm centres:
 - .1 Longitudinal slip joints: lap circumferential joints 75 mm minimum and seal all joints with compatible waterproof lap cement.
- .8 Exposed Rectangular Ducts:
 - .1 Secure rigid insulation with galvanized anchors, or weld pins on 400 mm centres.
 - .2 Secure in place with retaining clips.
 - .3 Seal all insulation joints and breaks with joint tape.
 - .4 Use vapour barrier tape for insulation joints or breaks on cold ducts.
- .9 Round Ducts and Concealed Rectangular Ducts:
 - .1 Adhere flexible insulation to ductwork with adhesive applied in 150 mm wide strips on 400 mm centres.
 - .2 Provide annealed tie wire tied at 400 mm centres for securing duct insulation.
 - .3 Butt insulation and seal joints and breaks with lap seal adhesive; cover joints with joint tape.
 - .4 Use vapour barrier tape for cold ducts.
- .10 Breeching Insulation:
 - .1 Face breeching with 10 mm rib lath turn out to provide 13 mm space between insulation and hot surface and 13 mm mesh expanded lath on the outside.
 - .2 Butt blankets firmly together and secure with 1.519 mm galvanized wire.
 - .3 Lace metal mesh together.
 - .4 Coat with 13 mm thick insulating cement.
 - .5 Finish with a final 13 mm coat of insulating cement.
 - .6 Trowel to a smooth hard finish.
 - .7 Recover with aluminum jacket.
- .11 Fasten stainless aluminum recovery jacket in place with stainless steel banding on 200 mm centres or screws or rivets on 150 mm centres; longitudinal slip joints and 50 mm lap joints.

3.03 INSULATION INSTALLATION THICKNESS SCHEDULE

Insulation Duct and Equipment	Insulation Thickness	Jacket
Combustion Air and Relief Duct	50 mm	Canvas
Exhaust Ducts within 3 m of Exterior Walls or Openings	25 mm	Canvas
Outside Air Intake Ducts	50 mm	Canvas
Plenums (Heating Systems)	50 mm	–
Supply Ducts Ventilation Systems	25 mm	Canvas
Ventilation Equipment Casings	25 mm	Canvas
Indirect gas fired air handling units breeching	25 mm	Aluminum
Ventilation equipment	50 mm	Canvas

END OF SECTION

1. GENERAL

1.01 SUMMARY

- .1 Provide a small scale EMCS control system for HVAC consisting of the following:
 - .1 Complete system of automatic controls
 - .2 EMCS based control panels and sensors
 - .3 Control devices, components, wiring and material
 - .4 Instructions to Owner
 - .5 Other components and accessories required for a complete and functional installation.

1.02 RELATED REQUIREMENTS

- .1 Section 25 90 00 – Sequence of Operations for HVAC Controls
- .2 Section 25 09 00 – Instrumentation and Control Devices for Mechanical Systems.
- .3 Section 25 06 00 – Schedules for Integrated Automation.
- .4 Division 26 – Electrical, and Interface

1.03 SUBMITTALS

- .1 Provide required information in accordance with Section 01 00 06 – General Requirements: Submittals.
- .2 Submit shop drawings in accordance with Division 1.
- .3 Include complete operating data, component setpoints, system drawings, wiring diagrams, electrical control schematics, written detailed sequences of operation and Consultant data on each control system component. Include sizing as requested.
- .4 Label components on drawings and identify as to function.
- .5 Control components referenced to multiple systems or drawings to include page and point reference.

1.04 QUALITY ASSURANCE

- .1 Supply and install the complete system of automatic controls for mechanical systems by firms employing certified journeymen who specialize in this type of work and having proof of completing projects of similar size and complexity.
- .2 Provide equipment of one manufacturer and installed by certified mechanics and electricians regularly employed by the manufacturer.

1.05 OWNER ORIENTATION

- .1 At completion of installation, provide minimum of one day instruction period for operating personnel.

1.06 WARRANTY

- .1 Include warranty provisions identified in Section 20 05 00 – Common Work Results for Mechanical and Division 1.

1.07 SYSTEM ACTIVATION

- .1 Submit control component calibration check sheets prior to system acceptance. The check sheets to include sensor and controller calibration and equipment tag numbers.
- .2 In addition to service required for call backs, the controls manufacturer to provide two (2) complete inspections; one in heating and one in cooling season.
- .3 Adjust control system as required; submit written reports to the Consultant.

2. PRODUCTS**2.01 MANUFACTURERS**

- .1 Acceptable Materials Manufacturers: Subject to compliance with requirements specified in this Section; where multiple listings of manufacturers occur, use any of the following listed manufacturers' products in accordance with Section 01 00 06 – General Requirements: Substitutions and Product Options including the following:
 - .1 Delta Controls, installed by ESC Automation
 - .2 Johnson Controls Metasys, installed by Johnson Controls
 - .3 Reliable Controls, installed by Serv-All Mechanical

2.02 CONTROL SYSTEM DESIGN

- .1 Provide system components consisting of thermostats, control valves, dampers, operators, indicating devices, interface equipment and other apparatus required to operating mechanical system and to perform functions specified.
- .2 Control system shall be BACNet IP compatible to allow connection to BACNet devices.
- .3 Provide 10% spare point capacity in each remote control unit (RCU). Minimum communication rate shall be 38.4 kbps.
- .4 Provide materials and work necessary to connect control components. Unless specified otherwise, self-contained valves, filter gauges, liquid level controllers and similar instruments are not supplied or installed by this section.
- .5 Provide wire and wiring devices required for complete automatic temperature control system.
- .6 Provide all labour and materials including wiring, conduit boxes, relays, required to connect electrical control parts for mechanical equipment and leave in operating condition.
- .7 Conform to Canadian Electrical Code and other authorities having jurisdiction. Pay all permits and conform to Division 26 – Electrical specification for conduit requirements.
- .8 Coordinate motor, starter, switch and thermostat locations with electrical work.
- .7 All wiring to be installed in conduit.
- .8 Laminated, permanently installed I/O lists shall be secured to all EMCS panels.
- .9 The City of Edmonton will provide a data connection to the Transit Center Mechanical Room.
- .10 The CCU shall be connected to the City of Edmonton network system, via Ethernet, as follows:
 - .1 Delta sites will connect to the existing City owned server (CHIAJCS81). ESC Automation will be required to enter the server addressing and networking numbers into the site DSM RTR and Building Maintenance Services will enter the new site's addressing into the Server DSM RTR.

- .2 Metasys sites will connect to the existing City owned ADX server (CHIAJCS82) and must be programmed to reside on that server recognizing the ADX server as the site director.
- .3 Reliable Controls sites will be connected to the City server COEIRWV1 over IP connection. Serv-all mechanical will provide the license for adding the site to Webview and the cost of the license will be included in the tender price.

- .11 Provide dynamic color graphics with system representations including schematics, point information, and actual values.

2.03 THERMOSTATS

- .1 Provide room sensor with blank cover plate only for DDC sensors.
- .2 Line voltage thermostats to have temperature scale and manual adjustment.
- .3 Freeze protection thermostats: Manual reset type with 6 m element. Provide multiple thermostats for large duct cross-sectional areas.
- .6 Provide remote bulb elements of either averaging type of suitable length for air or rigid bulb type for liquids.

2.04 CONTROL VALVES

- .1 Provide 2-way and 3 way control valves with modulating operation, low voltage 24 VAC, fail safe. Control valves shall fail open.
- .2 Acceptable material: Belimo.

2.05 CONTROL PANELS

- .1 Provide local panels of unitized cabinet type for each system under automatic control. Mount relays and controllers with control point adjustment in cabinet and temperature indicators, pilot lights, pushbuttons and switches flush on cabinet panel face.
- .2 Provide general purpose panels with utility enclosures having an enamelled finished face panel and CSA approval for line voltage applications and panel assembly.
- .3 Mount panels adjacent to associated equipment on vibration free walls or free standing angle iron supports. One cabinet may accommodate more than one system in same equipment room. Provide engraved plastic nameplates for instruments and controls inside cabinet and engraved lamicoid nameplates on cabinet face.

3. EXECUTION

3.01 INPUT/OUTPUT DESIGNATIONS

- .1 Analog Input Sensors (AI):

TEMPERATURE				
Application	Type	Operating Range	End to End Accuracy	Remarks
Duct Mounted	Tp	0°C to 60°C	±0.3°C	
Pipe Well Mounted	Tw	0°C to 50°C 0°C to 100°C 50°C to 150°C	±0.2°C ±0.5°C ±0.5°C	With thermal wells

TEMPERATURE				
Application	Type	Operating Range	End to End Accuracy	Remarks
Averaging	Ta	-30°C to 60°C	±0.5°C	Length to suit duct side
Space Temp.	Tr	10°C to 301°C	±0.3°C	With tamperproof cover
Outside Air	To	-50°C to 50°C	±0.5°C	With solar shield
Surface Temp	Ts	-0°C to 50°C	±0.3°C	

RELATIVE HUMIDITY				
Application	Type	Operating Range	End to End Accuracy	Remarks
Duct Mounted	Hp	5 - 90% RH 0°C to 60°C	±3%	
Space	Hr	5 - 90% RH	±5%	With tamperproof cover
Outside air	Ho	5 - 100% RH	±5%	With solar shield
Acceptable Materials: Hy-Cal, General Eastern				

PRESSURE				
Application	Type	Operating Range	End to End Accuracy	Remarks
Static-water	Ps	0 to 104 kPa	±3%	
		0 to 208 kPa	±3%	
		0 to 689 kPa	±3%	
		0 to 2,000 kPa	±3%	
Static-air	Sp	0 to 500 Pa	±2%	
		0 to 1,250 Pa	±2%	
		0 to 2,500 Pa	±2%	
Instrument	Ia	0 to 120 kPa	±2%	
Velocity pressure monitoring station (water, steam)	Pv	As required	±2.0%	Annubar or orifice plate full scale
Acceptable Materials for Sp and Vp Sensors: Modus, Setra				

ELECTRICAL				
Application	Type	Operating Range	End to End Accuracy	Remarks
Watt Meters	Kw	110/208 V 347V 600V	±0.25%	3 current transformers full scale 2 potential transformers as applicable for "Y" or "D" configuration
Current transformers	Ct	As required	±0.25% full scale	
Acceptable Materials for Sp and Vp Sensors: Modus, Setra				

.2 Analog Output Sensors (AO):

Application	Type	Operating Range	End to End Accuracy	Remarks
To damper motors	Dm	0 – 10 VDC 4-20 MA	±2% full scale	
To valve actuators	Vm	0 – 10 VDC 4 – 20 MA	±1% full scale	

.3 Digital Input Sensors (DI):

Application	Type	Operating Range	End to End Accuracy	Remarks
Pressure Switches	Pd	As required	±1.5% full scale	Adjustable set point and differential Automatic reset
Temperature	Td	As required	±1°C	Adjustable set point and differential Automatic reset Normal reset for freeze protection
Current Sensing Relays	Ri	As required	N/A	Adjustable trip With LED status indication
Motor Status Relays	St	As required	N/A	Auxiliary contacts
Level	Ls	N/A	N/A	Pressure range suitable to application
Motion	Md			Passive Infrared Sentorl Series 6147

.4 Digital Output Sensors (DO):

Application	Type	Operating Range	End to End Accuracy	Remarks
Relays	Ry	N/A	N/A	Double voltage DPDT plug-in type with terminal base contacts rated at 5 amp 120 VAC

3.02 POINT SCHEDULE SUMMARY

.1 Refer to Section 25 06 00 – Schedules for Integrated Automation.

3.03 INSTALLATION

.1 Verify location of thermostats and other exposed control sensors with plans and room details before installation. Locate thermostats 1525 mm above floor.

.3 Install “hand-of-auto” selector switches such that only automatic interlock controls and safety controls and electrical overcurrent protection will override when switch is in the “hand” position.

END OF SECTION

1. GENERAL**1.01 SUMMARY**

- .1 This Section includes requirements for supply and installation of the following:
 - .1 Supply, return and exhaust ductwork
 - .2 Fasteners
 - .3 Sealants
 - .4 Duct cleanliness
 - .5 Built-up plenum
 - .6 Flexible ductwork

1.02 RELATED REQUIREMENTS

- .1 Section 07 84 00 – Firestopping: Firestop and smoke seal design requirements and materials.
- .2 Section 20 05 93.13 – Testing of Mechanical Materials
- .3 Section 20 05 93.19 – Balancing of Mechanical Systems
- .4 Section 23 01 30 – HVAC Duct Cleaning
- .5 Section 23 05 29 – Hangers and Supports for HVAC Ducting and Equipment
- .6 Section 23 07 13 – Duct Insulation
- .7 Section 23 33 00 – Air Duct Accessories
- .8 Section 23 37 13 – Diffusers, Registers and Grilles

1.03 REFERENCE STANDARDS

- .1 Air Diffusion Council (ADC):
 - .1 Flexible Duct Performance and Installation Standards.
- .2 American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE):
 - .1 Duct Fitting Database, 2002.
 - .2 2003 ASHRAE Handbook – HVAC Applications.
- .3 American Society for Testing and Materials (ASTM):
 - .1 ASTM A36/A36M-05, Standard Specification for Carbon Structural Steel.
 - .2 ASTM A167-99 (2004), Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
 - .3 ASTM A635/A635M-05, Standard Specification for Steel, Sheet and Strip, Heavy-Thickness Coils, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, and High-Strength Low-Alloy with Improved Formability, General Requirements.
 - .4 ASTM A653/A653M-05, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - .5 ASTM B209/B209M-04, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric).
 - .6 ASTM B221/B221M-05, Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
 - .7 ASTM E488-96 (2003), Standard Test Methods for Strength of Anchors in Concrete and Masonry Elements.

- .4 National Fire Protection Association (NFPA):
 - .1 NFPA 90A-2002, Standard for the Installation of Air-Conditioning and Ventilating Systems.
 - .2 NFPA 90B-2005, Standard for the Installation of Warm Air Heating and Air Conditioning Systems.
- .5 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA):
 - .1 SMACNA HVAC Duct Construction Standards - Metal and Flexible, 1995, 2nd Edition and Addendum No. 1, 1997.
 - .2 SMACNA HVAC Air Duct Leakage Test Manual, 1985, 1st Edition.
- .6 Underwriters Laboratories of Canada (ULC):
 - .1 CAN/ULC S110-M86, Standard Methods of Test for Air Ducts.
- .7 Underwriters Laboratories Inc. (UL):
 - .1 UL 181-2005, Standard for Factory-Made Air Ducts and Air Connectors.

1.04 DEFINITIONS

- .1 The following definitions apply to the Ductwork specification:
- .2 Low Pressure: Static pressure in duct less than 500 Pa and velocities less than 10 m/s.
- .3 Medium Pressure: Static pressure in duct less than 1500 Pa and velocities greater than 10 m/s.
- .4 High Pressure: Static pressure over 1500 Pa and less than 2500 Pa and velocities greater than 10 m/s.
- .5 Inside Clear Dimensions: Duct sizes shown on Drawings are inside clear dimensions; maintain inside duct sizes for acoustically lined or internally insulated ducts.

1.05 SUBSTITUTIONS

- .1 Materials other than the named products for the Project may be acceptable to the Consultant. Submit information in accordance with Section 01 00 06 – General Requirements: Substitutions and Product Options.
- .2 Obtain written acceptance from Consultant prior to making variations in duct configuration or sizes. Size alternatives using ASHRAE table for circular equivalents of rectangular ducts

1.06 QUALITY ASSURANCE

- .1 Supply and install ductwork meeting the requirements of NFPA 90A
- .2 Fabricate ductwork in accordance with SMACNA duct manuals and ASHRAE handbooks as a minimum where more stringent requirements are not identified in the contract documents.
- .3 Construct ductwork to meet duct leakage testing requirements specified in Section 20 05 93.13.
- .4 Alternatives to Indicated Duct Configurations and Sizes: Obtain written permission from Consultant prior to making and changes or variations in duct configuration or sizes; size alternatives using ASHRAE table for circular equivalents of rectangular ducts.

1.07 SUBMITTALS

- .1 Provide required information in accordance with Section 01 00 06 – General Requirements: Submittals.

1.08 PROJECT CONDITIONS

- .1 Field Measurements: Verify dimensions by field measurements before fabrication and indicate measurements on Shop Drawings; coordinate fabrication schedule with construction progress to avoid delaying the Work.

1.09 PRE-CONSTRUCTION MEETING

- .1 Arrange a pre-construction meeting with the Consultant, Contractor and affected Subcontractors on site.
- .2 Coordinate requirements for firestopping around ductwork on both sides of fire separations with Section 07 84 00; installed firestopping material must not distort duct; provide number of ductwork transits through fire rated construction and notify Section 07 84 00 when ductwork is ready for firestopping work.

1.10 COORDINATION

- .1 Coordinate actual locations of ductwork with Section 23 37 13 and to suit on site conditions; dimensions and locations indicated on Drawings are approximate only; actual locations shall align with adjacent architectural features and finishes as directed by the Consultant.

2. PRODUCTS**2.01 MATERIALS**

- .1 Waterproof Duct Coating:
 - .1 Primer:
 - .1 Primer meeting manufacturers requirements for substrates and in accordance with CGSB 37-GP-9M.
 - .2 Basis of Design Material: Bakor 910-01.
 - .2 Primary Membrane:
 - .1 Hot applied rubberized asphalt membrane meeting the requirements of CGSB 37.50.
 - .2 Basis of Design Material: Bakor 790-11.
 - .3 Fabric Reinforcement: Polyester fabric reinforcement for duct joints as recommended by manufacturer.
- .2 Firestopping:
 - .1 Provide 50 mm x 50 mm x 3 mm retaining angles ready for and firestops and smoke seals.
 - .2 Firestopping materials are specified in Section 07 84 00.
- .3 Galvanized Steel:
 - .1 Steel Sheet: Tension levelled, Forming Steel (FS) designation, Type A, Grade 230 in accordance with ASTM A653M.

- .2 Thickness: Minimum base metal thickness as noted for specific configuration or thicker as required to meet design loads.
- .3 Galvanizing Designation Z350 applied evenly to both sides.
- .4 Thickness, Fabrication and Reinforcement: to SMACNA requirements.

.4 Aluminum:

- .1 Ducts: Aluminum sheet, alloy 3003-H14 meeting the requirements of ASTM B209M.
- .2 Aluminum Connectors and Bar Stock: Extruded aluminum, alloy 6061-T6 meeting the requirements of ASTM B221M.
- .3 Thickness, Fabrication and Reinforcement: to SMACNA requirements.
- .4 Joints: to meet SMACNA requirements.

2.02 FASTENERS

- .1 Use rivets and bolts throughout; sheet metal screws accepted on low pressure ducts.
- .2 Rectangular Ducts:
 - .1 Fabricated ducts, fittings and specialties meeting SMACNA requirements.
 - .2 Transverse Joints: SMACNA Seal Class A and B.
 - .3 Fittings:
 - .1 Elbows: Smooth radius; minimum centreline radius 1.5 times the width of duct.
 - .2 Branches: Conical branch at 45° and 45° elbow.

2.03 BUILT-UP PLENUMS

- .1 Fabricate plenums and casings to configurations shown on Drawings.
- .2 Construct plenums of galvanized panels joined by standing seams on outside of casing riveted or bolted on approximately 300 mm centres.
- .3 Reinforce with suitable angles and provide diagonal bracing as required. Tightly fit at apparatus and caulk with sealant.
- .4 Reinforce door frames with steel angle tied to horizontal and vertical plenum supporting angles; install hinged access doors where shown, specified or where required for access to equipment for cleaning and inspection.
- .5 Fabricate fan plenums and plenums downstream of fan to match thickness of ducts.
- .6 Fabricate plenums between fan and upstream apparatus using 1.519 mm material.
- .7 Fabricate plenums between filters and upstream apparatus using 1.214 mm thick material.

3. EXECUTION

3.01 CONSTRUCTION

- .1 Construct ductwork from field measurements and not from plans and shop drawings exclusively; failure to do so will not constitute an extra to the Contract.
- .2 Complete metal ducts within themselves with no single partition between ducts; cross brace ducts for rigidity where width of duct exceeds 450 mm; open corners are not acceptable.
- .3 Lap metal ducts in direction of air flow; hammer down edges and slips to leave interior of duct smooth.

- .4 Construct ductwork using materials in thicknesses indicated; reinforced and sealed for pressure class indicated, and as follows:
 - .1 Increase duct size gradually, not exceeding 15° divergence wherever possible; do not exceed 30° divergence upstream of equipment; do not exceed 45° convergence downstream of equipment.
 - .2 Construct tees, bends and elbows with radius of not less than 1.5 times the width of duct on centreline; provide double wall air foil type turning vanes where turning radius is not possible and where rectangular elbows are specified; provide turning vanes of perforated metal type with fibreglass inside, where acoustical lining is provided.
- .5 Rigidly construct metal ducts with joints mechanically tight, substantially airtight, braced and stiffened so as not to breathe, rattle, vibrate or sag; caulk duct joints and connections using sealant as ducts are being assembled; seal seams on fresh air and exhaust ducts watertight with mastic or high velocity duct sealant.
- .6 Provide floor drains in fresh air and humidifier sections with deep seal traps.
- .7 Set plenum doors 150 mm above floor; arrange door swings so that fan static holds door in closed position.

3.02 DUCT SEALING

- .1 Seal all supply, return and exhaust duct joints, longitudinal as well as transverse, using the following:
 - .1 Low Pressure Ductwork:
 - .1 Slip Joints: Apply heavy brush-on high pressure duct sealant. Apply second application after the first application has completely dried out. Where metal clearance exceeds 1.519 mm use heavy mastic type sealant.
 - .2 Flanged Joints: Soft elastomer butyl or extruded form of sealant between flanges followed by an application of heavy brush-on high pressure duct sealant.
 - .3 Other Joints: Heavy mastic type sealant.
 - .2 Medium and High Pressure Ductwork: Combination of woven fabrics and sealing compound followed by an application of high pressure duct sealant.
- .2 Duct tapes as sealing method are not permitted.
- .3 Surfaces to receive sealant should be free from oil, dust, dirt, moisture, rust and other substances that inhibit or prevent bonding.
- .4 Prior to sealing all ductwork, demonstrate sealing of a section of each type of duct and obtain approval from the Consultant.
- .5 Do not insulate any section of the ductwork until it has been inspected and approved of duct sealant application.

3.03 INSTALLATION

- .1 Locate ducts with sufficient space around equipment to allow normal operation and maintenance activities.
- .2 Provide openings in ductwork where required to accommodate thermometers and controllers.
- .3 Provide pitot tube openings where required for testing of systems, including metal cap with spring device or screw to prevent air leakage; install insulation material inside a metal ring where openings are provided in insulated ductwork.

-
- .4 Interrupt duct linings at fire, balancing, backdraft and smoke dampers so as not to interfere with operation of devices; provide sheet metal edge protection over linings on both side of damper device.
 - .5 Shield ductwork from dust and construction material during construction; clean any ductwork found to be dirty at no extra cost to the Contract.
 - .6 Protect carbon steel ductwork exposed to weather by painting or coating with suitable weather resistant material.
 - .7 Install ducts associated with fans subject to forced vibration with flexible connections immediately adjacent to equipment, refer to Section 23 33 00.
 - .8 Do not use flexible duct to change direction.
 - .9 Provide a minimum of three (3) duct diameters of straight metal duct between box inlet and flexible connector.
 - .10 Connect diffusers or troffer boots to low pressure ducts with 300 mm maximum stretched length of flexible duct; hold in place with sealant, and strap or clamp.
 - .11 Prove that ductwork is substantially air tight before covering or concealing.
 - .12 Clean duct systems and force air at high velocity through duct to remove accumulated dust. To obtain sufficient air, clean half the system at a time. Protect equipment that may be harmed by excessive dirt with filters, or bypass during cleaning.
 - .13 Clean systems with power vacuum machines in accordance with Section 23 01 30.

END OF SECTION

1. GENERAL**1.01 SUMMARY**

- .1 Work in this section includes, but is not limited, to the following:
 - .1 Fire dampers
 - .2 Balancing dampers
 - .3 Flexible connections
 - .4 Backdraft dampers
 - .5 Test holes

1.02 RELATED REQUIREMENTS

- .1 Section 07 84 00 – Firestopping: Firestop and smoke-seal design requirements and materials.
- .2 Section 23 01 30 – HVAC Duct Cleaning
- .3 Section 23 31 00 – Ductwork
- .4 Section 23 05 29 – Hangers and Supports for HVAC Ducting and Equipment

1.03 REFERENCE STANDARDS

- .1 National Fire Protection Association (NFPA):
 - .1 NFPA 90A-2002, Standard for the Installation of Air-Conditioning and Ventilating Systems.
- .2 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA):
 - .1 SMACNA HVAC Duct Construction Standards – Metal and Flexible, 1995, 2nd Edition and Addendum No. 1, 1997.
- .3 Underwriters Laboratories Canada (ULC):
 - .1 CAN/ULC S112-M90, Standard Method of Fire Test of Fire-Damper Assemblies.
 - .2 CAN/ULC S112.1-M90, Standard for Leakage Rated Dampers for Use in Smoke Control Systems.
 - .3 CAN/ULC S112.2-M84, Standard Method of Fire Test of Ceiling Firestop Flap Assemblies.
 - .4 ULC S505-1974, Fusible Links for Fire Protection Services.

1.04 QUALITY ASSURANCE

- .1 List and construct fire dampers in accordance with ULC S112.
- .2 Construct fusible links on fire dampers in accordance with ULC S505.
- .3 Demonstrate re-setting of fire dampers to Authorities Having Jurisdiction and City's representative.
- .4 Label fire rated access doors in accordance with ULC requirements.
- .5 Construct accessories to meet the requirements of NFPA 90A and fabricate in accordance with ASHRAE Handbooks and SMACNA Duct Manuals.

- .6 Prove all dampers to inspector at job completion.

1.05 SUBMITTALS

- .1 Provide required information in accordance with Section 01 00 06 – General Requirements: Submittals.
- .2 Submit shop drawings of factory fabricated assemblies.
- .3 Submit samples of shop fabricated assemblies as requested by the Consultant.
- .4 Submit product data for standard components including, but not limited to manufacturer's printed product literature, specifications and data sheet for the following items:
 - .1 Flexible connections
 - .2 Dampers
 - .3 Duct access doors
 - .4 Turning vanes
 - .5 Instrument test ports

1.06 PROJECT CLOSEOUT SUBMISSIONS

- .1 Provide operations and maintenance information in accordance with Section 01 00 06 – General Requirements: Closeout Submissions.

2. PRODUCTS

2.01 MANUFACTURERS

- .1 Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - .1 Access Doors:
 - .1 Ductmate Industries Inc.
 - .2 Kees Incorporated
 - .3 Nailor Industries Inc.
 - .2 Fire and Control Dampers:
 - .1 Aire Technologies Inc.
 - .2 Nailor Industries Inc.
 - .3 E.H. Price
 - .4 Ruskin Company

2.02 DUCT ACCESS DOORS

- .1 Fabricate rigid and close-fitting doors of galvanized steel with sealing gaskets and suitable quick fastening locking devices:
 - .1 Duct access panels with screws are not acceptable.
 - .2 Install minimum 25 mm thick insulation with suitable sheet metal cover frame for insulated ductwork.
- .2 Fabricated with two butt hinges and two sash locks for sizes up to 450 mm, two hinges and two compression latches with outside and inside handles for sizes up to 610 mm x 1220 mm and an additional hinge for larger sizes.

2.03 FIRE DAMPERS

- .1 Fabricate of galvanized steel or prime coated black steel weighted to close and lock in closed position when released by fusible link.
- .2 Provide curtain type fire dampers with damper blades retained out of air stream in a recess so that free area of connecting ductwork is not reduced.
- .3 Set fusible links to activate at 160°C.

2.04 FIRE STOP FLAPS

- .1 Fabricate of heat retardant fabric in galvanized or prime coated black steel frame, spring loaded action to close and lock in closed position when released by fusible link.
- .2 Blanket shall be retained in a recess so free area of connecting ductwork is not reduced.
- .3 Set fusible links to activate at 160°C.

2.05 BALANCING DAMPERS

- .1 Fabricate of galvanized steel, minimum 1.519 mm core metal thickness; full blade length shafts of hollow square construction with blades rigidly fastened along entire blade length.
- .2 Lockable quadrant type operating mechanism with end bearings on accessible rectangular ducts up to 400 mm deep and on accessible round ducts.
- .3 Wide pitch screw operating mechanism with crank operator and end bearings on accessible rectangular ducts 425 mm and over in depth and on all inaccessible rectangular and round ducts.
- .4 On rectangular ducts up to 275 mm deep construct of single blade (butterfly) type.
- .5 On rectangular ducts 300 mm to 400 mm deep construct of two opposed blades mechanically interlocked with pivots at quarter points.
- .6 On rectangular ducts over 425 mm deep construct of multiple opposed blades, mechanically interlocked with blades no greater than 200 mm deep and pivots equally spaced.
- .7 On round ducts construct of single blade (butterfly) type. On 500 Pa Class and on all dampers over 300 mm diameter fabricate with full blade-length shaft.
- .8 Construct damper blades for medium and high pressure systems to block air passage 70% maximum. Provide complete with locking type handles.
- .9 Provide over-ride limiting stops on all operating mechanisms.
- .10 Identify the air flow direction and blade rotation and open and close positions on operating mechanism.
- .11 On round ductwork, install operating mechanism on a steel mounted base firmly secured to the ductwork.
- .12 On externally insulated ductwork, install operating mechanisms on a steel bridge type mounting base to permit continuity of insulation under the mechanism.

2.06 FLEXIBLE CONNECTIONS

- .1 Fabricate of ULC approved neoprene coated flameproof glass fabric approximately 150 mm wide tightly crimped into metal edging strip and attached to ducting and equipment by screws or bolts at 150 mm intervals. Flexible connection airtight at 500 Pa.

2.07 BACKDRAFT DAMPERS

- .1 Construct of minimum 1.214 mm core metal thickness galvanized steel channel frame.
- .2 Construct of minimum 0.635 mm aluminum blades, having stiffeners along trailing edge; fabricate single blade dampers for duct sizes less than or equal to 240 mm, multi-blade dampers for ducts greater than 240 mm.
- .3 Provide full blade-length shafts complete with brass or nylon bearings.
- .4 Provide neoprene anti-clatter blade strips on pivot side of blades.
- .5 Construct blade connecting linkage of minimum 2.00 mm aluminum rod with eyelet, pin bearings, and adjustable counter weight to assist blade opening action.
- .6 Maximum blade length of 750 mm.
- .7 Backdraft damper suitable for 10 m/s face velocity.

3. EXECUTION**3.01 APPLICATION**

- .1 Provide access door minimum 450 mm x 350 mm x 50 mm smaller than duct dimension for cleaning and inspection at positions indicated by drawings and as follows:
 - .1 At 6.0 m intervals on all horizontal ducts.
 - .2 At 12.0 m intervals in all vertical duct systems.
 - .3 At the base of all duct risers.
 - .4 Both sides of turning vanes in all ducts.
 - .5 At each fire damper location.
 - .6 At each side of all heating or cooling coils.
 - .7 At all locations of internally duct mounted devices including automatic dampers, damper motors, duct mounted smoke detectors and heat detectors, and control sensors and devices.
- .2 Provide 100 mm x 100 mm quick opening access doors within ductwork for inspection of all balancing dampers.
- .3 Provide fire dampers at locations shown, where ducts and outlets pass through fire rated components, and where required by authorities having jurisdiction. Fire dampers shall be complete with required perimeter mounting angles, sleeves, breakaway duct connections, corrosion resistant springs, bearings, bushings and hinges.
- .4 Seal opening around duct at each point where ducts pass through partitions with non-combustible material with the exception of fire dampered ductwork.
- .5 Provide balancing dampers at points on low pressure supply, return and exhaust systems where branches are taken from larger ducts.

- .6 Provide balancing dampers on medium and high pressure systems where indicated. Splitter dampers shall not be used on medium and high pressure system.
- .7 Install ducts associated with fans and equipment subject to forced vibration with flexible connections, immediately adjacent to equipment and/or where indicated on drawing.
- .8 Install 15 mm thick neoprene pad over fabric and hold in place with additional metal straps for connections to medium and high pressure fans.
- .9 Leave all fire dampers and fire stop flaps in the closed position for balancing contractor to fix open.
- .10 Support ceiling fire stops from the structure above the fire stop and not from air outlets on associated ductwork.

END OF SECTION

1. GENERAL**1.01 SUMMARY**

- .1 This Section includes requirements for supply and installation of the following:
 - .1 Centrifugal Fans
 - .2 Axial Fans
 - .3 Bathroom Exhaust Fans
 - .4 Fan Accessories
 - .5 Roof Curbs

1.02 RELATED REQUIREMENTS

- .1 Section 20 05 48 – Noise and Vibration Control
- .2 Section 23 01 30 – HVAC Duct Cleaning
- .3 Section 23 05 29 – Hangers and Supports for HVAC Piping and Equipment
- .4 Section 23 31 00 – Ductwork
- .5 Section 23 33 00 – Air Duct Accessories

1.03 REFERENCE STANDARDS

- .1 Air Conditioning and Mechanical Contractors (AMCA):
 - .1 AMCA Publication 99-2003, Standards Handbook.
 - .2 AMCA 300-1996, Reverberant Room Method for Sound Testing of Fans.
 - .3 AMCA 301-1990, Methods for Calculating Fan Sound Ratings from Laboratory Test Data.
- .2 American National Standards Institute (ANSI)/American Society of Mechanical Engineers (ASME).
 - .1 ANSI/AMCA 210-1999, Laboratory Methods of Testing Fans for Aerodynamic Performance Rating

1.04 QUALITY ASSURANCE

- .1 Conform to AMCA Bulletins regarding construction and testing; label fans with AMCA certified rating seal for performance and sound ratings; label fans with CSA conformance tag.

1.05 SUBMITTALS

- .1 Provide required information in accordance with Section 01 00 06 – General Requirements: Submittals.
- .2 Submit with shop drawings acoustical data and fan curves showing fan performance with fan and system operating point plotted on curves.
- .3 Submit manufacturer's printed product literature, specifications and datasheet in indicating product characteristics, performance criteria, and limitations.
- .4 Submit shop drawings and product data indicating, but not limited to, the following:
 - .1 Fan performance curves showing point of operation, kW and efficiency.
 - .2 Sound rating data at point of operation.
 - .3 Motors, sheaves, bearings, shaft details.

.4 Minimum performance achievable.

.5 Submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

1.06 PROJECT CLOSEOUT SUBMISSIONS

.1 Provide operations and maintenance information in accordance with Section 01 00 06 – General Requirements: Closeout Submissions; Operations and Maintenance Data a list of manufacturer's recommended spare parts and specific information with regards to bearings and belts, addresses of suppliers, and a list of specialized tools necessary for adjusting, repairing or replacing components.

1.07 JOB CONDITIONS

.1 Do not operate fans for any purpose, temporary or permanent until ductwork is clean, filters are in place, bearings are lubricated and fan has been run under close supervision of unit manufacturer.

2. PRODUCTS

2.01 MANUFACTURERS

.1 Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

.1 Bathroom Exhaust Fans:

- .1 Acme Engineering and Manufacturing Corp.
- .2 Broan
- .3 General Electric
- .4 Greenheck Fan Corp.

2.02 MATERIALS, GENERAL

.1 Fans:

- .1 Statically and dynamically balance fans so no objectionable vibration or noise is transmitted to occupied areas of the building.
- .2 Provide balanced variable sheaves for motors 11.2 kW and under and fixed sheave for 15 kW and over.
- .3 Provide fans capable of accommodating static pressure variations of $\pm 10\%$ with no objectionable operating characteristics.
- .4 Provide cross linkage for inlet vanes on double inlet fan.

.2 Motors:

- .1 As specified and as further supplemented in this Section.
- .2 Size motors for parallel operating fans for non-overloading operation with only one fan operating.
- .3 Sizes as indicated.
- .4 Bearing lubrication systems plus extension lubrication tubes where bearings are not easily accessible.

.3 Vibration Isolation: As specified in Section 20 05 48.

.4 Flexible Connections: to Section 23 33 00 – Air Duct Accessories.

.5 Accessories and Hardware:

- .1 External static pressure means external to the fan cabinet and all accessories such as back draft dampers, mixing boxes, filters and coils; these accessories if supplied as part of the unit are considered as internal losses for fan.
- .2 Matched sets of V-belt drives, adjustable motor bases, belt guards, coupling guards fan inlet and outlet safety screens as indicated and as specified; inlet and outlet dampers and vanes and as indicated.
- .3 Supply replacement pulleys and sheaves for fans as required to properly balance the systems to design flows at actual job site static pressure conditions; obtain requirements from balancing agency, refer to Section 20 05 93.
- .4 Provide belt guards with tachometer holes.

.6 Scroll Casing Drains: as indicated.

.7 Finishes:

- .1 Factory primed before assembly in colour standard to manufacturer.

2.03 BATHROOM EXHAUST FANS

- .1 Provide multi-blade, forward curved wheel in steel housing for between stud mounting.
- .2 Resiliently mount direct driven fan and motor. Motor shall be plug-in type with permanently lubricated bearings.
- .3 Provide one-piece aluminum intake grille.

3. EXECUTION

3.01 INSTALLATION

- .1 Install fans in accordance with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.
- .2 Install fans as indicated including, but not limited to, resilient mountings specified in Section 20 05 48, flexible electrical leads and flexible connections as specified in Section 23 33 00.
- .3 Provide safety screen where inlet or outlet is exposed.
- .4 Provide belt guards on belt driven fans complete with tachometer access.
- .5 Provide sheaves as necessary for final air balancing.
- .6 Set roof mounted fans on curbs 200 mm minimum above roof; provide acoustic insulation on duct to below roof line and on fan inlet plenum, and drip pan for collecting condensation with drain line to nearest drain.
- .7 Provide 100 mm high housekeeping base for floor mounted units.

3.02 PRIMING

- .1 Prime coat fan wheels and housing factory inside and outside. Prime coating on aluminum parts is not required.
- .2 Provide two additional coats of paint on fans handling air downstream of humidifiers.

3.03 PERFORMANCE

- .1 Fan performance based on 600 m conditions.
- .2 Refer to Fan Schedule on Drawing M4.01.

END OF SECTION

1. GENERAL**1.01 SUMMARY**

- .1 Work for this section includes, but is not limited to, the following:
 - .1 Supply air diffusers, registers and grilles
 - .2 Return air grilles
 - .3 Exhaust air grilles
 - .4 Transfer grilles

1.02 RELATED REQUIREMENTS

- .1 Section 07 84 00 – Firestopping: Firestop and smoke seal requirements for diffusers, registers and grilles installed in fire rated construction.
- .2 Section 09 21 16 – Gypsum Board Assemblies: Coordination of grilles and diffuser installed into gypsum board ceilings and bulkheads.
- .3 Section 09 91 00 – Painting: Blackout painting for interior of ductwork before installation of diffusers, registers and grilles.
- .4 Section 23 01 30 – HVAC Duct Cleaning
- .5 Section 20 05 93.13 – Testing of Mechanical Materials
- .6 Section 20 05 93.19 – Balancing of Mechanical Systems
- .7 Section 23 31 00 – Ductwork
- .8 Section 23 33 00 – Air Duct Accessories

1.03 REFERENCE STANDARDS

- .1 Air-Conditioning and Refrigeration Institute (ARI):
 - .1 ARI 890-2001, Standard for Diffusers and Air Diffuser Assemblies.
- .2 American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE):
 - .1 ANSI/ASHRAE 70-1991, Method of Testing for Rating the Performance of Air Outlets and Inlets.

1.04 SUBMITTALS

- .1 Provide required information in accordance Section 01 00 06 – General Requirements: Submittals.
- .2 Submit manufacturer's printed product literature, specifications and datasheets including, but not limited to, the following:
 - .1 Product characteristics, performance criteria, and limitations.
 - .2 Identify each Product with tag numbers matching Drawings and Specifications.
 - .3 Capacity.
 - .4 Throw and terminal velocity.
 - .5 Noise criteria.
 - .6 Pressure drop.
 - .7 Neck velocity.
 - .8 Fire rating and approval agency.

- .3 Submit confirmation of performance requirements including, but not limited to, catalogued or published ratings for manufactured items: tests carried out by manufacturer or those ordered by manufacturer from independent testing agency signifying adherence to codes and standards.

1.05 PROJECT CLOSEOUT SUBMISSIONS

- .1 Provide keys required for volume control adjustment and airflow pattern adjustment in accordance with Section 01 00 06 – General Requirements: Closeout Submittals.

1.06 QUALITY ASSURANCE

- .1 Carry out airflow tests and noise measurements in accordance with applicable ASHRAE and ARI Standards, and label fire rated assemblies in accordance with the requirements of the Authorities Having Jurisdiction.

1.07 PRE-CONSTRUCTION MEETING

- .1 Arrange a pre-construction meeting with the Consultant, Contractor, Subcontractor responsible for this Section, and other subcontractors affected by work of this Section.
- .2 Agenda shall include, but not be limited to, the following:
 - .1 Requirements for roughing-in and supply of blocking, supports and reinforcements.
 - .2 Confirmation of measurements and configurations of Products supplied for Project.
 - .3 Confirmation of delivery schedules to allow Products of this Section to be incorporated into the work of other subcontractors.
 - .4 Confirmation of actual layout and location of diffusers, registers and grilles.

1.08 COORDINATION

- .1 Coordinate metric measure for diffusers, registers and grilles installed in suspended unit ceiling systems; examples of coordination are as follows:
 - .1 Supply imperial measure 24" x 24" units where 610 mm x 610 mm ceiling grid is indicated.
 - .2 Supply true metric measure 600 mm x 600 mm units where 600 mm x 600 mm ceiling grid is indicated.
- .2 Coordinate actual locations of diffusers, registers and grilles to suit on site conditions; dimensions and locations indicated on Drawings are approximate only; actual locations shall align with adjacent architectural features and finishes as directed by the Consultant.
- .3 Coordination of blank-off panels and requirements for concealed fasteners in diffusers, registers and grilles with architectural drawings; confirm location of blank-off panels and fastener types before ordering materials.

2. PRODUCTS

2.01 MANUFACTURERS

- .1 Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - .1 Grilles and Registers:
 - .1 E. H. Price Ltd.
 - .2 Krueger
 - .3 Nailor Industries Inc.
 - .4 Titus

2.02 MATERIALS

- .1 Provide supply outlet units having space noise level of NC 35 maximum and with sponge rubber seal around edges.
- .2 Provide baffles to direct air away from walls, columns or other obstructions within the radius of diffuser operation.
- .3 Provide frames for diffusers to complement surfaces they are being installed into (i.e.: plaster trim for plaster surfaces); provide continuous trims for linear products where possible; notify the Consultant where continuous trims are not achievable and obtain written confirmation of where joints will be acceptable.

2.03 MANUFACTURED UNITS

- .1 Refer to Diffuser, Register and Grille Schedule on Drawing for specifications of air outlets.
- .2 Provide diffusers, registers and grilles of same generic type, using products from one manufacturer; provide concealed fastenings in locations where diffusers, registers and grilles will be exposed in final construction.
- .3 Provide blank-off screens to diffusers, registers and grilles as indicated on Drawings and as directed by Consultant.

3. EXECUTION**3.01 PREPARATION**

- .1 Locations for diffusers, registers and grilles indicated on Drawings are not intended to be used as exact; confirm location of all outlets and inlets and adjust location to conform with adjacent architectural features, symmetry, lighting and communication devices.

3.02 INSTALLATION

- .1 Install diffusers, registers and grilles in accordance with manufacturers written requirements.
- .2 Install using stainless steel or cadmium plated screws in countersunk holes where fastenings are visible.
- .3 Fire Rated Construction:
 - .1 Provide fire dampers, collars, sleeves and perimeter angles as required to preserve integrity of fire separations where diffusers, registers and grilles installed in fire rated construction.
 - .2 Provide enclosures constructed of gypsum board having same type and thickness as ceiling to cover sides and tops of diffusers, registers and grilles mounted in ceilings that form part of a fire rated assembly.
 - .3 Protect inlet and outlet of diffusers, registers and grilles at the enclosure penetration with a fire stop flap.

3.03 SCHEDULE

- .1 Sizing: Provide size and configuration of diffusers, registers and grilles as indicated on Drawings.
- .2 Performance: Refer to Diffuser, Register and Grille Schedule on Drawings.

END OF SECTION

1. GENERAL

1.01 SUMMARY

- .1 Work in this section includes, but is not limited to, the following:
 - .1 Roof Hoods
 - .2 Goosenecks

1.02 RELATED REQUIREMENTS

- .1 Section 07 62 00 – Sheet Metal Flashing and Trim: Counter flashing requirements for louvers and vents installed in exterior construction.
- .2 Section 23 01 30 – HVAC Duct Cleaning
- .3 Section 20 05 93.13 – Testing of Mechanical Materials
- .4 Section 20 05 93.19 – Balancing of Mechanical Systems
- .5 Section 23 31 00 – Ductwork
- .6 Section 23 33 00 – Duct Accessories

1.03 REFERENCE STANDARDS

- .1 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA):
 - .1 SMACNA HVAC Duct Construction Standards – Metal and Flexible, 1995, 2nd Edition and Addendum No. 1, 1997.

1.04 SUBMITTALS

- .1 Provide required information in accordance with Section 01 00 06 – General Requirements: Submittals
- .2 Submit manufacturer's printed product literature, specifications and datasheets including, but not limited to, the following:
 - .1 Product characteristics, performance criteria, and limitations.
 - .2 Identify each Product with tag numbers matching Drawings and Specifications.
 - .3 Capacity.
 - .4 Noise criteria.
 - .5 Pressure drop.
 - .6 Water penetration.
- .3 Submit confirmation of performance requirements including, but not limited to, catalogued or published ratings for manufactured items: tests carried out by manufacturer or those ordered by manufacturer from independent testing agency signifying adherence to codes and standards.

1.05 QUALITY ASSURANCE

- .1 Use highest quality materials conforming to the appropriate ASTM and ANSI specifications.
- .2 Install using tradesmen licensed by authority having jurisdiction.
- .3 Where indicated, comply with, or otherwise be guided by, standards issued by SMACNA.
- .4 Louver shall bear AMCA seal for free area and water penetration.

2. PRODUCTS

2.01 MANUFACTURERS

- .1 Not applicable.

2.02 MATERIALS

- .1 Bird Screens: Wire diameter 2 mm, aluminum, formed U frame around perimeter.
- .2 Roof Hoods:
 - .1 Air inlet or exhaust hoods shall have removable hood, curb flange and bird screen with 15 mm square mesh.
 - .2 Fabricate of galvanized steel minimum 1.519 mm base and 0.912 mm hood or aluminum minimum 1.519 mm base and 1.214 mm hood; provide suitable reinforcing to hood; louvers shall be storm proof.
 - .3 Mount unit on minimum 300 mm high curb base with insulation between duct and curb.
 - .1 Maintain top height of roof hood to be at maximum level with the surrounding parapet.
- .3 Goose Necks:
 - .1 Fabricate goosenecks of minimum 1.214 mm galvanized steel.
 - .2 Mount on minimum 300 mm high curb base where size exceeds 225 mm x 225 mm.

3. EXECUTION

3.01 INSTALLATION

- .1 Flash and counter flash all openings in all exterior walls and roofs.
- .2 Install field or factory fabricated curbs under all roof mounted intakes and relief vents, of sufficient height for 350 mm clearance from roof to horizontal discharge on hoods.
- .3 Equip relief and exhausts with back draft dampers unless motorized dampers specified.
- .4 Provide blank-off panels for inactive portions of stationary louvers.

3.02 SIZING

- .1 Size roof hoods and goosenecks as indicated on Drawings.

END OF SECTION

1. GENERAL**1.01 SUMMARY**

.1 This Section includes requirements for:

- .1 Site fabricated breeching.
- .2 Manufactured vents and chimney for atmospheric gas fired equipment.
- .3 Manufactured chimneys for forced draft natural gas fired equipment.

1.02 RELATED REQUIREMENTS

.1 Section 23 52 43.16 – High Efficiency Condensing Boilers.

1.03 DEFINITIONS

.1 The following definitions apply to the Breechings, Chimneys and Stacks specification:

.2 Vent: Enclosed passageway for conveying flue gases from the appliances to outdoors.

.3 Breeching: Portion of vent extending from the appliance to the chimney.

.4 Chimney: Primarily vertical portion of vent.

.5 Draft: Flow of air or combustion products or both, through an appliance and its venting system produced as follows:

.6 Mechanical Draft: Draft produced by a mechanical device such as a fan, blower, or aspirator that may supplement natural draft.

.1 Forced Draft: Mechanical draft produced by a device upstream of the combustion zone of an appliance.

.2 Induced Draft: Mechanical draft produced by a device downstream from the combustion zone of an appliance.

.3 Natural Draft: Draft other than mechanical draft.

1.04 REFERENCE STANDARDS

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

.1 ASTM C401-91(2000), Standard Classification of Alumina and Alumina-Silicate Castable Refractories

.2 Canadian Standards Association (CSA):

.1 CAN/CSA B149.1-05, Natural Gas and Propane Installation Code

.3 Underwriters' Laboratories of Canada (ULC):

.1 CAN/ULC S604-M91, Standard for Factory-Built Type A Chimneys

.2 CAN/ULC S605-M91, Standard for Gas Vents

.3 CAN/ULC S629-M87, Standard for 6500C Factory-Built Chimneys

.4 ULC S641-00, Standard for Factory-Built Chimney Connectors and Wall Pass-Through Assemblies

1.05 SUBMITTALS

- .1 Provide required information in accordance with Section 01 00 06 – General Requirements: Submittals
- .2 Submit shop drawings and product data clearly indicating, but not limited to, the following:
 - .1 Methods of sealing sections.
 - .2 Methods of expansion.
 - .3 Details of thimbles.
 - .4 Bases/Foundations.
 - .5 Supports.
 - .6 Guy details.
 - .7 Rain caps.

1.06 CLOSEOUT SUBMISSIONS

- .1 Provide operations and maintenance information in accordance with Section 01 00 06 – General Requirements: Closeout Submissions.
- .2 Submit certificates of catalogued or published ratings obtained from tests carried out by independent testing agency or manufacturer signifying adherence to codes and standards.

1.07 QUALITY ASSURANCE

- .1 Comply with requirements of CSA B149.1 and B149.2 and all other referenced standards using only highest quality materials; use only products labelled by ULC as appropriate for intended service.
- .2 Use tradesmen licensed by authority having jurisdiction for the particular service.

2. PRODUCTS**2.01 VENTS**

- .1 Type B Vent: in accordance with CAN/ULC S605:
 - .1 Application: gas fired appliances certified with draft hoods or diverters.
 - .2 Service Temperature: maximum flue gas temperature of 243°C (470°F).

2.02 BREECHING

- .1 Breeching Type 1: for natural draft, gas burning appliances with draft hoods, use one of the following:
 - .1 Galvanized steel with thicknesses as follows:

Vent Diameter	Min. Thickness
Smaller than 127 mm (5")	0.4 mm (0.157")
127 mm (5") to 203 mm (8")	0.5 mm (0.0196")
Larger than 203 mm (8")	0.6 mm (0.0236")
 - .2 Breeching constructed of same vent components as chimney.

- .2 Breeching Type 2: for forced, induced, or natural draft with dilution, gas or liquid fuel fired appliances, use one of the following:

- .1 Mild steel, all welded construction with thicknesses as follows:

Vent Diameter	Min. Thickness
305 mm (12") and smaller	1.2 mm (0.0472")
325 mm (13") to 610 mm (24")	1.6 mm (.0629")
625 mm (25") to 900 mm (36")	2.0 mm (0. 0.787")
925 mm (37") and larger	3.0 mm (0.0.118")

- .2 Breeching constructed of same vent components as chimney.

2.03 ACCESSORIES

- .1 Cleanouts: bolted, gasketed type, full size of breeching area.

3. EXECUTION

3.01 VENT INSTALLATION

- .1 Install vents, complete with accessories and appurtenances, in accordance with CAN/CSA B149.1 Building Code, manufacturer's instructions and as follows:
- .2 Do not penetrate flue gas chamber of vent with screws or mechanical fasteners.
- .3 Install breeching with positive slope upward from appliance.
- .4 Suspend breeching using trapeze hangers at 1525 mm (60") centres.
- .5 Install cleanout at base of chimney.
- .6 Provide barometric damper as indicated.
- .7 Support chimney at bottom, roof and intermediate levels.
- .8 Install thimbles where penetrating roof, floor, ceiling and where breeching enter masonry chimney.
- .9 Install fly ash screen on all chimneys serving solid fuel fired appliances.
- .10 Install rain cap on chimney outlet.
- .11 Install counter flashing where chimneys pass through roof.
- .12 Provide for expansion and contraction of chimney and breeching.

END OF SECTION

1. GENERAL

1.01 SUMMARY

- .1 Provide complete high efficiency boiler, to circulate 50% propylene glycol, package including, but not limited to, the following components:
 - .1 Boilers.
 - .2 Controls and boiler trim.
 - .3 Hot water connections.
 - .4 Fuel connections.
 - .5 Electrical hook-up.
 - .6 Direct, concentric venting.

1.02 RELATED REQUIREMENTS

- .1 Section 20 05 00 – Common Work Results for Mechanical

1.03 REFERENCE STANDARDS

- .1 American Boiler Manufacturer's Association (ABMA)
- .2 American National Standards Institute (ANSI):
 - .1 CSA 4.9/ANSI Z21.13-2014, Gas-Fired Low-Pressure Steam and Hot Water Boilers
- .3 American Society of Heating, Refrigeration and Air Conditioning Engineers Inc. (ASHRAE):
 - .1 ASHRAE 90.1 2013 (SI Edition), Energy Standard for Buildings Except Low-Rise Residential Buildings
 - .2 ASHRAE 135-2012, BACnet-A Data Communication Protocol for Building Automation and Control Networks
- .4 American Society of Mechanical Engineers (ASME):
 - .1 ASME BPVC-IX-2015, Boiler and Pressure Vessel Code, Section IX: Welding and Brazing Qualifications
- .5 Canadian Standards Association (CSA):
 - .1 CSA B51-14, Boiler, Pressure Vessel, and Pressure Piping Code
 - .2 CSA B149.1-15, Natural Gas and Propane Installation Code
 - .3 CAN1-3.1-77 (R2006), Industrial and Commercial Gas-Fired Package Boilers

1.04 DESIGN REQUIREMENTS

- .1 Rating based on 650 m altitude.
- .2 Refer to boiler schedule on Drawings.

1.05 SUBMITTALS

- .1 Provide required information in accordance with Section 01 00 06 – General Requirements: Submittals.
- .2 Submit shop drawings indicating the following:
 - .1 General arrangement showing terminal points and instrumentation test connections.
 - .2 Clearances for operation, maintenance, servicing, tube cleaning, and tube replacement.

- .3 Foundations with loadings and anchor bolt arrangements.
- .4 Piping hook-ups.
- .5 Equipment electrical drawings.
- .6 Burners and controls.
- .7 Miscellaneous equipment.
- .8 Flame safety control system.
- .9 Breeching and stack configuration.

.3 Submit engineering indicating the following:

- .1 Boiler efficiency at 25%, 50%, 75%, and 100% of design capacity.
- .2 Radiant heat loss at 100% design capacity.

.4 Provide operations and maintenance information in accordance with Section 01 00 06 – General Requirements: Closeout Submittals; Operation and Maintenance Data.

1.06 QUALITY ASSURANCE

- .1 Comply with Provincial Regulations and identify units with appropriate CSA labelling.
- .2 Construct to applicable Section of ASME Code.
- .3 Provide factory tests to check construction, controls and operation of unit.
- .4 Boilers shall be guaranteed to operate at a minimum efficiency above 89% for the entire range of firing rate, 100% to 35%.
- .5 Boiler shall be suitable for continuous low water temperatures as low as 21°C.
- .6 The boiler pressure vessel shall be warranted against thermal stress cracking for a period of ten years from date of shipment. The warranty shall cover the boiler pressure vessel under all operating conditions.
- .7 The entire heat exchanger and burner shall carry a 3-year limited warranty. The heat exchanger shall also have a 10-year limited warranty against thermal shock.
- .8 The boiler shall be UL approved for installation on combustible floors without any additional parts or safety provisions.

2. PRODUCTS

2.01 MANUFACTURERS

- .1 Acceptable Materials Manufacturers: Subject to compliance with requirements specified in this Section; where multiple listings of manufacturers occur, use any of the following listed manufacturers' products in accordance with Section 20 05 03 – Mechanical Product Options and Substitutions including the following:
 - .1 Peerless
 - .2 Lochinvar-Intellifin
 - .3 Laars-Rheos
 - .4 Viessmann-Vertomat

2.02 TYPE

- .1 Provide high efficiency, direct vent, gas burning, copper tube hot water boiler, complete with gas burning system, controls and boiler trim.

- .2 The unit shall be factory assembled and fire-tested, requiring only connection to the water circulating system, fuel electric utilities and flue gas vent. Complete operating and maintenance instructions are to be furnished with the unit.

2.03 CONSTRUCTION

- .1 Burner: stainless steel, providing equal distribution of heat through the entire heat exchanger,
- .2 Heat Exchanger: stainless steel, inspected and tested to ASME Section IX requirements, maximum working pressure of 1100 kPa.
- .3 The heating boiler shall be direct vented as a Category II condensing appliance. All units shall utilize an approved stainless steel venting system and components for cold-start condensate.
- .4 Venting Options the following venting option shall be utilized: Concentric intake and exhaust through the roof.
- .5 Header castings: bronze.

2.04 TRIM

- .1 Provide ASME rated pressure relief valve. Coordinate pressure setting with boiler manufacturer.
- .2 Provide low water cut-off and flow switch to automatically prevent burner operation when water falls below safe level or when there is no flow through boiler.
- .3 Limit temperature controller with automatic reset shall control burner to prevent boiler water temperature from exceeding safe system temperature.
- .4 Provide temperature and pressure gauge integral with unit.

2.05 FUEL BURNING SYSTEM

- .1 Gas burner shall be fully modulating with electric ignition and gas pressure regulator.
- .2 The burner shall operate as fully modulating down to a minimum 35% of the heating load. Light off shall be at no more than 50% input to assure rumble free soft start.
- .3 The gas train shall consist of a gas valve with a pressure regulating electro-hydraulic actuator to provide slow opening, fast closing, safety shutoff and air/gas ratio control. A factory pre-set combination metering valve and orifice shall be provided for setting combustion parameters.
- .4 The ignition module shall employ a proved igniter with 3 tries for ignition followed by lockout. Trial for ignition shall be 10 seconds with 15 seconds between retrieals.
- .5 The combustion chamber shall be fully enclosed by a stainless-steel chamber inside of which is assembled a cylindrical copper coil Heat Exchanger having a maximum allowable working pressure of 1100 kPa. An access door shall be provided for ease of service and inspection of the Heat Exchanger.

2.06 CONTROLS

- .1 Controls shall include an electronic proportional integrated combination limit/operator control accurate to 0.5°C having a 4-20 mA output signal suitable for control of a variable frequency motor drive.

- .2 The control shall also provide readouts of boiler target, differential and inlet/outlet temperatures, percentage of boiler fire, as well as accumulated runtime. On/off switch, and full diagnostic light package shall be provided. The complete control package shall be mounted on the front panel with hinged door for easy access to all control modules.
- .3 All wiring between the panel and the boiler control and alarm device shall be the responsibility of the boiler supplier.
- .4 Provide terminal strip with contacts to monitor boiler status on the BMS.
- .5 Provide factory condensate neutralization unit with granular limestone supply.

2.07 CONTROLS COMMUNICATION PROTOCOL

- .1 Description: Electronic controls packaged with this equipment are required to communicate with the building Direct Digital Control (DDC) system as follows:
 - .1 DDC system must communicate with these controls to read the information and change the control set points as shown in the points list, sequences of operation, and control schematics.
 - .2 Information communicated between the DDC system and these controls must be in the standard object format defined in ASHRAE 135.
 - .3 Controllers must communicate with other BACnet objects on the internetwork using the Read (Execute) Property service as defined in Clause 15.5 of ASHRAE 135.
- .2 Distributed Processing: Controller must be capable of standalone operation and shall continue to provide control functions without being connected to the network.
- .3 I/O Capacity: Controller must contain sufficient I/O capacity to control the target system.
- .4 Communication: Controller must reside on a BACnet network using the MS/TP Data Link/Physical layer protocol; each network of controllers shall be connected to one building controller and as follows:
 - .1 Controller shall have a BACnet Data Link/Physical layer compatible connection for a laptop computer or a portable operator's tool.
- .5 Environment: Hardware must be suitable for anticipated ambient conditions and as follows:
 - .1 Controllers used outdoors and/or in wet ambient conditions shall be mounted within waterproof enclosures and shall be rated for operation at -40°C to 65°C (-40°F to 150°F).
 - .2 Controllers used in conditioned space shall be mounted in dust-proof enclosures and shall be rated for operation at 0°C to 50°C (32°F to 120°F).
- .6 Serviceability: Provide diagnostic LEDs for power, communication, and processor using field-removable wiring connections and modular terminal strips or to a termination card connected by a ribbon cable.
- .7 Memory: Provide controller that maintain all BIOS and programming information in the event of a power loss for at least 90 days.
- .8 Immunity to Power and Noise: Provide controller able to operate at 90% to 110% of nominal voltage rating and perform an orderly shutdown below 80%; protect operation against electrical noise of 5 to 120 Hz and from keyed radios up to 5 W at 1 m (3 ft.).
- .9 Transformer: Power supply for the Controller must be rated at minimum of 125% of ASC power consumption and shall be fused or current limiting type.

3. EXECUTION

3.01 HOUSEKEEPING PADS

- .1 Mount boilers on 100 mm housekeeping pads.
- .2 Provide insulated base if mounted over imbedded conduit or occupied space.

3.02 CLOSEOUT ACTIVITIES

- .1 System Start-Up: Provide services of factory-trained personnel to conduct initial boiler start-up and boil out and as follows:
 - .1 Provide start-up service, make adjustments, test efficiency and instruct operators. Submit detailed start-up report.
 - .2 Provide services of factory trained representative for a period of 1 day to start up unit and train operators.
- .2 Controls Communications Protocol Start-up: Start-up, check-out, and test hardware and software and verify communication between all components as follows:
 - .1 Verify that control wiring is properly connected and free of shorts and ground faults, and verify that terminations are tight.
 - .2 Verify that analog and binary input/output points read properly.
 - .3 Verify alarms and interlocks.
 - .4 Verify operation of the integrated system.

END OF SECTION

1. GENERAL

1.01 SUMMARY

- .1 Gas Fired Radiant Heaters.

2. PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- .1 Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include; but are not limited to, the following:

- .1 Superior Radiant Products

2.02 GENERAL

- .1 Provide a CGA approved, natural gas, packaged radiant heating system, complete with hangers, thermostats, vent terminals, Stainless Steel flexible connectors, control panel and vacuum pump. Equipment must also conform to requirements of Provincial and Municipal codes.
- .2 Burner shall have a variable firing rate and a heat exchanger to match the specified firing rate.
- .3 Provide manufacturer's published warranty covering construction of units for a period of three (3) years.
- .4 Clearance to combustibles shall be as per manufacturer's recommendation.
- .5 System shall operate under negative pressure for maximum safety.

2.03 CONSTRUCTION

- .1 Units shall consist of:
 - .1 Electronic, spark or hot surface ignition module.
 - .2 Vacuum pump motor shall be totally enclosed, require no oiling, and shall be equipped with a thermal overload switch.
 - .3 Burner shall be equipped with a zero governor to balance fuel flow with combustion airflow regardless of vacuum draw.
 - .4 Burner controls and all burner operation components to be enclosed in a sealed welded, powder coated, burner housing to be enclosed in a sealed, welded, powder coated, burner housing.
 - .5 Burner colour: custom colour chosen by architectural during shop drawings
 - .6 Gas and electric controls to be separate from the combustion air stream.
 - .7 Gas valve shall include safety shut off, a manual valve, two magnetic operators and a standard gas pressure regulator.
 - .8 Combustion air shall be filtered by means of an air filter provided in each burner. Filter shall be replaceable without removing outside air connection. Outside air adapter and flue adapter to be standard equipment.
 - .9 Reflectors shall be of finished 1100 aluminum alloy, no less than 0.759 mm (22 gauge) thickness, and formed of eight to ten reflective sides. Reflectors shall extend no less than 60 mm below the lowest portion of the radiant tubes on each side for maximum control of radiant output and minimum convection loss. Couplings shall be aluminized steel 300 mm in length.
 - .10 Reflector shall be able to be mounted in a level altitude.
 - .11 Radiant tubing to be heat treated aluminized or hot rolled steel – 100 mm O.D., 1.519 mm (16 gauge), (CAL-20A 75 mm O.D. 1.519 mm (16 gauge)).

- .12 Units to be certified for use with stainless steel flexible gas connector, or ridged piping connection to gas distribution system.
- .13 Burner electrical rating not to exceed 120v, 60Hz, 0.2 A.
- .14 Unit to come with built in capability to operate with low voltage, thermostat control or with line voltage, thermostat control.
- .15 Tube and reflector hangers shall be of the integral type. They are to be installed inside the reflector every 3 m or 1.5 m, physically forming an individual dead air space under each ten 3 m section of reflector. Wrap around or "coat hanger wire" style hangers are not acceptable.
- .16 Ignition Control shall:
 - .1 Provide pre-purge of 30 seconds before ignition attempt
 - .2 Make 3 ignition attempts before lockout with purge before each attempt.
 - .3 Recycle again in one hour with 3 ignition attempts.
- .17 System shall incorporate a vacuum proving switch capable of flue blockage or failure of vacuum pump.
- .18 Vacuum pump shall be cast aluminum connected to the system by means of high temperature flexible connector.
- .19 Vacuum pump motor shall be 115/230 VAC, 1 phase 60Hz, 3450RPM,.75 HP TENV Sealed ball bearings, thermally protected.
- .20 Control panel incorporating pre- and post-purge functions shall be provided controlled by 24V thermostats. Night set-back operation is available as an option. Control panel shall be CGA certified.
- .21 Control sequence shall maintain the space to 5°C.

3. EXECUTION

3.01 INSTALLATION

- .1 General: Install gas fired radiant systems as indicated, in accordance with manufacturers installation instructions and in compliance with applicable codes.
- .2 Support: Suspend heat exchangers, burners, gas piping, vacuum pump, conduit and reflectors from building structure as indicated, or if not indicated, in manner to provide durable and safe installation and in accordance with manufacturers installation instruction. Coordinate locations to accommodate the architectural shroud.
- .3 Clearance to combustibles: Do not exceed clearance to combustibles outlined and printed on burner nameplate and in manufacturers product data. Provide 50mm non-combustible insulation to vent piping on exterior of building.
- .4 Venting: Install vent piping as indicated. Terminate where indicated.
- .5 Electrical wiring: Install electrical wiring as indicated. Connect power wiring to burners, and pump control wiring between burners, pump and thermostats, in accordance with manufacturers wiring diagrams and electrical codes.
- .6 Thermostats: Mount thermostats 1.5 m above finished floor, if not otherwise indicated. Provide tamperproof box. Coordinate location with architectural location.
- .7 Start Up: Start up, test and adjust gas fired radiant heaters in accordance with manufacturers start up instructions and utility company's requirements. Check and calibrate controls.

3.02 PERFORMANCE

- .1 Refer to Radiant Heater Schedule on Drawings.

END OF SECTION

1. GENERAL

1.01 SUMMARY

- .1 Provide air-to-air energy exhaust only heat recovery ventilator for indoor installation sized for

1.02 RELATED REQUIREMENTS

- .1 Section 20 05 00 – Common Work Results for Mechanical
- .2 Section 23 05 29 – Hangers and Supports for HVAC Ducting and Equipment
- .3 Section 23 31 00 – Ductwork

1.03 REFERENCE STANDARDS

- .1 American National Standards Institute (ANSI):
 - .1 CSA 4.9/ANSI Z21.13-2014, Gas-Fired Low-Pressure Steam and Hot Water Boilers
- .2 American Society of Heating, Refrigeration and Air Conditioning Engineers Inc. (ASHRAE):
 - .1 ASHRAE 90.1 2013 (SI Edition), Energy Standard for Buildings Except Low-Rise Residential Buildings

1.04 SUBMITTALS

- .1 Provide required information in accordance with Section 01 00 06 – General Requirements: Submittals.
- .2 Submit shop drawings indicating project layout including, but not limited to the following:
 - .1 Complete fan performance curves for both Supply Air and Exhaust Air, with system operating conditions indicated, as tested in an AMCA Certified Chamber.
 - .2 Energy core performance data for both summer and winter operation.
 - .3 Motor ratings, electrical characteristics and motor and fan accessories.
 - .4 Material types and gauges of all component pieces and assemblies.
 - .5 Dimensioned drawings and service clearance requirements.
 - .6 Remote Control Panel description to include all functions.
- .3 Provide operations and maintenance information in accordance with Section 01 00 06 – General Requirements: Closeout Submissions; Operation and Maintenance Data.

1.05 QUALITY ASSURANCE

- .1 Source Limitations: Obtain unit with all appurtenant components or accessories from a single manufacturer.
- .2 For the actual fabrication, installation and testing of work under this section, use only thoroughly trained and experienced workers completely familiar with the items required and with the manufacturer's current recommended methods of installation.
- .3 Product Options: Drawings must indicate size, profiles and dimensional requirements of Energy Recovery Units and are to be based on the specific system indicated. Refer to Division 1 Section "Product Requirements".

.4 Certifications:

- .1 Entire unit shall be ETL Certified per U.L. 1812 and bear an ETL sticker.
- .2 Energy Core shall be AHRI Certified, per Standard 1060.

1.06 COORDINATION

- .1 Coordinate size and location of all building penetrations required for installation of each unit and associated plumbing and electrical systems.
- .2 Coordinate sequencing of construction of associated HVAC, electrical supply.

2. PRODUCTS

2.01 MANUFACTURERS

- .1 Acceptable Materials Manufacturers: Subject to compliance with requirements specified in this Section; where multiple listings of manufacturers occur, use any of the following listed manufacturers' products in accordance with Section 20 05 03 – Mechanical Product Options and Substitutions including the following:
 - .1 Venmar
 - .2 VanEE
 - .3 Greenheck
 - .4 Systemair
 - .5 Daikin

2.02 MANUFACTURED UNITS

- .1 Unit shall be fully assembled at the factory and consist of an insulated metal cabinet, recovery device, frost control, filter assembly for intake and exhaust air, supply air blower assembly, exhaust air blower assembly, and an electrical control center. All specified components and internal accessories factory installed and tested and prepared for single-point high voltage connection.

2.03 CABINET

- .1 Housing: 18 gauge or higher, galvanized steel meeting ASTM A653 for components that do not receive a painted finish.

2.04 BLOWER

- .1 Supply Air and Exhaust Air Blowers:
 - .1 Blower performance shall be factory tested for flow rate, pressure, power, air density, rotation speed and efficiency. Ratings are to be established in accordance with AMCA 210, "Laboratory Methods of Testing Fans for Rating".
 - .2 Motor type: PSC Motors with sealed, sleeved bearings, 3 speeds, 1625 RPM, ¼ hp
 - .3 Motor Type: EC Motors, 208V/3Ph/60Hz
 - .4 Fan type: direct drive centrifugal blower
 - .5 Housing: Galvanized steel
- .2 Fan speed control: 2-speed available to user, set to high speed.

2.05 UNIT CONTROLS

- .1 The unit shall be controlled by the building DDC system based on programmed operating schedules set in the BMS.

2.06 FILTERS

- .1 Four washable filters and two disposable 30% medium efficiency filters
- .2 Supply Air: MERV 13
- .3 Extract Air: MERV 9

2.07 HEAT RECOVERY CORE:

- .1 Exchange surface: 200ft²
- .2 Type: Plate to plate core
- .3 Quantity: 2
- .4 Material: Aluminum or Polypropylene Core

2.08 ELECTRICAL CHARACTERISTICS:

- .1 120V,
- .2 Basis of design unit: 5.7 Amps, 640 Watts
- .3 208V
- .4 Input power for each fan motor: 1860Watts
- .5 Current: 6 Amps
- .6 MCA: 6.1 Amps
- .7 MOP: 15 Amps

3. EXECUTION**3.01 EXAMINATION**

- .1 Prior to start of installation, examine area and conditions to verify correct location for compliance with installation tolerances and other conditions affecting unit performance.
- .2 Examine roughing-in of electrical and HVAC services to verify actual location and compliance with unit requirements.
- .3 Proceed with installation only after all unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- .1 Installation shall be accomplished in accordance with these written specifications, project drawings, manufacturer's installation instructions as documented in manufacturer's IOM, Best Practices and all applicable building codes.

3.03 CONNECTIONS

- .1 In all cases, industry Best Practices shall be incorporated. Connections are to be made subject to the installation requirements shown above.
- .2 Duct installation and connection requirements are specified in Division 23 of this document.
- .3 Electrical installation requirements are specified in Division 26 of this document.

END OF SECTION

1. GENERAL**1.01 SHORT FORM SPECIFICATIONS**

- .1 The Electrical Project Specification is in Short Form Format and is based on the "MasterFormat" published jointly by Construction Specifications Canada and The Construction Specifications Institute.
- .2 The nature of the Short Form Specification Format indicates that detailed execution and regulatory requirements may not be present in this section.
- .3 It is expected that the Contractor shall make allowance for any exclusions arising from the use of the Short Form Specification in the Bid Price, and include all requirements that would be necessary if this had been a Standard, Three Part Format specification.
- .4 Requirements of work requiring coordination or combined skills will be read as one requirement, applicable to all parties providing work.
- .5 These documents include all drawings and specifications and contract requirements; what is required by one component is required by all.
- .6 These specifications should be read in conjunction with all other documents; where differences occur between different documents, the most restrictive requirement will apply.
- .7 Coordinate activities with other sections and trades to minimize conflicts that may arise.

1.02 DEFINITIONS

- .1 The following definitions apply to the Electrical Project Specifications specification:
- .2 Provide: The word provide means to supply, install and make operational, and is applicable to the Contractor of the work of this section.
- .3 Alternates: The word alternate is applied to a product listed by the Consultant that is different than products specified for the project, and that has been determined to essentially function, operate and perform in a manner similar to or better than the specified product; will not alter construction methods or dimensions; and will have the same visual appearance, fit and finish including any additional requirements as listed as a part of the properties listed in this Section.

1.03 ADMINISTRATIVE REQUIREMENTS

- .1 General Provisions: Provide labour, materials, products, equipment, services and all incidentals required to complete, test and commission all electrical work shown on the drawings or noted in this specification:
 - .1 Drawings are diagrammatic except where specific details are given.
 - .2 Obtain accurate dimensions from the architectural, structural, or by on-site measurements.

1.04 SUBMITTALS

- .1 Provide required information in accordance with Section 01 00 06 – General Requirements: Submittals.

.2 Action Submittals: Provide the following submittals before starting any work of this Section:

.1 Shop Drawings: Submit manufacturer's detailed drawings showing dimensions, capacities, weights, and electrical data and performance characteristics for equipment including, but not limited to, the following:

- .1 Light fixtures
- .2 Other items reasonably requested by the Consultant, or as listed in these specifications.

1.05 QUALITY ASSURANCE

.1 Regulatory Requirements: Complete Work in accordance with current Canadian Electric Code, CSA Standards, the local Electrical Inspection Authority's requirements, and with the requirements of all authorities having jurisdiction:

.1 Submit the necessary plans and information to the Electrical Inspection Authority and pay for all permits and fees as required before commencement of work.

.2 Qualifications: Provide proof of qualifications when requested by Consultant:

.3 Materials: Use only new materials having appropriate CSA labelling indicating approval, and conform with NEMA or EEMAC Standards where applicable and as follows:

.1 Only use new materials, except where specifically detailed or indicated that existing materials shall be re-used.

.4 Workmanship: Use only skilled workers who perform their work in a neat and professional manner; as a minimum, the Consultant will expect that:

- .1 Exposed conduit and wiring be installed square and plumb to building lines and levels.
- .2 Damaged or incorrectly installed materials be removed and replaced.
- .3 Loose bundles of wire or equipment be bound and properly secured to adjacent construction.
- .4 Damaged finishes are restored to match original finishes.
- .5 Structural, Architectural or Mechanical items are not damaged, altered, or interfered with by installation of materials by this Section, whether caused directly or indirectly because of their work.
- .6 Site is left in clean and tidy at the end of each workday by removing tools, equipment, ladders, and empty cardboard boxes from site and premises are left broom clean at the end of the week.

2. PRODUCTS

2.01 ALTERNATES AND SUBSTITUTIONS

.1 Bid price shall be based on materials and equipment specified; alternates will be considered for materials and equipment that perform similarly to or better than the Acceptable Materials or Basis-of-Design Materials listed and as follows:

- .1 Submit proposed alternates where alternate equipment is proposed indicating proposed cost saving or improved value to the project in accordance with Section 01 00 06 – General Requirements: Substitutions.
- .2 Include costs for additional work required by substitute materials where the change in materials requires a change in the design based on the originally specified equipment, including work required by other divisions to accommodate alternate equipment.

2.02 CONDUIT

- .1 Install wiring in EMT conduit c/w rain tight couplings and connectors, except where specifically stated otherwise or where subject to injury where same shall be rigid metallic conduit.
- .2 Conduit in contact with earth shall be rigid metallic conduit with protective coating or rigid PVC.
- .3 Install conduit parallel or perpendicular to structural lines wherever possible and as follows:
 - .1 Conduits shall be concealed in framed walls wherever possible.
 - .2 Run all conduits concealed in finished areas.
 - .3 Conduits in service areas may be surface mounted.
 - .4 Maintain 50 mm between parallel conduits in cast concrete construction, except immediately adjacent to cast in outlet boxes, where conduit run can be adjusted to fit.
 - .5 Install a continuous 180 kg test nylon cord in all empty conduits, with cap at each end of conduit.
- .4 Provide suitable metal brackets, frames, hangers, clamps and related types of support to support conduit and cable runs:
 - .1 Fasten exposed conduits to building construction or support system using one-hole malleable iron straps.
 - .2 Support two or more conduits on U-channels supported by minimum 6 mm diameter threaded rod hangers where direct fastening to building construction is impractical.
 - .3 Support conduits from U-channels using one-piece pipe clamps.
 - .4 Use EMT conduit with die-cast set screw-type concrete tight couplings and connectors in dry areas.
- .5 Use liquid-tight flexible metal conduit with compression-type rain-tight couplings and connectors with insulated throat for connection to all equipment.
- .6 Provide junction and outlet boxes where necessary for proper pulling of wires.
- .7 Provide outlet box for lighting fixtures, each wiring device, communications outlets and as indicated. Use electro-galvanized steel boxes. Provide gang boxes where wiring devices are grouped. Support boxes independently of connection conduits. Do not install outlet boxes back-to-back in walls. Such outlets must be staggered and sealed against noise transmission.

2.03 WIRE AND CABLE

- .1 Building and control wires shall be 98% conductivity copper conductors; size as indicated with 600 V insulation, cross linked thermosetting polyethylene material rated RW90XL.
- .2 Size wire for branch circuits to limit voltage drop from the panelboard to the furthest receptacle at 3% with a test current of 80% of branch circuit breaker rating.
- .3 Branch Circuit Wiring Guidelines:
 - .1 Power Conductors smaller than 12 AWG not permitted.
 - .2 Wire for 120 Volt control circuits: minimum 14 AWG
 - .3 Wire for 120 Volt circuits using shared neutrals, minimum wire sizes as follows:
 - .1 12 AWG for runs up to 23 m.
 - .2 10 AWG for runs of 23 m to 37 m.
 - .3 Runs more than 37 m shall use a wire size that complies with the requirements of item 2.03.2 above.

- .4 Provide 35 mm C Rigid PVC conduit complete with CAT 6 cable from the clock tower to the nearest ETS communication room. Should the CAT6 cable extend over 90meters the contractor shall coordinate with ETS.

2.04 LIGHTING FIXTURES

- .1 Lighting fixtures, as specified, shall be complete with the appropriate LED's and Drivers.
 - .1 **Type L1:** Custom field cut-able LED tile rated for wet locations. IP65 rated thermally stabilized PET and LED drivers. LED shall be 4000K High output Sheets @ 600 lumen/sq ft. CRI of 80 or greater. Provide quick- connect cable and jumper system to form a complete and operational system. Coordinate tile and systems sizing with the electrical and architectural drawings. LED Drivers to be rated for -20°C to +35°C.
 - .2 **Manufacture:** Cool Edge
 - .3 PART: Tile- EXT-600-4000 c/w (TACC- EXT-FIT-1,2 or 3) as required.
 - .1 Manufacture to supplier adequate drivers to power entire LED systems

2.05 GROUNDING

- .1 Provide all necessary grounding, whether shown on the drawings or not, to Canadian Electrical Code requirements.
- .2 Provide separate ground wire in all conduits.

END OF SECTIO