

**CHILD CARE ADDITION AT
ÉCOLE ÉLÉMENTAIRE RENAISSANCE
1226 LOCKHART RD
BURLINGTON, ON**

FOR

CONSEIL SCOLAIRE VIAMONDE

PROJECT MANUAL

**WORKSHOP
6 SOUSA MENDES ST
TORONTO, ON**

**ISSUED FOR TENDER
JANUARY 2025**

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Geotechnical Investigation, prepared by Pinchin Ltd. (114 pages), dated February 7, 2023

1 GENERAL

1.1 NORMAL BUSINESS HOURS

- .1 The building is occupied and is to be considered “fully operational” from 9am Monday to 6pm Friday.

1.2 PROJECT DELIVERIES

- .1 All deliveries are to be communicated to Site Staff for coordination purposes. It is preferred that deliveries are performed outside school drop-off/pick-up hours.

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

- .1 Painting, gluing, working with substances that contain volatile organic compounds (VOC's) and /or have strong odours and tarring work (sealants, roofing, etc.) are to be performed outside normal business hours.
- .2 The Contractor shall minimize any reduction in comfort at the facility.

1.4 PARKING

- .1 Owner will make some parking available to Contractor. Location and quantity of parking spaces will be confirmed with Owner.
- .2 Determine and make arrangement as required for loading and unloading of equipment and products at times that will not affect public traffic flow and that will be permitted by the City of Waterloo. Conform to City by-laws with regard to parking restrictions and other conditions.

1.5 SITE PROTECTION

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

1.6 ADVANCE NOTIFICATION

- .1 Seven (7) business days advance notification is required for any work affecting the building occupants such as the following:
 - .1 Mold remediation (removal) work / asbestos abatement (removal) work.
 - .2 Scanning and core drilling.
 - .3 Notification of start time for painting.
 - .4 Notification of exterior work.
 - .5 Notification of any building system shutdown (i.e. power, water, etc.).
 - .6 Notification of any loss of use area (i.e. washroom shutdown, lunchroom, etc.).

1.7 BREAKER PANELS

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

1.8 DOORS

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

1.9 PROTOCOL FOR SCANNING, CORE DRILLING

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

1.10 CORE DRILLING

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

1.11 DESIGNATED SUBSTANCES

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

1.12 MAINTANING LIFE SAFETY SYSTEMS IN OCCUPIED FACILITIES

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

1.13 PROJECT CONDITIONS, GENERAL

- .1 Most of the project will be performed during regular business hours in an operational business setting. Areas will be occupied during normal business hours. At end of each shift, broom clean and leave areas clean and in normal working condition.
- .2 All items removed shall be replaced / returned / reinstalled during same shift.
- .3 The Contractor shall not be responsible for moving furniture and equipment in areas of Work unless specifically specified in the Scope of Work. The Contractor shall be responsible for repairs or replacements of any damaged furniture.
- .4 The Contractor shall cooperate / coordinate with moving contractors retained by CSV, and / or agencies.

1.14 CONTINUITY OF SERVICE

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

END OF SECTION

1.1 CASH ALLOWANCES

- .1 Refer to the CCDC 2 – 2020 Paragraph GC 4.1 Cash Allowances and CCDC 2 – 2020 Supplementary Conditions Paragraph GC 4.1 Cash Allowances for the base details.
- .2 Progress payments for Work and Products authorized under allowances will be made in accordance with the payment terms set out in Conditions of the Contract.
- .3 Progress payments on accounts of Work authorized under cash allowances shall be included in the Consultant's monthly certificate for payment.
- .4 Cash allowances, unless otherwise specified, cover the net cost to the Contractor of services, products, construction machinery and equipment, freight, handling, unloading, storage, installation where indicated, and other authorized expenses incurred in performing the Work. Cash allowances shall not be included by a Subcontractor in the amount for their Sub-contract work.
- .5 Supply only allowances shall include:
 - .1 Net cost of products.
 - .2 Delivery to Site.
 - .3 Applicable taxes and duties, excluding HST.
- .6 Supply and install allowances shall include:
 - .1 Net cost of products.
 - .2 Delivery to Site.
 - .3 Unloading, storing, handling or products on Site.
 - .4 Installation, finishing and commissioning of products.
 - .5 Applicable taxes and duties, excluding HST.
 - .6 The amount of each cash allowance does not include Contractor's overhead and profit, and other related costs, which shall be included in the Contract Price and not in the cash allowance.
- .7 Inspection and testing allowances shall include:
 - .1 Net cost of inspection and testing services.
 - .2 Applicable taxes and duties, excluding HST.
- .8 Other costs related to work covered by cash allowances are not covered by the allowance but shall be included in the Contract Price.
- .9 Where costs under a cash allowance exceed the amount of the allowance, the Contractor will be compensated for any excess incurred and substantiated plus an allowance for overhead and profit as set out in the Contract Documents.
- .10 Accord, through Consultant, may request Contractor to identify potential Suppliers or Subcontractors, as applicable, and to obtain at least three competitive prices for each cash allowance item.
- .11 Submit, before application for final payment, copies of all invoices and statements from suppliers and Subcontractors for work which has been paid from cash allowances.
- .12 Accord, through Consultant, will determine by whom and for what amount each cash allowance item will be performed. Obtain Accord's prior written approval in the form of a Cash Allowance Disbursement Authorization (CADA) before entering into a subcontract, amending an existing subcontract, or performing own forces work included in a cash allowance. Upon issuance of the CADA, the Contractor's responsibilities for a cash allowance item shall be the same as for work of the Contract.

- .13 The "Cash Allowances" expected and the amount of each allowance is listed in the Bid package.

END OF SECTION

1 GENERAL

1.1 ALTERNATIVES AND SUBSTITUTIONS

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

- .10 Textures,
- .11 Compatibility with other materials, products, assemblies and components.
- .4 Substitutions to methods or process described in the Specifications or drawings, may be proposed for the consideration of the Consultant.
- .5 Ensure that such substitutions are in accordance with the following requirements:
 - .1 Time spent by the Consultant in evaluating the substitution shall not be the basis for a claim by the Contractor for extensions;
 - .2 Clearly indicate how the proposed substitutions would be advantageous to the Owner or in the opinion of the Contractor would improve the operation of the installation;
 - .3 The cost of all changes in the work of Other Contractors, necessitated by the substituted methods or processes, if accepted, is borne by the Contractor;
 - .4 The substituted methods or processes fit into space allotted for the specified methods or processes. Revisions to the drawings for incorporation of the substitutions shall be made by the Consultant and all costs associated with the revisions shall be borne by the Contractor.
- .6 Substitutions will not be considered if:
 - .1 They are indicated or implied on shop drawings or product data without formal request;
 - .2 Acceptance will require substantial revision of the Specifications and Drawings.
 - .3 Contractor fails to order a specified Product or order a Product by a specified manufacturer in adequate time to meet Contractor's construction schedule
- .7 Do not substitute products or methods or processes into the Work unless such substitutions have been specifically approved for the Work by the Consultant.
- .8 Approved substituted products shall be subject to Consultant's sole discretion. Approved substituted products shall only be installed after receipt of the Consultant's written approval.
- .9 The cost of changes in the Work of a Contractor necessitated by the use of proposed material and / or product substitution is to be borne by the Contractor proposing the substitution.
- .10 The Contract Price will be adjusted accordingly to any and all credits arising from the substitutions mentioned above.

1.2 SUBMISSION REQUIREMENTS FOR PROPOSED SUBSTITUTIONS

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

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

1.3 METHODS OR PROCESSES SUBSTITUTIONS

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

1.4 CREDITS ARISING FROM SUBSTITUTIONS

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

1.5 RELATED CHANGES

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

END OF SECTION

1.1 SUMMARY

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

1.2 CONSTRUCTION PROGRESS SCHEDULE

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

1.3 SUBMITTALS SCHEDULE

- .1 Format and Content:
 - .1 Prepare schedule identifying all required *Shop Drawing*, *Product* data, and sample submissions, including samples required for testing.
 - .2 Prepare schedule in electronic format.
 - .3 Provide a separate line for each required submittal, organized by

Specifications section names and numbers, and further broken down by individual *Products* and systems as required.

- .4 For each required submittal, show planned earliest date for initial submittal, earliest date for return of reviewed submittal by *Consultant* and latest date for return of reviewed submittal without causing delay.
- .5 Allow time in schedule for resubmission of submittals, should resubmission be necessary.
- .2 Submission:
 - .1 Submit initial schedule to Consultant within 15 Working Days after Contract award via email.
 - .2 Submit updated submittals schedule monthly to Owner and Consultant.

1.4 SCHEDULE MANAGEMENT

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

1.5 RECORDING ACTUAL SITE CONDITIONS ON AS-BUILT DRAWINGS

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

- .4 Field changes of dimension and detail.
- .5 Changes made by Change Orders and Supplemental Instructions
- .6 References to Shop Drawings, where Shop Drawings show more detail.
- .4 Do not use as-built drawings for construction purposes.

1.6 PROGRESS PHOTOGRAPHS

- .1 Arrange for periodic digital photography to document and provide a photographic record of the progress of the *Work*.
- .2 Identify each photograph by project name and date taken.
- .3 Submission: Submit .jpg format files in standard resolution via project web site monthly.
- .4 Do not use progress or any other *Project* photographs for promotional purposes without *Owner's* written consent.

END OF SECTION

1.1 ADMINISTRATIVE

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

1.2 SHOP DRAWINGS AND PRODUCT DATA

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

responsible for *Shop Drawing* review, indicating that each *Shop Drawing* has been reviewed for compliance with *Contract Documents* and, where applicable, that field measurements have been verified.

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

1.3 SAMPLES

- .1 Submit samples for *Consultant's* review in triplicate where specified in the technical *Specifications*. Label samples as to origin, *Project* name, and intended use.

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

END OF SECTION

1 GENERAL

1.1 TEMPORARY WORK

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

1.2 TEMPORARY UTILITIES - GENERAL

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

1.3 TEMPORARY WATER SUPPLY

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

1.4 TEMPORARY HEATING AND VENTILATION

- .1 *Contractor* may connect to and use *Owner's* existing supply of natural gas for temporary use during construction, subject to existing available volume and pressure. Usage at no cost to *Contractor*.
- .2 Vent construction heaters in enclosed spaces to the outside or use flameless type of construction heaters.
- .3 Provide temporary heat for the *Work* as required to:
 - .1 Facilitate progress of *Work*.
 - .2 Protect the *Work* against dampness and cold.
 - .3 Prevent moisture condensation on surfaces, freezing, or other damage to finishes or stored *Products*.
 - .4 Maintain specified minimum ambient temperatures and humidity levels for storage, installation and curing of *Products*.
 - .5 After building is enclosed, maintain interior temperature of minimum 10 degrees C.
- .4 Provide temporary ventilation for the *Work* as required to:
 - .1 Prevent accumulations of fumes, exhaust, vapours, gases and other hazardous, noxious, or volatile substances in enclosed spaces, as required to maintain a safe work environment meeting applicable regulatory requirements.
 - .2 Ensure that hazardous, noxious, or volatile substances do not migrate to *Owner* occupied spaces.
 - .3 Ventilate temporary sanitary facilities.
 - .4 New permanent building heating and ventilation systems may be used during construction, at Contractor's option. If used during construction:

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

END OF SECTION

1.1 CONSTRUCTION FACILITIES - GENERAL

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

1.2 CONSTRUCTION PARKING

- .1 Limited parking will be permitted at *Place of the Work*, within the assigned limits of construction only, during normal working hours, provided it does not disrupt continuing operation of the facility. Outside of normal working hours, staff parking can be used.

1.3 VEHICULAR ACCESS

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

1.4 SITE OFFICES

- .1 Space within the existing building will not be made available to the Contractor for use as a Site Office.
- .2 Contractor shall provide a temperature controlled and ventilated office, with suitable lighting, of sufficient size to accommodate site meetings.

1.5 SANITARY FACILITIES

- .1 Provide sanitary facilities for workers.
- .2 Do not use permanent washroom facilities during construction.
- .3 Keep sanitary facilities clean and fully stocked with the necessary supplies.

1.6 FIRE PROTECTION

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

END OF SECTION

1.1 BARRIERS AND ENCLOSURES - GENERAL

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

1.2 FENCING

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

1.3 WEATHER ENCLOSURES

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

1.4 DUST TIGHT PARTITIONS

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

1.5 FIRE ROUTES

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

1.6 PROTECTION OF BUILDING FINISHES

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

END OF SECTION

1.1 SURVEYOR QUALIFICATIONS

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

1.2 SUBMITTALS

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

1.3 SURVEY REFERENCE POINTS

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

1.4 SURVEY REQUIREMENTS

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

1.5 EXISTING UTILITIES AND STRUCTURES

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

1.6 VERIFICATION OF EXISTING CONDITIONS

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

END OF SECTION

1.1 SUMMARY

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

1.2 MANUFACTURER'S INSTRUCTIONS

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

1.3 CONCEALMENT

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

1.4 FASTENINGS - GENERAL

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

1.5 FASTENINGS - EQUIPMENT

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

1.6 FIRE RATED ASSEMBLIES

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

1.7 LOCATION OF FIXTURES, OUTLETS AND DEVICES

- .1 Consider location of fixtures, outlets, and devices indicated on *Drawings* as approximate.

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

1.8 PROTECTION OF COMPLETED WORK AND WORK IN PROGRESS

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

1.9 REMEDIAL WORK

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

END OF SECTION

1.1 REQUEST FOR CUTTING, PATCHING AND REMEDIAL WORK

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

1.2 PRODUCTS

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

1.3 PREPARATION

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

1.4 EXISTING UTILITIES

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

1.5 CUTTING, PATCHING, AND REMEDIAL WORK

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

END OF SECTION

1.1 READY-FOR-TAKEOVER

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

1.2 INSPECTION AND REVIEW BEFORE READY-FOR-TAKEOVER

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

1.3 PREREQUISITES TO FINAL PAYMENT

- .1 After Ready-for-Takeover of the Work and before submitting an application for final payment in accordance with the General Conditions and Supplementary Conditions of Contract:
 - .1 Correct or complete all remaining defective, deficient, and incomplete work.
 - .2 Remove from the Place of the Work all remaining surplus Products, Construction Equipment, and Temporary Work.
 - .3 Perform final cleaning and waste removal necessitated by the Contractor's work performed after Ready-for-Takeover, as specified by General Condition 12.1.

1.4 PARTIAL USER OCCUPANCY

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

1.5 SUBSTANTIAL PERFORMANCE OF THE WORK

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

END OF SECTION

1.1 OPERATION AND MAINTENANCE MANUAL

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

1.2 OPERATION AND MAINTENANCE MANUAL FORMAT

- .1 Organize data in the form of an instructional manual.
- .2 Binders: vinyl, hard covered, three D-rings, loose leaf, 216 x 279 mm, with spine and face pockets.
- .3 When multiple binders are used, correlate data into related consistent groupings. Identify contents of each binder on spine.
- .4 Cover: Identify each binder with typed or printed title "Operation and Maintenance Manual", name of Project or facility, and subject matter of contents.
- .5 Arrange content [by systems,] [process flow,] under Section numbers and sequence of Table of Contents.
- .6 Provide tabbed fly leaf for each separate Product or system, with typed description of Product and major component parts of equipment.
- .7 Text: Manufacturer's printed data, or typewritten data.
- .8 Drawings: provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.
- .9 Provide electronic copy of manual in PDF format.
- .10 Provide electronic copy of Shop Drawings in manual as CAD files in.dwg format on electronic media acceptable to Owner.

1.3 OPERATION AND MAINTENANCE MANUAL – GENERAL CONTENT

- .1 Table of contents for each volume.
- .2 Introductory information including:
 - .1 Date of manual submission.
 - .2 Complete contact information for *Consultant*, subconsultants, other consultants, and *Contractor*, with names of responsible parties.
 - .3 Schedule of *Products* and systems indexed to content of volume.
- .3 For each *Product* or system, include complete contact information for *Subcontractors*, *Suppliers* and manufacturers, including local sources for

- supplies and replacement parts.
- .4 *Product Data*: mark each sheet to clearly identify specific products, options, and component parts, and data applicable to installation. Delete or strike out inapplicable information. Supplement with additional information as required.
- .5 *Reviewed Shop Drawings*.
- .6 Permits, certificates, letters of assurance and other relevant documents issued by or required by authorities having jurisdiction.
- .7 Warranties.
- .8 Operating and maintenance procedures, incorporating manufacturer's operating and maintenance instructions, in a logical sequence.
- .9 Training materials as specified in Section 01 79 00 - Demonstration and Training.

1.4 **OPERATION AND MAINTENANCE MANUAL - EQUIPMENT AND SYSTEMS CONTENT**

- .1 Each Item of Equipment and Each System: include description of unit or system and component parts. Give function, normal operation characteristics, and limiting conditions. Include performance curves, with engineering data and tests, and complete nomenclature and commercial number of replaceable parts.
- .2 Panel Board Circuit Directories: provide electrical service characteristics, controls, and communications.
- .3 Include installed colour coded wiring diagrams.
- .4 Operating Procedures: include start-up, break-in, and routine normal operating instructions and sequences. Include regulation, control, stopping, shut-down, and emergency instructions. Include summer, winter, and any special operating instructions.
- .5 Maintenance Requirements: include routine procedures and guide for trouble-shooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.
- .6 Provide servicing and lubrication schedule, and list of lubricants required.
- .7 Include manufacturer's printed operation and maintenance instructions.
- .8 Include sequence of operation by controls manufacturer.
- .9 Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.
- .10 Provide installed control diagrams by controls manufacturer.
- .11 Provide Contractor's coordination drawings, with installed colour coded piping diagrams.
- .12 Provide charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.

- .13 Provide list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.
- .14 Include testing and balancing reports.
- .15 Include additional content as specified in technical Specifications sections.

1.5 OPERATION AND MAINTENANCE MANUAL - PRODUCTS AND FINISHES CONTENT

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

1.6 OPERATION AND MAINTENANCE MANUAL - WARRANTIES CONTENT

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

1.7 CONTRACTOR'S AS-BUILT DRAWINGS

- .1 Submit final as-built drawings in the form specified in Section 01 32 00 – Construction Progress Documentation to Consultant.

1.8 PROJECT RECORD DRAWINGS

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

1.9 SPARE PARTS, MAINTENANCE MATERIALS, AND SPECIAL TOOLS

- .1 Supply spare parts, maintenance materials, and special tools in quantities specified in technical *Specifications* sections.
- .2 Ensure spare parts and maintenance materials are new, not damaged nor defective, and of same quality, manufacturer, and batch or production run as installed *Products*.

- .3 Provide tags for special tools identifying their function and associated *Product*.
- .4 Deliver to and store items at location directed by *Owner* at *Place of the Work*. Store in original packaging with manufacturer's labels intact and in a manner to prevent damage or deterioration.
- .5 Catalogue all items and submit to *Consultant* an inventory listing organized by *Specifications* section. Include *Consultant* reviewed inventory listing in operation and maintenance manual.

END OF SECTION

1.1 SUMMARY

- .1 Demonstrate and provide training to *Owner's* personnel on operation and maintenance of equipment and systems prior to scheduled date of *Ready-for-Takeover of the Work*.
- .2 *Owner* will provide list of personnel to receive training and will coordinate their attendance at agreed upon times.
- .3 Coordinate and schedule demonstration and training provided by *Subcontractors* and *Suppliers*.

1.2 SUBMITTALS

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

1.3 PREREQUISITES TO DEMONSTRATION AND TRAINING

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

1.4 DEMONSTRATION AND TRAINING

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

END OF SECTION

1 General

1.1 SUMMARY

- .1 Review drawings, site conditions, and other specification sections to ascertain the extent and nature of work of this section.
- .2 The Work of this Section includes, but is not limited to the following:
 - .1 Demolish and removal of the following, where indicated on the Drawings:
 - .1 Soil and sod;
 - .2 Tress, stumps and roots;
 - .3 Cast-in-place concrete;
 - .4 Pre-cast concrete pavers
 - .5 Pressure treated step retaining walls;
 - .6 Pressure treated timber curbs;
 - .7 Wrought iron, wood and metal fencing;
 - .8 Light standards;
 - .9 Steel handrails.
 - .2 Dispose of demolished materials except where required to be salvaged or reused.
 - .3 Refer to demolition notes indicated on all disciplines Drawings.
 - .4 Payment for salvage, stockpiling, sealing, disposal, recycling, excavating and backfilling will be included in above removal items.
 - .5 Measure removal of waste, and materials designated for alternate disposal from site in tonnes.
- .3 Drawings contain details that suggest directions for solving some of the major demolition and removal requirements for this project; Contractor is required to develop these details further by submitting a demolition plan prepared by a professional engineer employed by the Contractor.

1.2 REFERENCE STANDARDS

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

- .6 Transport Canada (TC)
 - .1 Transportation of Dangerous Goods Act, 1992 (TDGA), c. 34.

1.3 DEFINITIONS

- .1 Demolish: Detach items from existing construction and legally dispose of them off site, unless indicated to be removed and salvaged or removed and reinstalled.
- .2 Remove and Salvage: Detach items from existing construction and deliver them to Owner ready for reuse.
- .3 Remove and Reinstall: Detach items from existing construction, prepare them for reuse, and reinstall them where indicated.
- .4 Existing to Remain: Existing items of construction that are not removed and that are not otherwise indicated as being removed, removed and salvaged, or removed and reinstalled.
- .5 Hazardous Materials: dangerous substances, dangerous goods, hazardous commodities and hazardous products, may include but not limited to: asbestos PCB's, CFC's, HCFC's poisons, corrosive agents, flammable substances, ammunition, explosives, radioactive substances, or other material that can endanger human health or well being or environment if handled improperly.
- .6 Waste Audit (WA): detailed inventory of materials in building. Indicates quantities of reuse, recycling and landfill.
 - .1 Involves quantifying by volume/weight amounts of materials and wastes generated during construction, demolition, deconstruction, or renovation project.
 - .2 Indicates quantities of reuse, recycling and landfill.
- .7 Waste Reduction Workplan (WRW): written report which addresses opportunities for reduction, reuse, or recycling of materials. WRW is based on information acquired from WA.

1.4 ADMINISTRATIVE REQUIREMENTS

- .1 Site Meetings.
 - .1 Convene pre-demolition meeting one week prior to beginning work of this Section in accordance with Division 01, to:
 - .1 Verify project requirements.
 - .2 Review installation and substrate conditions.
 - .3 Co-ordination with other building subtrades.
 - .4 Review manufacturer's installation instructions and warranty requirements.
 - .2 Arrange for site visit with Consultant, to examine existing site conditions adjacent to demolition work, prior to start of Work.
 - .3 Hold project meetings weekly, unless otherwise agreed upon by the Consultant and the Contractor.
 - .4 Reporting Requirements: Contractor to complete.
 - .5 Provide verbal reporting on status of waste diversion activity at each meeting.
 - .6 Consultant will provide written notification of change of meeting schedule established upon contract award 24 hours prior to scheduled meeting.

1.5 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Division 01.
- .2 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province, Canada.
 - .2 Submit for approval drawings, diagrams or details showing sequence of demolition work and supporting structures and underpinning, where required by authorities having jurisdiction.
- .3 Waste Reduction Workplan:
 - .1 Prior to beginning of Work on site submit detailed Waste Reduction Workplan in accordance with Division 01 and indicate:
 - .1 Descriptions of and anticipated quantities in percentages of materials to be salvaged reused, recycled and landfilled.
 - .2 Schedule of selective demolition.
 - .3 Number and location of dumpsters.
 - .4 Anticipated frequency of tipping.
 - .5 Name and address of haulers, waste facilities, and waste receiving organizations.
 - .4 Certificates:
 - .1 Submit copies of certified receipts from authorized disposal sites and reuse and recycling facilities for material removed from site on monthly basis.
 - .2 Written authorization from Consultant is required to deviate from haulers and receiving facilities listed in Waste Reduction Workplan.

1.6 DELIVERY, STORAGE AND HANDLING

- .1 Store and manage hazardous materials in accordance with Division 01.
- .2 Storage and Protection.
 - .1 Protect in accordance with Section 31 23 33 Excavation, Trenching and Backfilling.
 - .2 Protect existing items designated to remain and items designated for salvage. In event of damage to such items, immediately replace or make repairs to approval of Consultant and at no cost to the Owner.
 - .3 Remove and store materials to be salvaged, in manner to prevent damage.
 - .4 Store and protect in accordance with requirements for maximum preservation of material.
 - .5 Handle salvaged materials as new materials.
- .3 Develop Waste Reduction Workplan related to Work of this Section and in accordance with Division 01.

1.7 SITE CONDITIONS

- .1 Site Environmental Requirements.
 - .1 Ensure that selective demolition work does not adversely affect adjacent watercourses, groundwater and wildlife, or contribute to excess air and noise pollution.

- .2 Do not dispose of waste of volatile materials including but not limited to, mineral spirits, oil, petroleum based lubricants, or toxic cleaning solutions into watercourses, storm or sanitary sewers.
 - .1 Ensure proper disposal procedures are maintained throughout the project.
- .3 Do not pump water containing suspended materials into watercourses, storm or sanitary sewers or onto adjacent properties.
- .4 Control disposal or runoff of water containing suspended materials or other harmful substances in accordance with local authorities, as directed by Consultant.
- .5 Protect trees, plants and foliage on site and adjacent properties where indicated.

2 Products

2.1 EQUIPMENT

- .1 Leave machinery running only while in use, except where extreme temperatures prohibit shutting machinery down.

3 Execution

3.1 PREPARATION

- .1 Inspect site with Consultant and verify extent and location of items designated for removal, disposal, alternative disposal, recycling, salvage and items to remain.
- .2 Locate and protect utilities. Preserve active utilities traversing site in operating condition.
- .3 Notify and obtain approval of utility companies before starting demolition.

3.2 REMOVAL OF HAZARDOUS WASTES

- .1 Remove contaminated or dangerous materials defined by authorities having jurisdiction, relating to environmental protection, from site and dispose of in safe manner to minimize danger at site or during disposal.

3.3 REMOVAL OPERATIONS

- .1 Remove items as indicated.
- .2 Do not disturb items designated to remain in place.
- .3 Removal of pavements, curbs and gutters:
 - .1 Square up adjacent surfaces to remain in place by saw cutting or other method approved by Consultant.
 - .2 Protect adjacent joints and load transfer devices.
 - .3 Protect underlying and adjacent granular materials.
- .4 Prevent contamination with base course aggregates, when removing asphalt pavement for subsequent incorporation into hot mix asphalt concrete paving,
- .5 Excavate at least 300mm below pipe invert, when removing pipes under existing or future pavement area.
- .6 Remove designated trees during site demolition.
 - .1 Obtain written approval of Consultant prior to removal of trees not designated.
- .7 Stockpile topsoil for final grading and landscaping:
 - .1 Provide erosion control and seeding if not immediately used.

- .8 Disposal of Material:
 - .1 Dispose of materials not designated for salvage or reuse on site at authorized facilities approved in Waste Reduction Workplan.

3.4 STOCKPILING

- .1 Label stockpiles, indicating material type and quantity.
- .2 Designate appropriate security resources/measures to prevent vandalism, damage and theft.
- .3 Locate stockpiled materials convenient for use in new construction to eliminate double handling wherever possible.
- .4 Stockpile materials designated for alternate disposal in location which facilitates removal from site and examination by potential end markets, and which does not impede disassembly, processing, or hauling procedures.

3.5 REMOVAL FROM SITE

- .1 Remove stockpiled material as directed by Consultant, when it interferes with operations of project.
- .2 Remove stockpiles of like materials by alternate disposal option once collection of materials is complete.
- .3 Transport material designated for alternate disposal using approved facilities and haulers listed in Waste Reduction Workplan, and in accordance with applicable regulations.
- .4 Dispose of materials not designated for alternate disposal in accordance with applicable regulations.
 - .1 Disposal Facilities: approved and listed in Waste Reduction Workplan.

3.6 RESTORATION

- .1 Restore areas and existing works outside areas of demolition to conditions that existed prior to beginning of Work.
- .2 Use soil treatments and procedures which are not harmful to health, are not injurious to plants, and do not endanger wildlife, adjacent water courses or ground water.

3.7 CLEANING

- .1 Progress Cleaning: Clean in accordance with Division 01.
 - .1 Leave Work area clean at end of each day.
 - .2 Remove debris, trim surfaces and leave work site clean, upon completion of Work
 - .3 Use cleaning solutions and procedures which are not harmful to health, are not injurious to plants, and do not endanger wildlife, adjacent water courses or ground water.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Division 01.
- .3 Waste Management: separate waste materials for reuse or recycling in accordance with Division 01.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.8 PROTECTION

- .1 Repair damage to adjacent materials or property caused by selective site demolition.

END OF SECTION

1 General

1.1 SUMMARY

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

1.2 REFERENCE STANDARDS

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

1.3 DEFINITIONS

- .1 Demolish: Detach items from existing construction and legally dispose of them off site, unless indicated to be removed and salvaged or removed and reinstalled.
- .2 Remove and Salvage: Detach items from existing construction and deliver them to Owner ready for reuse.

- .3 Remove and Reinstall: Detach items from existing construction, prepare them for reuse, and reinstall them where indicated.
- .4 Existing to Remain: Existing items of construction that are not removed and that are not otherwise indicated as being removed, removed and salvaged, or removed and reinstalled.

1.4 EXAMINATION

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

1.5 SUBMITTALS

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

1.6 QUALITY ASSURANCE

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

1.7 PROTECTION

- .1 Prevent movement or settlement of adjacent work. Provide and place bracing or shoring and be responsible for safety and support of such work. Be liable for any such movement or settlement, and any damage or injury caused.

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

1.8 REMAINING AND ADJACENT STRUCTURES

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

1.9 PROTECTION OF SERVICES AND STRUCTURES

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

1.10 EXISTING SERVICES

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

1.11 DECOMMISSIONED SERVICES

- .1 Remove fully decommissioned electrical and mechanical service lines, plumbing, ducting, fixtures and all fasteners and supports for decommissioned items.

- .1 Remove sewer and water lines where required within existing building as deemed necessary, and cap to prevent leakage, in accordance with authorities having jurisdiction.
- .2 Patch and repair surfaces affected by this selective demolition to match existing adjacent surfaces, as approved by the Consultant.

1.12 EXISTING WARRANTIES

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

2 Products

2.1 DEBRIS, SALVAGED MATERIAL AND EQUIPMENT DISPOSAL

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

2.2 PROTECTION

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

2.3 REPAIR MATERIALS

- .1 Use repair materials identical to existing materials:
 - .1 If identical materials are unavailable or cannot be used for exposed surfaces, use materials that visually match existing adjacent surfaces to the fullest extent possible.
 - .2 Use a material whose installed performance equals or surpasses that of existing material.
 - .3 Comply with material and installation requirements specified in individual Specification Sections.
- .2 Floor Patching and Levelling Compounds: Cement based, trowelable, self-levelling compounds compatible with specified floor finishes; as indicated in Sections 03 35 00 Concrete Finishing, 09 30 00 Tile and 09 65 00 Resilient Flooring.
- .3 Concrete Unit Masonry: Lightweight concrete masonry units, and mortar, cut and trimmed to fit existing opening to be filled. Provide standard hollow core units, square end units and bond beam units.
 - .1 Refer to drawings for schedule/extent of patching required.
- .4 Gypsum Board Patching Compounds: Joint compound to ASTM C475, bedding and finishing types thinned to provide skim coat consistency to patch and prepare existing gypsum board walls ready for new finishes in accordance with Section 09 29 00.

- .5 Fireproofing: Patch and repair all fireproofing damaged during demolition of adjacent surfaces with compatible fireproofing materials. Provide test reports from fireproofing manufacture warranting installation, adhesion and compatibility between existing and new fireproofing materials.

2.4 EXISTING MATERIALS

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

3 Execution

3.1 GENERAL

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

3.2 PREPARATION

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

3.3 SAFETY AND SECURITY

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

3.4 ACCESS ROUTES

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

3.5 SELECTIVE DEMOLITION

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

3.6 PATCHING AND REPAIRING

- .1 Floors and Walls:
 - .1 Where walls or partitions that are demolished extend from one finished area into another, patch and repair floor and wall surfaces in the new space.
 - .2 Provide a level and smooth surface having uniform finish colour, texture, and appearance.
 - .3 Remove existing floor and wall coverings and replace with new materials, if necessary, to achieve uniform colour and appearance.
 - .4 Patch with durable seams that are as invisible as possible.
 - .5 Provide materials and comply with installation requirements specified in other Sections of these Specifications.
 - .6 Patch any existing areas adjoining / adjacent to new construction in good workmanship, filling and finishing gaps between finishes to allow new work to blend seamlessly with existing work.

- .7 Where patching occurs in a painted surface, apply primer and intermediate paint coats over patch and apply final paint coat over entire unbroken surface containing patch. Provide additional coats until patch blends with adjacent surfaces.
- .8 Where feasible, test and inspect patched areas after completion to demonstrate integrity of installation.
- .2 Exterior Walls:
 - .1 Where existing doors and/or windows are schedule to be removed during demolition, patch and repair exterior walls using similar wall construction techniques as adjacent wall construction. Provide exterior and interior substrate and finish materials, matching existing adjacent materials, to provide an even-plane surface of uniform appearance suitable for application of air barrier membrane AB-01 and/or finishes as scheduled.
- .3 Parging:
 - .1 Patch and repair existing parging damaged or spalling, at areas identified in the Document, using single-component, sand/cement blend designed for coating or parging vertical surfaces. Build up in multiple layers in locations where depth of required repair cannot be filled in a single layer.

3.7 EQUIPMENT

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

3.8 EXCESSIVE DEMOLITION

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

3.9 COMPLETION

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

END OF SECTION

1 General

1.1 SUMMARY

- .1 Work of this Section includes the supply and installation of the following concrete floor treatments, as well as testing and measurement for floor flatness and levelness.
 - .1 Liquid-Applied Penetrating Sealer;
 - .2 Cementitious Levelling Treatments;
 - .3 Cementitious Topping, Patching and Flash Patching Materials.

1.2 DEFINITIONS

- .1 Floor Classifications: Classification of concrete floor slabs based on their intended use, methods of finishing and finish materials applied to flooring as denoted by the F-rating below, and as follows:
 - .1 Single Course Floor: Floors placed in a single course with final finishing applied to properly levelled concrete.
- .2 Finish or Finishes: Materials applied to finished concrete surface, i.e.: stained or coloured concrete, carpet, resilient flooring or ceramic tile.
- .3 Finishing: Methods, tools and equipment employed to achieve levelness or surface flatness for shored slabs and slabs-on-grade, and durability indicated and as follows:
 - .1 F3-Finishing: Floors having a straightedge value of $\pm 1.6\text{mm}$ over 3048mm (1/6" over 10'); similar to CSA A23.1 Class C Slab Finishing.

1.3 REFERENCE STANDARDS

- .1 American Society for Testing and Materials (ASTM):
 - .1 ASTM C309-11, Standard Specification for Liquid Membrane-Forming Compound for Curing Concrete.
 - .2 ASTM C979/C979M-10, Standard Specification for Pigments for Integrally Colored Concrete.
- .2 American Concrete Institute (ACI):
 - .1 ACI 117-2010, Specifications for Tolerances for Concrete Construction and Materials and Commentary
 - .2 ACI 302.1R-15, Guide for Floor and Slab Construction
- .3 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.
- .4 International Concrete Repair Institute (ICRI):
 - .1 ICRI 310.2R-2013, Guideline for Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, Polymer Overlays and Concrete Repair

1.4 ADMINISTRATION REQUIREMENTS

- .1 Coordination:
 - .1 Coordinate a meeting between the Contractor, Subcontractor responsible for concrete placement, and the Consultant to determine site quality control testing section borders and sample measurement line locations, method of measurement, and accuracy requirements of the measuring devices.

- .2 Pre-Construction Meetings:
 - .1 Pre-Construction Conference: Arrange a site meeting, to coincide with regular bi-weekly site meetings, attended by the Contractor, the Subcontractor's representative and foreman for this project, the Consultant, materials supplier(s), and other relevant personal before commencement of work for this Section.
 - .2 Prepare an outline agenda for meeting in accordance with Division 01.

1.5 SUBMITTALS

- .1 Provide submittals in accordance with Division 01.
- .2 Action Submittals: Provide the following submittals before starting any work of this Section:
 - .1 Product Data: Submit manufacturer's product data for each materials specified including recommended application rates and methods of installation.
- .3 Informational Submittals: Provide the following submittals during the course of the work:
 - .1 Site Quality Control Submittals: Submit results for straightedge measurements to demonstrate compliance with specified tolerances. Record the following information on a drawing indicating floor slab layout, column locations and slab penetrations:
 - .1 Indicate variance from specified straightedge measurements as a + or - value.
 - .2 Failed tests in excess of 50% of the straightedge will require the Subcontractor to flash patch floor to achieve specified tolerance; example of tolerance failure.
 - .3 Slabs-On-Grade: Measurement of 1.6mm (1/16") or greater than ± 6 mm (1/4") measurement will be considered as a failed test and will require flash patching.
 - .4 Suspended Slabs: Measurement of 3mm (1/8") or greater than ± 6 mm (1/4") measurement (80% tolerance allowance) will be considered as a failed test and will require flash patching.

1.6 PROJECT CLOSEOUT SUBMISSIONS

- .1 Operation and Maintenance Data:
 - .1 Submit detailed cleaning and maintenance instructions for concrete densifier products, and instruct Owner in proper care and maintenance of specified floor finishes, including a complete list of floor care products that will be required for ongoing maintenance, in accordance with Division 01.

1.7 QUALITY ASSURANCE

- .1 Subcontractor executing work of this Section shall employ installers having a minimum of five (5) years continuous experience in successful installation of work of type and quality shown and specified. Submit proof of experience upon Consultant's request.
- .2 Ensure proper use of proprietary materials in strict accordance with the material manufacturer's directions.

1.8 SITE CONDITIONS

- .1 Environmental Requirements:
 - .1 Ensure that adequate temporary heating is provided as required for cold weather work.
 - .2 Provide adequate moisture, sun shades and wind barriers to prevent too rapid drying of concrete during hot weather.

- .2 Protection:
 - .1 Ensure that finished concrete floor areas are protected from abrasion from foot or wheeled traffic, and from damage caused by spillage of oil or other harmful materials.

2 Products

2.1 MATERIALS

- .1 Liquid-Applied Penetrating Sealer (SCON):
 - .1 Clear water based silane micro emulsion penetrating concrete sealer, formulated to prevent water and chloride intrusion into concrete surfaces.
 - .1 Basis of Design Materials:
 - .1 Planiseal WR 40 by Mapei Inc.
 - .2 Cipadm S-40 by CPD Construction Products
 - .3 Sikagard SN40 by Sika Canada Inc.
 - .4 Hydrozo Silane 40 VOC by BASF.
 - .5 or approved equivalent.
 - .2 Patching and Flash Patching Materials:
 - .1 Cementitious based, polymer modified, fine aggregate, single component, rapid curing, early strength floor patching compounds having high adhesion, for application in thicknesses to a minimum of 1/8" to 1".
 - .2 Basis of Design Materials:
 - .1 SikaQuick 1000 by Sika Canada Ltd.
 - .2 Planitop 18ES by MAPEI Canada Inc.
 - .3 Meadow-Crete H by W.R. Meadows of Canada
 - .4 or approved equivalent.
 - .3 Joint Sealant: Refer to Section 07 92 00.

3 Execution

3.1 EXAMINATION

- .1 Before commencing work, ensure that surfaces are acceptable to receive and maintain concrete finishing, and that specified installation will be achieved.

3.2 FINISHING FLOORS AND SLABS

- .1 Finish floors and slabs in accordance with CSA A23.1 and ACI 302.1R recommendations for screeding, re-straightening, and finishing operations for concrete surfaces; do not wet concrete surfaces.

3.3 INSTALLATION

- .1 Installation - Liquid-Applied Penetrating Sealer:
 - .1 Vertical Surfaces:
 - .1 Apply using a brush, roller or low pressure spray, working from top to bottom by maintaining a 305mm (12") parallel curtain (run down).
 - .2 When applying the material on a vertical surface, avoid accumulation and run-off of the material. In the event of material accumulation or run-

- off lines being formed, redistribute the material on the surface or remove by sponging.
- .3 Apply flood coat in two (2) passes, "wet on wet" with the second pass at right angles to the first. Material coverage should not be greater than 2.5 m²/L total (100 ft²/US gal.), unless otherwise recommended by the Manufacturer.
- .2 Horizontal Surfaces:
 - .1 Apply using a roller or low pressure spray, ensuring that product penetrates the substrate and does not "pond" or "puddle" on the surface.
 - .2 If ponding occurs, redistribute or remove the excess material on the surface before material starts to dry and form a film that will prevent penetration of excess material.
 - .3 Material coverage should not be greater than 4.4 m²/L (180 ft²/US gal.), unless otherwise recommended by the Manufacturer.
 - .4 Apply flood coat in two (2) passes, "wet on wet" with the second pass at right angles to the first.
 - .5 Complete and correct coverage of surfaces is crucial to the success of such sealers
 - .3 Control Joints:
 - .1 Install bond breaker of silica sand, polyethylene film strip or foam filler in bottom of joints.
- .2 Cementitious Topping, Patching and Flash Patching Materials:
 - .1 Leak Prevention:
 - .1 Fill cracks and voids in subfloor where leakage of slurry could occur using suitable quick setting patch material or caulk, as recommended by underlayment manufacturer.
 - .2 Prime substrate according to manufacturer's recommendations.
 - .3 Installation shall not begin until building is enclosed and ventilated.
 - .4 Mix levelling treatments and cementitious topping, patching and flash patching materials in accordance with Manufacturer's written instructions.
 - .5 Pour levelling treatments and cementitious topping, patching and flash patching materials to recommended thickness and immediately spread and screen to desired surface finish and level.
 - .3 Control Joints – Interior Surfaces:
 - .1 Follow existing control joints in concrete levelling and topping finishes to prevent cracking. When concrete levelling and topping finishes are firm enough not to be torn or damaged by cutting, cut 5mm (3/16") wide control joints into surface of concrete with abrasive blade power saw.
 - .2 Once levelling and topping finishes are cured, fill control joints with joint sealant.
 - .1 Completely clean side joint surfaces of dirt, oil, grease, and similar contaminants, and mask floor surfaces at joints while installing joint sealant.
 - .2 Prime side joint surfaces with compatible primer if surfaces are not completely dry.

- .4 Saw Cuts / Control Joints – Exterior Surfaces:
 - .1 Follow saw cut / control joint locations as indicated on the Landscape Drawing L-101.
 - .2 Joint width and depth as indicated on Landscape Drawing L-106.
 - .3 Fill saw cut / control joints with joint sealant.
 - .1 Completely clean side joint surfaces of dirt, debris, and similar contaminants, and mask floor surfaces at joints while installing joint sealant.
 - .2 Prime side joint surfaces with compatible primer if surfaces are not completely dry.

3.4 PATCHING AND REFINISHING

- .1 Before completion of project, patch and refinish defective surfaces to match surrounding areas with no discernible variation in appearance.

END OF SECTION

1 General

1.1 SUMMARY

- .1 This Section includes supply and installation of single wythe unit masonry assemblies, complete with mortar and grout, masonry joint reinforcement, ties, anchors, and miscellaneous masonry accessories.
 - .1 Standard Concrete Masonry Units
 - .2 Fire Resistant Concrete Masonry Units
 - .3 Ceramic Glazed Clay Masonry Veneer
 - .4 Architectural Trim Units
 - .5 Architectural Clay Masonry Veneer
 - .6 Mortar, and Grout
 - .7 Reinforcing steel
 - .8 Masonry joint reinforcement
 - .9 Ties and anchors
 - .10 Miscellaneous masonry accessories

1.2 REFERENCE STANDARDS

- .1 American Concrete Institute: (ACI):
 - .1 ACI 530.1-99/ASCE 6-99/TMS 602-99, Commentary on Specification for Masonry Structures
- .2 Canadian Standards Association (CSA):
 - .1 CAN/CSA A82, Fired Masonry Brick Made From Clay or Shale.
 - .2 CSA A165 Series-04 (R2009), CSA Standards on Concrete Masonry Units
 - .3 CSA A179-04 (R2009), Mortar and Grout for Unit Masonry
 - .4 CSA A370-04 (R2009), Connectors for Masonry
 - .5 CAN/CSA A371-04 (R2009), Masonry Construction for Buildings
 - .6 CSA S304.1-04 (R2010), Design of Masonry Structures
 - .7 CSA W186-M1990 (R2012), Welding of Reinforcing Bars in Reinforced Concrete Construction
- .3 American Society for Testing of Materials (ASTM):
 - .1 ASTM A123/A123M-09, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
 - .2 ASTM A153/A153M-09, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
 - .3 ASTM A496/A496M-07, Standard Specification for Steel Wire, Deformed, for Concrete Reinforcement
 - .4 ASTM A563-07a, Standard Specification for Carbon and Alloy Steel Nuts
 - .5 ASTM A653/A653M-11, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process

- .6 ASTM A1011/A1011M-12, Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength
- .7 ASTM C67-11, Standard Test Methods for Sampling and Testing Brick and Structural Clay Tile.
- .8 ASTM C207-06(2011), Standard Specification for Hydrated Lime for Masonry Purposes
- .9 ASTM C270-12, Standard Specification for Mortar for Unit Masonry.
- .10 ASTM C494-11, Standard Specification for Chemical Admixtures for Concrete.
- .11 ASTM E488/E488M-10, Standard Test Methods for Strength of Anchors in Concrete Elements
- .12 ASTM E514/E514M-11, Standard Test Method for Water Penetration and Leakage Through Masonry
- .13 ASTM E2556/E2556M-10, Standard Specification for Vapour Permeable Flexible Sheet Water Resistive Barriers Intended for Mechanical Attachment.
- .14 ASTM F593-02(2008)e1, Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs
- .15 ASTM F594-09e1, Standard Specification for Stainless Steel Nuts
- .4 Ontario Concrete Masonry Block Association (OCBA):
 - .1 OCBA Metric Technical Manual
- .5 Underwriters Laboratories of Canada (ULC):
 - .1 ULC List of Equipment and Materials for Fire Rated Construction

1.3 ADMINISTRATIVE REQUIREMENTS

- .1 Pre-Construction Conference: Arrange a site meeting, to coincide with regular bi-weekly site meetings, attended by the Contractor, the Subcontractor's representative and foreman for this project, the Consultant, materials supplier(s), and other relevant personnel before commencement of work for this Section; agenda for meeting will include; but not be limited to, the following:
 - .1 Confirmation of specifications and details for the project;
 - .2 Required mortar, grout and concrete testing, batch control and grouting procedures;
 - .3 Confirmation of appearance of exposed block lintels;
 - .4 Confirmation of reinforcement at corners and wall intersections;
 - .5 Coordination of interior crack control measures;
 - .6 Confirmation of trowelled or tooled joints to concealed and exposed masonry faces.
- .2 Coordination: Coordinate components of the work of this Section with work performed by other Sections including; but not limited to, the following:
 - .1 Steel Support Angles and Brackets:
 - .1 Coordinate requirements for structural steel support angles and brackets supplied and installed onto the building structure by Structural.
 - .2 Provide requirements for supply of loose steel lintels and shelf angles installed by this section to Section 05 50 00.
 - .2 Masonry Anchors:

- .1 Coordinate supply of anchor sections connecting to structural frame installed by Structural.
- .2 Include additional products for coordination furnished, but not installed, under this Section.

1.4 SUBMITTALS

- .1 Provide submittals in accordance with Division 01.
- .2 Samples: Submit samples of the following; Clay Veneer Masonry, Glazed/Architectural Concrete block, Concrete block, mortar, masonry reinforcement, ties and anchors for Consultant's approval before commencing work of this section.
- .3 Shop Drawings: Submit shop drawings indicating the following:
 - .1 Indicate sizes, profiles, coursing, and locations of special shapes for concrete masonry units and clay masonry veneer units.
 - .2 Detail corner units, end dam units, and other special applications for fabricated flashings.
- .4 Informational Submittals: Provide the following submittals when requested by the Consultant:
 - .1 Submit ULC Assembly Listings and Materials cut sheets for fire rated assemblies as follows:
 - .1 Not later than thirty (30) working days following Award of Contract, submit copies of ULC Assembly and Materials Listing for indicating ULC Number and how assembly meets the rating criteria for assemblies listed on drawings.
 - .2 Use the same system and material as would be required for a tested assembly for the project; ULC Listings are tested with the specific materials indicated; substitutions will not be permitted unless evidence of equivalency is confirmed.
 - .3 Submit manufacturer's product data for materials and prefabricated devices, providing descriptions are sufficient for identification at job site; include manufacturer's printed instructions for installation.
- .5 Certificates: Submit statements of material properties indicating compliance with specified requirements for each type and size of the following:
 - .1 Masonry Units:
 - .1 Include material test reports substantiating compliance with requirements.
 - .2 Include ULC Listings for fire resistance rated materials and construction equivalent to assemblies with indicated on drawings indicating fire resistance ratings.
 - .2 Cementitious Materials:
 - .1 Include brand, type, and name of manufacturer for site mixed mortar materials.
 - .2 Include description of type and proportions of ingredients for pre-blended, dry mortar mixes.
 - .3 Include description of type and proportions of ingredients for grout mixes.
 - .3 Accessories:
 - .1 Reinforcing bars
 - .2 Joint reinforcement

- .3 Anchors, ties, and metal accessories
- .4 Site Quality Control Submissions: Submit detailed description of methods, materials, and proposed unit masonry cleaning techniques.

1.5 SITE CONDITIONS

- .1 Protection of Masonry: Protect masonry and other work from marking and other damage and as follows:
 - .1 Cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work during construction until permanent flashings and membranes are completed.
 - .2 Cover partially completed masonry when construction is not in progress to prevent wetting of inside wythes of construction and contribution to efflorescence.
 - .3 Extend cover a minimum of 610mm (24") down both sides and hold cover securely in place.
 - .4 Secure cover a minimum of 610mm (24") down face next to un-constructed wythe and hold cover in place where one (1) wythe of multi-wythe masonry walls is completed in advance of other wythes.
 - .5 Provide adequate bracing for masonry during construction and until permanent lateral supports are in place.
 - .6 Do not apply uniform floor or roof loads for a minimum of twelve (12) hours and concentrated loads for a minimum of three (3) days after building masonry walls or columns.

1.6 DELIVERY, STORAGE, HANDLING AND PROTECTION

- .1 Delivery and Acceptance Requirements: Deliver pre-blended, dry mortar mix in moisture resistant containers designed for lifting and emptying into dispensing silo; store dry mortar mix in delivery containers on elevated platforms, under cover, and in a dry location or in a metal dispensing silo with weatherproof cover.
- .2 Storage and Handling Requirements: Store masonry units on elevated platforms in a dry location and as follows:
 - .1 Stack materials on floors of building so that structural design loads are not exceeded; coordinate with Consultant.
 - .2 Cover tops and sides of stacks with waterproof sheeting securely tied to pallets if units are not stored in an enclosed location; do not install masonry units that become wet until they are dry.
 - .3 Store cementitious materials on elevated platforms, under cover, and in a dry location; do not use cementitious materials that have become wet or damp.
 - .4 Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

2 Products

2.1 CONCRETE MASONRY UNITS (CMU-01)

- .1 Standard concrete blocks: Autoclave or bubble cure process, high pressure steam cured, modular, conforming to CSA A165 Series-04 (R2009), with lineal shrinkage and moisture movement not to exceed 0.035% and shall be as follows:
 - .1 Classification: S/15/A/M, 75% solid for all locations where structural members bear on concrete block.
 - .2 H/15/A/M, for all other block work.

- .3 Size: Modular to sizes indicated on Drawings and schedules.
- .4 Special shapes:
 - .1 Provide square units for exposed corners.
 - .2 Provide purpose made shapes for lintels and bond beams.
 - .3 Provide additional special shapes required for project.
 - .4 Manufacture special shapes at same time and with the same batch as standard concrete block to be used.
- .2 Fire Resistant Concrete Masonry Units: Manufactured in accordance with CSA A165 Series-04 (R2009) as modified below:
 - .1 Classification:
 - .1 1 Hour Fire Rating: H/15/A/O
 - .2 Concrete Composition – 2 Hour Fire Rating: Type L₂20S Concrete.
 - .3 Size: Modular to sizes indicated on Drawings.
 - .4 Where concrete block walls are required as fire separations or barriers, they shall conform to the local Building Code with respect to equivalent thickness and type of concrete. Consult with Consultant for locations and special conditions.

2.2 CERAMIC GLAZED CLAY MASONRY (GLB)

- .1 Pattern
 - .1 Running Bond
- .2 Characteristics
 - .1 Ceramic Glazed Brick: ASTM C216, Grade SW, and C126 or ASTM C1405, Class Exterior. Glazed finish to be provided to all exposed faces.
 - .2 Size: Manufacturer's standard units with face dimensions of 7 5/8" long x 2 1/4" tall x 3 5/8" deep or as indicated in drawings/schedules.
 - .3 Special Shapes: Provide where shown or scheduled and where required to complete masonry work as indicated, including corners, intersections, end/end caps, control joints, bond beams and other special conditions, all of one manufacturer. Glazed finish required on exposed surfaces, including returns into door/window openings.
- .3 Colour: As selected later by Architect from manufacturers full colour range, allow for 1 colour.
- .4 Acceptable Products:
 - .1 Glazed Brick as manufactured by Belden Brick Company
 - .2 Glazed Brick as manufactured by Elgin Butler
 - .3 Equivalent per Specification 01 25 00.

2.3 CLAY MASONRY VENEER BRICK (BRK)

- .1 Pattern
 - .1 Running Bond
- .2 Characteristics
 - .1 Size shall be Modular, 57mm height x 194mm length x 92mm depth and complies with ASTM C 216, Grade SW, Type FBS.

- .3 Shapes: Provide where shown or scheduled and where required to complete masonry work as indicated, including corners, intersections, ends, control joints, and other special conditions, all of one manufacturer.
 - .1 Finish: smooth.
 - .2 Colour: to be selected by Consultant at later date from manufacturer full colour range.
- .4 Acceptable Products:
 - .1 Canada Brick, Collection: Canada Architectural Series
 - .2 Endicott Brick
 - .3 Equivalents as per Specification 01 25 00

2.4 MORTAR MATERIALS (TYP)

- .1 Mortar materials shall conform to CSA A179.
- .2 Water: Potable (clean, exempt of ice, oils, acid, alkalis, organic matter, sediments or any other harmful matter).
- .3 Aggregate: Meeting CSA A179, and as follows:
 - .1 Use same brands of materials and source of aggregate for entire project.
 - .2 Use washed aggregate consisting of natural sand or crushed stone for mortar that is exposed to view.
 - .3 Use aggregate graded with 100% passing the No. 16 (1.18-mm) sieve for joints less than 6 mm thick.
- .4 Cement: Normal portland, in accordance with CSA A3000-08, Type GU.
- .5 Grout: In accordance with CSA A179, Table 3.
- .6 Hydrated Lime: ASTM C207, Type S.

2.5 MORTAR MATERIALS (AT GLB)

- .1 Non-loadbearing glazed masonry: Chemical/corrosion resistant, 3-component epoxy brick mortar with the following physical properties, to be used at glazed brick veneer.

Water absorption (ASTM C413)	0.1%
Working time (minutes) at 70°F (21°C)	35-45 minutes
Setting time (hours) at 70°F (21°C)	1.5-2.5 hours
Density (ASTM C138)	115 lbs./cu. ft. (1842 kg per meter ³)
Tensile (ASTM C307)	2,250 psi (15.5 MPa)
Compressive strength (ASTM C579)	12,000 psi (83 MPa)
Shrinkage (ASTM C531)	0.04%
Coefficient of thermal expansion (ASTM C531)	37 x 10 ⁻⁶ / °F (67 x 10 ⁻⁶ / °C)
Maximum service temperature	225°F (107°C)

2.6 MORTAR MIXES

- .1 Mixing:
 - .1 Prepare and mix mortar materials under strict supervision and in small batches for immediate use only.

- .2 Mix proprietary mortars in strict accordance with CSA A179. Do not use re-tempered mortars for coloured mortars.
- .2 For Exterior Wythe of Cavity/Composite Walls (non load-bearing, above grade):
 - .1 Use Type 'N', 1:1:6 pre-mixed, pre-coloured, Portland cement/lime/sand mortar, 'Betomix Plus' by Daubois Inc., or Maxi-Mix silo. Use non-staining "white" cement where required to achieve colour as selected later by the Consultant.
- .3 For Interior Reinforced or Non-Reinforced Block Walls:
 - .1 Use Type 'S', premixed 'Bloc Mix' by Daubois Inc., or approved equivalent by Maxi-Mix.
- .4 Mortar pigment (for exterior wythe of cavity/composite walls):
 - .1 'Bay FerroX' by Bayer Inc. or approved alternative by Elementis Pigments. Colour to later selection by Consultant.

2.7 MASONRY REINFORCEMENT, TIES AND ANCHORS

- .1 Masonry Joint Reinforcement: In accordance with to CSA A371 and ASTM A496, with corrosion protection in accordance with CSA S304.1 and CSA A370, and as follows:
 - .1 Interior Walls: Hot dip galvanized, carbon steel.
 - .2 Exterior Walls: Stainless steel.
 - .3 Lengths: A minimum of 3048mm (10') with prefabricated corner and tee units.
- .2 Connectors: In accordance with to CSA A370-04 (R2009) and CSA S304.1-04(R2010) with hot dip galvanized finish.
- .3 Single Wythe Masonry Joint Reinforcement: Either ladder or truss type with single pair of side rods.
- .4 Ties and anchors specified in this section shall be designed in accordance with CSA A370-04 (R2009) for non-conventional masonry connectors as follows:
 - .1 Deflection: Maximum 1.6mm (1/16") including free play, when acted upon by a lateral load of 0.45 kN, in all possible positions of adjustment.
 - .2 Positive restraint at position of maximum adjustment.
 - .3 Free play of multi-component ties maximum 0.8mm (1/32") when assembled in all possible configurations.
 - .4 Anchors shall allow vertical adjustment but resist tension and compression forces perpendicular to plane of wall.
- .5 Wall Ties (masonry veneer/insulated cavity/masonry backup): Single screw, Type 304 stainless steel veneer tie for concrete/CMU construction featuring a dual-diameter barrel with factory-installed EPDM washers to seal both the face of the insulation and the air/vapor barrier, and thermal wings to decrease thermal transfer through cavity insulation. Provide 3/16" diameter, type 304 stainless steel 2X-Hook to wire tie. Length of tie/hook to suit thickness of cavity insulation and air space as detailed.
 - .1 Acceptable product: 2-Seal Thermal Concrete Wing Nut Anchor by Blok-Lok or equivalent.
- .6 Lateral Partition Supports (Top of Wall Anchors):
 - .1 Angle Support: Fabricated from 3mm (1/8") core metal thickness angled steel plate having 75mm (3") long legs fastened to deck structure to allow vertical movement of masonry assembly; hot dip galvanized; coordinate with Section 07 84 00 for firestopping insulation and smoke seals.
 - .1 Basis of Design Materials: Blok-Lok BL-LSA1 & 2 (or approved equivalent).

- .2 Plate Support: Fabricated from 3mm (1/8") core metal thickness stainless steel plate with 10mm (3/8") diameter metal 150mm (6") long welded to plate having closed end plastic tube fitted over rod that allows rod to move in and out of tube.
- .3 Anchor Bolts: Where required provide Headed or L-shaped steel bolts in accordance with ASTM A307-10, Grade A; with ASTM A563-07a hex nuts and, where indicated, flat washers; hot-dip galvanized in accordance with ASTM A153, Class C.
- .7 Galvanizing for Masonry Reinforcement, Ties and Anchors:
 - .1 Hot Dip Hardware and Bolts: In accordance with ASTM A153/A153M-09, Class B-2 regardless of location.
 - .2 Hot Dip Sheet Steel: In accordance with ASTM A653, Coating Designation Z600, regardless of location.
 - .3 Structural Shapes and Pipes: In accordance with ASTM A123, Grade 85, regardless of location.
- .8 Rebar Positioners: 9 gauge diameter wire, hot dipped galvanized.
 - .1 Basis of Design Materials: Blok-Lok BL-RB Rebar Positioners (or approved equivalent).
- .9 Fastening Into Solid Concrete or Solidly Grouted Installation: Two component, injectable adhesive specifically manufactured for use in installing dowels or threaded anchor rods and inserts into new or existing concrete or grout, and as follows:
 - .1 Epoxy Composition: Sealed packaging containing resin, hardener, cement and water; components.
 - .2 Curing Time: Rapid set, high strength and stiffness; maximum time 45 minutes at 20 deg C.
 - .3 Basis-of-Design Materials: Hilti Inc., HIT HY150 System (or approved equivalent).
- .10 Fastening through Hollow Wall Installation: Two-component, injectable adhesive specifically manufactured for use in installing dowels or threaded anchor rods and inserts, with cylindrical mesh screen tube into new or existing masonry cavity wall, and as follows:
 - .1 Epoxy Composition: Sealed packaging containing resin, hardener, cement and water.
 - .2 Curing Time: Rapid set, high strength and stiffness; maximum time 60 minutes at 20 deg C.
 - .3 Basis-of-Design Materials: Hilti Inc., HIT HY20 System (or approved equivalent).

2.8 MISCELLANEOUS MASONRY ACCESSORIES

- .1 Packing Insulation: As indicated in Section 07 20 00.
- .2 Firestopping: As specified under Section 07 84 00.
- .3 Sealants: As specified under Section 07 92 00, and as follows:
 - .1 Vertical Sealant: Colour to match masonry veneer
 - .2 Horizontal Sealant: Colour to match mortar
- .4 Maintenance Cleaners: Manufacturer's recommended maintenance cleaners.
- .5 Support Angle: Hot dip galvanized, in accordance with CSA A370 and ASTM A153.
- .6 Fasteners: Galvanized fasteners meeting the requirements of ASTM A325, and as recommended by manufacturer.

- .7 Compressible Joint Filler: Pre-moulded filler strips in accordance with ASTM D1056-07, Grade 2A1; compressible up to 35%; of width and thickness indicated; formulated from neoprene, urethane or PVC.
- .8 Bond Breaker Strips: #15 asphalt saturated, organic roofing felt in accordance with CSA A123.3-05 (R2010).
- .9 Weep hole vents: Flexible ultra-violet resistant polypropylene-copolymer plastic, 'Cell-Vent' by Blok-Lok, 'Mortar Maze Cell Vents' by Advanced Building Products Inc. or approved alternative. Provide at 600mm intervals at through-wall flashing/base course and as vents at high level below sill/horizontal interruptions to encourage air movement within cavity. Stagger high level vents in relation to base vents.
- .10 Metal through wall flashings: Prefinished metal flashings in accordance with Section 07 62 00, continuous strips with a 19 mm folded drip edge.
- .11 Membrane through wall flashing: Reinforced SBS rubberized asphalt compound laminated to cross-laminated polyethylene film, 40 mils thick; 'Airshield Thru Wall Flashing' by W.R. Meadows or approved alternative, complete with primer and adhesive recommended by flashing manufacturer. Refer also to Specification 07 27 39.

2.9 MASONRY COATINGS

- .1 Proprietary Masonry Cleaner: Masonry manufacturer's recommended cleaner designed for removing mortar/grout stains, efflorescence, and other new construction stains from new masonry without discolouring or damaging masonry surfaces.
 - .1 Clear coating.
 - .2 Verify acceptability of cleaner for cleaning masonry with mortar joints and for kinds of masonry units specified.

3 Execution

3.1 EXAMINATION

- .1 Examine conditions for compliance with requirements for installation tolerances and other conditions affecting performance of work.
 - .1 Prepare written report listing conditions detrimental to performance of work and submit to the Consultant.
 - .2 Verify that reinforcing dowels are properly placed.
- .2 Examine rough-in and built-in construction for piping systems to verify actual locations of piping connections before installation of unit masonry.
- .3 Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION - GENERAL

- .1 Thickness: Build single wythe walls to actual widths of masonry units, using units of widths indicated on Drawings.
- .2 Single wythe masonry construction shall conform with the Ontario Concrete Block Association (OCBA) requirements for water resistant single wythe masonry construction.
- .3 Use full size units without cutting except as follows:
 - .1 Cut units with motor driven saws if cutting is required to provide a continuous pattern or to fit adjoining construction.
 - .2 Provide clean, sharp, un-chipped edges.
 - .3 Allow units to dry before laying unless wetting of units is specified.

- .4 Install cut units with cut surfaces and cut edges concealed where possible; obtain Consultant's acceptance where cut edges must be exposed.
- .4 Select and arrange units for exposed unit masonry to produce a uniform blend of colours and textures; mix units by drawing units diagonally down multiple rows from at least three different pallets as masonry units are placed. "Exposed" means visible in complete work, unpainted and painted.
 - .1 Large variations in colour or texture between adjacent blocks of material will cause the Consultant to reject the installation, and the installer to rebuild the assembly at no additional cost to Contract.
- .5 Wet masonry before laying when recommended by manufacturer; allow units to absorb water so they are damp but not wet at time of laying.
- .6 Maintain dimensions, lines and levels.
- .7 Keep exposed faces free from stains, chips and cracks.
- .8 Keep tolerance in plane of 3mm in 2440mm (1/8" in 96"). Do not use chipped, cracked or deformed units in exposed work.
- .9 Buttering corners of units, throwing mortar droppings into joints, will not be permitted. Do not shift or tap units after mortar has taken initial set, where adjustments must be made after mortar has started to set, remove mortar and replace with fresh supply.

3.3 LAYING MASONRY WALLS

- .1 Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement type joints, returns, and offsets; avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.
- .2 Bond Pattern for Exposed Masonry: Lay exposed masonry in bond as indicated on the Drawings; do not use units with less than 100mm (4") horizontal face dimensions at corners or jambs. Lay masonry in running bond where not otherwise indicated on the Drawings.
- .3 Lay concealed masonry with all units in a wythe in running bond or bonded by lapping a minimum of 100mm (4"), and as follows:
 - .1 Bond and interlock each course of each wythe at corners.
 - .2 Do not use units with less than nominal 100mm (4") horizontal face dimensions at corners or jambs.
- .4 Stopping and Resuming Work:
 - .1 Stop work by racking back units in each course from those in course below; do not tooth.
 - .2 Clean masonry surfaces that are to receive mortar, remove loose masonry units and mortar, and wet brick if required before laying fresh masonry when resuming work.
- .5 Built-In Work:
 - .1 Build in items specified in this and other Sections as construction progresses.
 - .2 Fill in solidly with masonry around built-in items.
 - .3 Fill space between steel frames and masonry solidly with mortar.
 - .4 Place a layer of metal lath, wire mesh, or plastic mesh in the joint below and rod mortar or grout into core where built-in items are to be embedded in cores of hollow masonry units.
 - .5 Protect built-in items from damage arising from work of this Section.

- .6 Grouting Hollow Concrete Masonry Units – Load Barring Application:
 - .1 Fill cores in hollow concrete masonry units with grout 610mm (24") under bearing plates, beams, lintels, posts, and similar items.
 - .2 Use concrete or fine grout where indicated, and also for vertical core filling, lintel beams, bond beams and other filled cores where reinforcing steel is indicated.
 - .3 Use fine grout where the space being grouted is 50mm (2") or less in its least dimensions; use concrete in all other applications that call for grout.
 - .4 Use square end concrete masonry units wherever a full or half concrete masonry unit will receive concrete fill.
 - .5 Use full mortar bedding of cross webs for cores that are filled.
 - .6 Fill cores in lifts of 1220mm (4') maximum; provide cleanout openings for lifts in excess of 4' where Consultant has accepted larger lifts.
 - .7 Consolidate core fill during placement by vibration or puddling.
 - .8 Stop concrete core fill 38mm (1-1/2") below top surface of lift whenever filling will be stopped for more than a 1 hour time duration.
 - .9 Fill all cores of roof parapets with concrete.
 - .10 Secure vertical reinforcement in position at top and bottom of core, and a maximum 4' spacing, refer to Drawings for location of vertical reinforcement.
 - .11 Fill voids solid with mortar so that ties and anchors are set in full mortar bed where masonry walls abut steel or concrete columns.
- .7 Build non-load bearing interior partitions full height of storey to underside of solid floor or roof structure above, leaving a gap to allow for structural deflection, and as follows:
 - .1 Fasten lateral partition supports to structure above and build into top of partition; grout cells of concrete masonry units solidly around plastic tubes of anchors and push tubes down into grout to provide 13mm (1/2") clearance between end of anchor rod and end of tube; space anchors at 1220mm (4') O.C.

3.4 MORTAR BEDDING AND JOINTING

- .1 Lay solid masonry units with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place; do not deeply furrow bed joints or slush head joints.
- .2 Lay block work as follows:
 - .1 Provide special shapes and sizes as required such as halves, jambs, lintels, solids, corners, semi-solids, etc.
 - .2 Webs to align plumb over each other with thick ends of webs up. Leave no cells open in exposed work. Reinforce all block.
 - .3 Minimize cutting block. Cut exposed work with power driven abrasive cutting disc or diamond cutting wheel for flush mounted electrical outlets, grilles, pipes, conduit, etc., leaving 3mm (1/8") maximum clearance.
 - .4 Do not wet concrete masonry units before or during laying.
 - .5 Locate corners accurately. Use full bed of mortar for first course. Bed face shells and cross and end web fully in mortar. Stagger joints in every course. Align joints plumb over each other in every other course.
 - .6 Bond intersecting block walls in alternate courses. Where block abuts concrete, bond each block course with dovetail anchors, ties and dovetail slot. Do not break bond of corridor walls or other walls of exposed units where partitions

- intersect and if bonding would show through on intersect with prefabricated intersection masonry reinforcement in each course.
- .7 Take special care in erecting block walls to which other sections will be applying finishes or attaching equipment to ensure tolerances required for work of other sections can be met with reasonable construction procedures. (e.g. thin-set application of ceramic tile.)
 - .8 Provide bullnose block at all exposed block corners.
 - .9 Build block lintels, ensure that lintel jointing coincides with regular bond.
- .3 Set trim units in full bed of mortar with full vertical joints, and as follows:
- .1 Fill dowel, anchor, and similar holes.
 - .2 Clean soiled surfaces with fibre brush and soap powder and rinse thoroughly with clear water.
 - .3 Lay trim units so that joints are even and so that average distance between joint centrelines is equal to the nominal modular dimension of adjacent masonry. Lay trim units in running bond, unless otherwise indicated on the Drawings.
 - .4 Set trim units in accordance with manufacturers recommended installation practices and materials. Review manufacturer's written recommendations with the Consultant before proceeding.
 - .5 Use chipped or blemished units only where the defect will be concealed; reject all defective and broken units or units with chipped edges or corners.
 - .6 Install cut units with cut surfaces and, where possible, cut edges concealed. Where complex cutting is required, place mortar along the cut edge and trowel smooth to provide a consistent 50mm (2") wide gap.
- .4 When mortar is "thumbprint" hard, tool all joints (exposed or concealed) concave except at blockwork designated to receive ceramic tile finish which blockwork shall be struck flush.
- .1 Use sufficient force to press mortar tight against masonry units on both sides of joints.
 - .2 Remove excess material or burrs left after jointing. Use trowel or rub with burlap bag.
- .5 Lay all joints 10mm (3/8") thick unless otherwise specified or otherwise indicated. Fill all joints solidly with mortar except where specifically designated to be left open.
- .6 Stagger joints in every course. Align joints plumb over each other in every other course. Vertical and horizontal joints to be uniform in thickness.

3.5 PARTITIONS (OTHER THAN LOAD-BEARING)

- .1 Carry following partitions up through ceiling to structure above, unless noted or specified otherwise; corridor partitions, partitions around staircases and shafts, partitions around washrooms, and any other partitions so indicated on drawings. Terminate all other partitions at first coursing joint above finished ceiling.
- .2 Except around staircases and shafts, terminate through partitions within 19mm (3/4") of structure above, i.e. floor, roof decking depending under which partitions occur, and where such partitions occur directly under and parallel to structural framing carry these partitions up to within 19mm (3/4") of bottom of such structural framing.
- .3 Around staircases and shafts, wedge and grout masonry solidly to structure above. Laterally support other partitions as required by building code. Where tops of partitions are exposed to view, lateral supports shall be concealed.

- .4 Where walls and partitions are pierced by structural members, ducts or pipes, fill voids with mortar to within 19mm (3/4") of such members flush with wall fins.
- .5 Fill spaces between partition and structure, ducts and pipes with compressed glass fibre or mineral wool insulation completely from one side of wall to other.

3.6 CONTROL JOINTS

- .1 Provide vertical through wall control joints 7620mm (25') O.C. maximum (except as otherwise shown or specified) in continuous walls having no openings, intersections or columns. Control joints as shown on Drawings.
- .2 Locate control joints at high stress concentrations and at points of weakness such as at abrupt changes in work height, wall thickness changes such as at chases and at pilasters and maximum of 3658mm (12') from corners.
- .3 Construct joint as detailed and generally as follows:
 - .1 Place building paper against end of block on one side of control joint. Extend bond breaker full wall thickness.
 - .2 Fill voids between ends of block with mortar to form key and strike back exposed vertical joints 19mm (3/4") deep, install backer rod and caulk in accordance with Section 07 92 00.
 - .3 Reinforce joints every third course with two 6mm (1/4") diameter greased smooth rods. Locate rods 32mm (1-1/4") in from faces of block centres on joint running parallel to wall.

3.7 REINFORCEMENT AND REINFORCING TIES

- .1 Reinforce all masonry walls with continuous masonry horizontal reinforcement in every second block course.
- .2 Provide extra reinforcement or reinforcing ties at openings so that first and second courses above and below openings are reinforced. Extend extra reinforcement 610mm (2') beyond opening in each direction.
- .3 Anchor new masonry to structural steel to concrete elements, to existing construction at maximum 406mm (16") O.C., vertically in accordance with local building code requirements.

3.8 BUILT-INS

- .1 Built-in items provided by other Sections, anchor bolts, sleeves, inserts, loose steel lintels, shelf angles, access panels, and other such items.
- .2 Built-in items to present neat, rigid, true and plumb installation. Leave wall openings required for ducts, grilles, pipes and other items.
- .3 Fill voids between masonry and metal frames with masonry mortar.

3.9 REPOINTING OR TUCKPOINTING

- .1 Repoint defective joints as follows:
 - .1 Cut back joints 13mm (1/2"), taking care not to damage units. Remove dust and loose materials by brushing or by water jet.
 - .2 If water jet is used, allow excess water to drain before repointing.
 - .3 Repoint with same mix as original. Pack mortar tightly in thin layers, and tool joints or strike flush as required.

3.10 CLEANING

- .1 Keep work clean and free of mortar stains during laying. Allow mortar droppings which adhere to wall to dry out but not set.

- .2 Rub with small piece of masonry followed by brushing to remove all traces.
- .3 On completion of masonry, after mortar is thoroughly set and cured, and defective joints tucked and pointed, clean masonry thoroughly.
- .4 Remove mortar with wood paddles and scrapers before wetting. Saturate masonry with clean water and flush off loose mortar and dirt. Clean block work using water, scrubbing brushes and wood paddles only.
- .5 All masonry shall be free of efflorescence.

END OF SECTION

1 General

1.1 SUMMARY

- .1 Section Includes the following:
 - .1 Load-bearing steel framing systems and accessories for support of cladding at exterior walls.
 - .2 Load-bearing and/or laterally supported interior framing for bulkheads, support for head supported sliding doors and additional elements as detailed/scheduled.
- .2 Unless otherwise specified conform to CSA-S16, Steel Structures for Building - Limit States Design and CAN/CSA-S136, Cold Formed Steel Structural Members.

1.2 REFERENCE STANDARDS

- .1 Canadian Institute of Steel Construction (CISC):
 - .1 CISI - Specification for the Design of Cold-Formed Steel Structural Members, in accordance with CAN/CSA-S136.
- .2 American Society for Testing and Materials (ASTM):
 - .1 ASTM A153/A123M-09, Zinc Coating (Hot-Dipped) on Iron and Steel Hardware.
 - .2 ASTM A568/A568M-11b, General Requirements for Steel Sheet, Carbon, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled.
 - .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 C955-11c, Standard Specification for Load-Bearing (Transverse and Axial) Steel Studs, Runners (Track), and Bracing or Bridging for Screw Application of Gypsum Board and Metal Plaster Bases.
 - .5 ASTM C1513 - Standard Specification for Steel Tapping Screws for Cold Formed Steel Framing Connections.
- .3 American National Standards Institute/American Welding Society:
 - .1 ANSI/AWS D1.3, Structural Welding Code - Sheet Steel.
- .4 Canadian Standards Association:
 - .1 CSA-W47.1, Certification of Companies for Fusion Welding of Steel Structures.
 - .2 CSA-W59-03 (R2008), Welded Steel Construction (Metal Arc Welding).
 - .3 CSA-S16-09, Design of Steel Structures
 - .4 CAN/CSA-S136-07, North American Specification for the Design of Cold-Formed Steel Structural Members
- .5 Canadian General Standards Board (CGSB):
 - .1 CAN/CGSB-1.181-99, Ready-Mixed Organic Zinc-Rich Coating
 - .2 CAN/CGSB-51.32-M77, Sheathing, Membrane, Breather Type
- .6 Canadian Sheet Steel Building Institute:
 - .1 CSSBI 51M-1991, Lightweight Steel Framing Design Manual.

1.3 SYSTEM DESCRIPTION

- .1 Design Requirements:
 - .1 Have work of this section designed by a professional engineer licensed to design structures and registered in the place of Work.

- .2 Design cold formed metal framing system to resist pressure and suction of wind loads, snow loads, snow load build-up and temperature range, expected in the geographical area for this project, under the local Building Code, climatic information for 30 year probability without any detrimental effects on appearance and performance.
- .3 Design shall be based on Limit States Design principles using factored loads and resistances.
- .4 Deflection (inward or outward) shall not be greater than $L/720$ of the span between points of support.
- .5 Resistance strength and resistance factors shall be determined in accordance with applicable building code requirements and CAN/CSA-S136.
- .6 Construct work of this section to provide for expansion and contraction of components as will be caused by ambient temperature range without causing buckling, failure of joint seals, undue stress on fasteners or other effects detrimental to appearance or performance.
- .7 Section properties shall be computed on the basis of the nominal core thickness.
- .8 Design bridging to prevent member rotation and member translation perpendicular to the minor axis. Provide for secondary stress affects due to torsion between lines bridging. Sheathing shall not be used to help restrain member rotation and translation perpendicular to the minor axis for wind bearing studs.
- .9 Design cold formed metal framing system to support loads and superimposed loads transferred from cladding and include for design of support and attachment components between other assemblies and stud system. Responsibility for design of exterior wall loads transferred from other envelope components is part of work of this section.
- .10 Design of cold formed metal framing system shall account for deflection of primary structural elements as necessary.

1.4 SUBMITTALS

- .1 Provide submittals in accordance with Division 01.
- .2 Shop Drawings:
 - .1 Prepare and submit shop and erection drawings which conform to the requirements of the CAN/CSA-S16, and as specified herein.
 - .2 Cold formed metal framing system must have shop drawings prepared by qualified draftsmen, checked by and bearing the seal of a professional engineer registered to design structures and practice in the place of Work.
 - .3 Show the size, spacing and location of connections, attachments, reinforcing and anchorage. Include necessary plans, elevations and details. Indicate size and type of fastening. For weld connections use welding symbols in compliance with AWS and indicate clearly net weld lengths.
 - .4 Submit typical details of connections, and any special connections for approval before preparation of shop drawings.
 - .5 Review of shop drawings by the Consultant and Structural Engineer will not absolve the Contractor from his responsibility of providing materials and equipment to complete and finish work of this section in accordance with the architectural and structural drawings. Departures or differences from the referenced drawings shall be approved in writing by the Consultant.

1.5 QUALITY ASSURANCE

- .1 Conform to requirements of CAN/CSA-S16, Steel Structures for Buildings, and CAN/CSA-S136, Cold Formed Steel Structural Members.
- .2 Work to be executed by firm thoroughly conversant with laws, by-laws and regulations which govern, and capable of workmanship of best grade of modern shop and field practice known to recognized manufacturer's specializing in this work.
- .3 Work shall be executed by workers especially trained and experienced in this type of work. Have a full time, senior, qualified representative at the site to direct the work.
- .4 Install system to provide for movement of components without damage, failure of joint seals, undue stress on fasteners, or other detrimental effects when subject to seasonal or cyclic day/night temperature ranges.
- .5 Install system to accommodate construction tolerances, deflection of building structural members, and clearances of intended openings.

1.6 INSPECTION AND TESTING

- .1 An independent inspection and testing company appointed and paid for by the Cash Allowance may carry out inspection and testing of the structural steel stud systems in accordance with Division 01.
- .2 Provide free access for inspectors to all places where work is being done.
- .3 Inspectors are to ensure that materials conform to the requirements of this section.
- .4 Any inspection and/or testing required because of an error by the Contractor, or due to departure from the Contract Documents shall be paid for by the Contractor.
- .5 Inspection and testing of structural metal stud systems shall include, but shall not be limited to the following:
 - .1 Checking that mill test reports are properly correlated to materials.
 - .2 Sampling fabrication and erection procedures for general conformity to the requirements of the specification.
 - .3 Checking that the welding conforms to the requirements of CSA W47.1, CSA W59 (R2008) and/or ANSI/AWS D1.3, whichever is applicable.
 - .4 Checking fabricated members against specified member shapes.
 - .5 Visual inspection of all welded connections including sample checking of joint preparation and fit-up.
 - .6 Sample checking of screwed and bolted joints.
 - .7 Sample checking that tolerances are not exceeded during fit-up and/or erection.
 - .8 Additional inspection and testing of welded connections at required by CSA W59.
 - .9 General inspection of field cutting and alterations required by other trades.
 - .10 Submission of reports to the Consultant covering the work inspected with details of deficiencies discovered.
- .6 The inspection and testing provided in this Section does not relieve the Contractor of his responsibility for the performance of the Contract. The Contractor shall implement his own supervisory and quality control procedures.
- .7 Materials and/or workmanship not conforming to the requirements of the Contract Documents may be rejected at any time during the progress of the work, and shall be replaced and/or repaired without cost to the Owner.

1.7 DELIVERY, STORAGE, HANDLING AND PROTECTION

- .1 Coordinate deliveries to comply with Construction Progress Schedule and arrange ahead for off-the-ground storage location. Do not load any area beyond the design limits.
- .2 Adequately protect steel against rust and damage during manufacturing, delivery and storage.
- .3 Store material on planks on a dry area and protect from damage. Make good immediately any damage done, clean scratches and the like, touch-up with specified primer.

2 Products

2.1 MANUFACTURERS

- .1 Cold formed metal framing as indicated on drawings and as specified herein shall be by one of the following:
 - .1 Bailey Metal Products Limited, or;
 - .2 Canadian Steel Manufacturing, Division of British Steel Canada Inc., or;
 - .3 Lightsteel Inc., Boucherville, Quebec;
 - .4 Or equivalent per Specification 01 25 00.

2.2 MATERIALS

- .1 Framing materials shall conform to the requirements of CAN/CSA-S136.
- .2 Galvanized Sheet Steel:
 - .1 Conform to ASTM A653/A653M, minimum Grade D, 50 PSI (345 Mpa) yield for 1.5mm (.060") material.
- .3 Structural Metal Studs:
 - .1 Galvanized sheet steel formed to channel shape, of minimum gauge, sizes, and section properties to meet design requirements, and conforms to ASTM C955.
- .4 Metal Stud Runners/Top and Bottom Tracks:
 - .1 Galvanized sheet steel formed to channel shape, having same width as studs, with tight fit and solid web, of minimum gauge to meet design requirements, but no less than gauge of metal studs, and conforms to ASTM C955.
- .5 Metal Plates, Bridging, Gussets and Clips:
 - .1 Formed from galvanized sheet steel, of gauges, shapes and sizes required to meet design requirements determined for conditions encountered, and of same finish as framing members.
- .6 Fastenings:
 - .1 Self-drilling, Self-tapping Screws, Bolts, Nuts and Washers: Hot-dip galvanized to 1.25 ounce per square foot and conforms to ASTM A153/A153M-09, Class B3, '12-24 x 7/8 HWH #4STLG' by Hilti Canada, or approved equivalent.
 - .2 Anchorage Devices: Power driven, powder actuated, drilled expansion bolts, or screws with sleeves, as application dictates.
 - .3 Welding Materials: Conforms to CSA W59.
 - .4 Electrodes for welding shall have minimum 480 Mpa tensile strength series, (E480XXX,E480S-X).
- .7 Touch-Up Primer:
 - .1 Ready mixed, zinc-rich primer, and conforms to CAN/CGSB-1.181, 'Sealtight Galvafruid Zinc-Rich Coating' by W.R. Meadows of Canada Limited, or 'Zinc Clad

No.7 Organic Zinc Rich Primer' by Sherwin Williams Company of Canada Ltd., or approved equivalent.

.8 Dampproof Course:

.1 No. 15 asphalt building paper conforming to CAN/CGSB-51.32-M77.

2.3 FABRICATION

- .1 Fit and assemble work in shop where possible. Execute work according to details and reviewed shop drawings.
- .2 Take measurements at the building for work which is to fit or be connected to steel, concrete framing or masonry, before commencing fabrication.
- .3 Structural metal studs shall have one unreinforced service cut-out centred in the web of the studs and with the centreline of the cut-out a minimum of 455mm (1'-6") from the bottom of the studs. In addition to the above, provide cut-outs for internal bridging as required. All unreinforced cut-outs shall conform to dimension limitations of Table 1, in the CSSBI M50-1987 Manual.
- .4 Provide pre-punched cut-outs in inner top track for anchor clearances so that deflection clearances are not reduced.
- .5 Fabrication tolerances for cold formed steel framing members shall to Table 2 of the CSSBI M50-1987 Manual.
- .6 Cutting of cold formed steel framing members shall be by "power saw" or "shear" methods. Cutting by "torch" method shall not be permitted.
- .7 Steel thickness, exclusive of coating shall be marked on all cold formed steel framing members by embossing, or by stamping with indelible ink, or by colour coding method.
- .8 Gauges and sizes of metal shall be adequate for various conditions.

2.4 CLADDING ACCOMODATION

- .1 Provide an engineered designed framing support assembly to maintain dimensions to face of cladding materials indicated on drawings to include the framing supports configuration, size, spacing, and adjust as needed to accommodate support for each cladding type, in accordance with the engineering and/or contract documents including but not limited to:
 - .1 Metal Cladding specified by Section 07 46 19.
 - .2 Canopy/soffits as detailed.
- .2 Tolerances
 - .1 Accommodate deflection of structural members as it applies to the Work.
 - .2 Maintain clearances at adjacent construction.
 - .3 Prevent load transfer to non-structural elements.
 - .4 Thermally isolate fasteners from metal using thermal isolation washers or other means.
- .3 Effect on Wall Assemblies
 - .1 Framing system must not degrade complete wall assembly's thermal resistance by reasonable amount and conform to ASHRAE 90.1 prescriptive U-value of wall assembly for appropriate climate zone.

3 Execution

3.1 EXAMINATION

- .1 Verify at site that the work to receive the work of this section is free of irregularities detrimental to the installation and performance of the work and that it is located correctly and at proper levels before delivery and installation.
- .2 Verify that building framing components are ready to receive work.
- .3 Beginning of installation means acceptance of existing conditions.

3.2 ERECTION OF STUDS

- .1 Install components in strict accordance with manufacturer's written instructions.
- .2 Methods of construction may be either piece by piece (stick-built), or by fabrication into panels (panelized) either on or off site. Handling and lifting of prefabricated panels shall not cause permanent distortion to any member or collateral material.
- .3 Cold formed steel framing shall be erected true and plumb within the tolerances specified herein. Temporary bracing shall be employed wherever necessary to withstand all loads to which the structure may be subject during erection and subsequent construction. Temporary bracing shall be left in place as long as required for the safety and integrity of the structure. The Contractor shall ensure that during erection a margin of safety consistent with the requirements of the National Building Code and CAN/CSA-S136 exists in the uncompleted structure.
- .4 Erection Tolerances:
 - .1 For the purposes of erection tolerances, "camber" is defined as the deviation from straightness of a member or any portion of a member with respect to its major axis and "sweep" is defined as the deviation from straightness of a member or any portion of a member with respect to its minor axis.
 - .2 For wind bearing studs, out of plumbness shall not exceed 1/500th of the member length. Out of straightness (camber and sweep) shall not exceed 1/1000th of the member length.
 - .3 For runners/tracks, camber shall not exceed 1/1000th of the member length.
 - .4 Studs shall seat into top and bottom runners/tracks. The gap between the end of the stud and the web of the runner/track shall not exceed 4mm (5/32") for wind bearing studs.
 - .5 Where cold formed metal framing is made in prefabricated panels, align adjacent prefabricated panels to provide surface continuity at the interface.
 - .6 Spacing of studs shall not be more than 3mm (1/8") from the design spacing. The cumulative error in spacing shall not exceed the requirements of the finishing materials.
- .5 Align floor and ceiling runners/tracks, locate to wall or partition layout. Secure in place with screws or welding at maximum 610mm (24") O.C. Coordinate installation of sealant with floor and ceiling track.
- .6 Place studs to meet design requirements as indicated on approved shop drawings, and not more than 50mm (2") from abutting walls, and at each side of openings. Connect studs to tracks using clips and ties, screws, or welding. Diameter of screws shall be equal to, or exceed the minimum diameter indicated on the reviewed shop drawings. Penetration of screws beyond joined materials shall be not less than three (3) exposed threads. Thread types and drilling capability of screws shall conform to the manufacturer's written recommendations to suit design requirements and conditions. Screws to be covered by sheathing materials shall have "low profile" type heads.
- .7 Field cutting of cold formed steel framing members shall be by "power saw" or "shear" methods. Cutting by "torch" method shall not be permitted.
- .8 Holes that are field cut into cold formed steel framing members shall conform to the dimensional requirements of Table 1, in the CSSBI M50-1987 Manual.

- .9 Brace structural metal studs as required to meet design requirements and as indicated on reviewed shop drawings.
- .10 Provide continuous dampproof course to underside of bottom runner/track.
- .11 Construct corners using minimum of three studs. Double studs at door, window jambs, and wall openings.
- .12 Erect studs one piece full length. Splicing of studs is not permitted.
- .13 Erect load bearing studs, brace, and reinforce to develop full strength to meet design requirements.
- .14 Refer to drawings for height of partition framing.
- .15 Coordinate placement of insulation in multiple stud spaces made inaccessible after erection.
- .16 Install intermediate studs above and below openings to match wall stud spacing.
- .17 Provide deflection allowance in stud bottom runner/track, directly below horizontal building framing for non-load bearing framing.
- .18 Attach cross studs or furring channels to studs for attachment of fixtures anchored to walls. Install framing between studs for attachment of mechanical and electrical items, and to prevent stud rotation.
- .19 Touch-up field welds and damaged galvanized surfaces with two coats of zinc rich touch-up primer.

3.3 ERECTION OF CLADDING SUPPORT

- .1 Install in accordance with manufacturer's instructions and approved submittals, and in proper relationship with adjacent construction.
 - .1 Attach cladding support system to structural backup anchor size/frequency as per engineered shop drawings.
 - .2 Attach cladding panels or tiles to cladding support system per cladding panels manufacturer's recommendations. Refer to Specifications 07 46 19.
 - .3 Frame as required for window, door and louvre openings. Install framing below sills and at jambs of openings to match framing at heads of openings.

3.4 PROTECTION

- .1 Protect installed products until completion of project. repair or replace damaged products before Substantial Completion.

END OF SECTION

1 General

1.1 SUMMARY

- .1 Supply and install all miscellaneous metal work indicated on drawings and not included in the work of other Sections in addition to items listed in this Section.
- .2 Section includes the supply and installation of decorative steel railings and elements, as detailed on the Drawings for use in the following locations:
 - .1 Guardrail/handrails at ramp/stairs;
 - .2 Various fabrications as detailed

1.2 RELATED REQUIREMENTS

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

1.3 REFERENCE STANDARDS

- .1 American Society for Testing and Materials (ASTM):
 - .1 ASTM A53/A53M-12, Standard Specification for Pipe, Steel, Black and Hot Dipped, Zinc Coated, Welded and Seamless
 - .2 ASTM A325-10, Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
 - .3 ASTM A653/A653M-11, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
 - .4 ASTM C939-10, Standard Test Method for Flow of Grout for Preplaced Aggregate Concrete (Flow Cone Method)
 - .5 ASTM A1011/A1011M-12b, Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with improved Formability, and Ultra-High Strength
 - .6 ASTM C1107/C1107M-11, Standard Specification for Packaged Dry, Hydraulic Cement Grout (Nonshrink)
- .2 Canadian Standards Association (CSA):
 - .1 CSA G40.20-04/G40.21-04 (R2009), General Requirements for Rolled or Welded Structural Quality Steel / Structural Quality Steel
 - .2 CAN/CSA-G164-M92 (R2003), Hot Dip Galvanizing or Irregularly Shaped Articles
 - .3 CSA-S16-09, Design of Steel Structures
 - .4 CSA-S136-07, North American Specification for the Design of Cold Formed Steel Structural Members
 - .5 CSA W47.1-09, Certification of Companies for Fusion Welding of Steel
 - .6 CSA W55.3-08, Certification of Companies for Resistance Welding of Steel and Aluminum
 - .7 CSA W59-03 (R2008), Welded Steel Construction (Metal Arc Welding)
- .3 Canadian General Standards Board (CGSB):
 - .1 CAN/CGSB-1.181-99, Ready-Mixed Organic Zinc-Rich Coating
 - .2 CAN/CGSB-51.32-M77, Sheathing, Membrane, Breather Type
 - .3 CGSB 31-GP-105Ma, Zinc Phosphate Conversion Coatings for Paint Base

- .4 The Society for Protective Coatings (SSPC):
 - .1 SSPC1 Solvent Cleaning - 2004
 - .2 SSPC2 Hand Tool Cleaning - 2004
 - .3 SSPC-3 Power Tool Cleaning - 2004
 - .4 SSPC-6 Commercial Blast Cleaning - 2007

1.4 QUALITY ASSURANCE

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

1.5 SUBMITTALS

- .1 Provide submittals in accordance with Division 01, bearing stamp or seal and signature of the Professional Engineer responsible for the design of the work of this Section.
- .2 Shop Drawings:
 - .1 Make thorough examination of drawings and details, determine the intent, extent, and materials, and be fully cognizant of requirements when preparing shop drawings.
 - .2 Submit shop drawings showing and describing in detail all work of this Section including large scale detail of members and materials, of connection and interfacing with work of other Sections, jointing details, and of anchorage devices, dimension, gauges, thicknesses, description of materials, metal finishing, as well as other pertinent data and information.
 - .3 Digital files of design drawings shall not be used in the preparation of shop drawings.
- .3 Samples:
 - .1 Provide samples of duplex powder coat finish over hot dip galvanizing, on 100 x 100mm sheet steel (in triplicate).

1.6 STORAGE, DELIVERY, HANDLING AND PROTECTION

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

- .3 Cover and protect the work of other Sections in the area of work from damage. Make good all damage to the satisfaction of the Consultant.
- .4 Protect the installed work of this Section and on completion the work shall be examined and damage shall be remedied to the complete satisfaction of the Consultant.

2 Products

2.1 PERFORMANCE REQUIREMENTS

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

2.2 MATERIALS

- .1 Structural Steel Sections and Steel Plate: New stock (not weathered or rusted); to conform to CAN/CSA-G40.21, Grade 300W (44W) and Grade 350W (50W) for wide flange shapes.
- .2 Hollow Structural Sections (HSS): New stock; to conform to CAN/CSA-G40.21, Grade 350W (50W), Class C, stress relieved.
- .3 Sheet Steel (Structural Quality): Conforms to ASTM A1011/A1011M.
- .4 Sheet Steel (Commercial Quality): Conforms to ASTM A653/A653M, stretcher levelled or temper rolled.
- .5 All Stainless Steel for interior use to be type 304, brushed satin finish, analysis 18-8.
- .6 All Stainless Steel for exterior use to be type 316, brushed satin finish.
- .7 Galvanized Sheet Steel (Commercial Quality): Galvanized coating G90 (Z275) in accordance with ASTM A653/A653M, minimized spangle, stretch levelled or temper rolled. Specially treat by phosphate conversion process conforming to CGSB 31-GP-105Ma ready to receive prime paint finish.
- .8 Steel Pipe: Hot-dip galvanized, zinc coated, welded and seamless type steel pipe conforming to ASTM A53/A53M.
- .9 Aluminum Plate and Sheet: ASTM B209M, Alloy 6061-T6.
- .10 Aluminum Extrusions: ASTM B221M, Alloy 6063-T6.
- .11 Non-Shrink Grout: Premixed, high strength, maximum bearing, impact resistant, non-shrink non-metallic aggregate grout having minimum 76 Mpa 28 day compressive strength and conforms to ASTM C939 and ASTM C1107/C1107M, 'Embeco Premixed Grout' by Master Builders Technologies Ltd., or 'Tartan Grout Iron' by Webster & Sons Ltd., or 'Sika Grout 212 HP' by Sika Canada Inc., or approved equivalent.

- .12 Galvanizing: All uncoated steel specified to be galvanized shall be galvanized after fabrication by the hot dip process according to CAN/CSA-G164, with minimum coating of 2 oz./sq.ft. Galvanize after all welding is complete. Welding of galvanized material will not be permitted. Specially treat by phosphate conversion process conforming to CGSB 31-GP-105Ma ready to receive prime paint finish.
- .13 Primer Paint: CISC/CPMA 2-75.
- .14 Bolts, Nuts, Washers: Conforms to ASTM A325.
- .15 Welding Materials: Conforms to CSA W59.
- .16 Metal Filler: Polyester based type.
- .17 Painting:
 - .1 Shop Applied Structural Steel Primer: Steel Spec Universal Primer (B50RV6227 Red), by Sherwin Williams Company of Canada Ltd., or approved equivalent. Apply a minimum of 2 mils dft./coat. Grey coloured primer is acceptable.
 - .2 Zinc Rich Paint For Touch-up of Galvanized Metals: Ready mixed, zinc-rich primer conforming to CAN/CGSB-1.181, Sealtight Galvafruid Zinc-Rich Coating by W.R. Meadows of Canada Limited or Zinc Clad No. 5 Organic Zinc Rich Primer by Sherwin Williams Company of Canada Ltd., or approved equivalent.
 - .3 Touch-up Primer (On Site): Procryl Universal Acrylic Primer by Sherwin Williams Company of Canada Ltd, or approved equivalent. Touch-up primer shall be no less than 3 mil dft.
 - .4 Refer to Section 09 90 00, and coordinate with the above.
- .18 Isolation Coating: Acid and alkali resistant bituminous paint.
- .19 Building Paper: Conforms to CAN/CGSB-51.32.
- .20 Butyl Tape: Extruded, high grade, macro-polyisobutylene tape of size, width and shore hardness to suit conditions.

2.3 FABRICATION

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

- .9 Gauges and sizes of metal shall be adequate for various conditions.
- .10 Make exposed metal fastenings and accessories of same material, texture, colour and finish as base metal on which they occur unless otherwise shown or specified. Keep exposed fastenings to an absolute minimum evenly spaced and neatly laid out. Make fastenings of permanent type unless otherwise indicated.

2.4 HOT DIP GALVANIZING

- .1 Hot dip galvanize, after fabrication, steel metal fabrication items. Straighten shapes and assemblies true to line and plane after galvanizing. Repair damaged galvanized surfaces with brush or spray-applied anti-corrosion coating containing 92-95% zinc, in accordance with manufacturer's printed directions.
 - .1 Members exposed to elements when in final location.
 - .2 Members embedded on exterior side of exterior walls.
 - .3 Members imbedded in concrete.
 - .4 Members specified in this Section or indicated on Drawings.
- .2 Hot-dip galvanize members in accordance with CAN/CSA G164 and requirements of the following ASTM standards, with minimum coating weights or thicknesses as follows, unless otherwise indicated that high performance organic finish is required:
 - .1 Rolled, Pressed and Forged Steel Shapes, Plates, Bars and Strips: ASTM A123/A123M; average weight of zinc coating of actual surface
 - .1 4.8 mm (3/16") and less member thickness: 600 g/sq.m.
 - .2 6 mm (1/4") and heavier members: 640 g/sq.m.
 - .2 Iron and Steel Hardware: ASTM A153/A153M; minimum weight of zinc coating, in gram per square meter of surface, in accordance with Table 1 for the various classes of materials used in the Work.
- .3 Components scheduled for powder coat finish after galvanizing shall be prepared according to ASTM D7803, including:
 - .1 Grind and fill as required to remove all bumps, runs and drips.
 - .2 Remove organic material with mild alkaline, acidic or solvent solution.
 - .3 Rinse and remove cleaning solution; thoroughly dry.
 - .4 Profile all surfaces using either sweep blasting, grinding or zinc phosphate solution.
 - .5 Bake at minimum 30C above temperature used to cure powder coat finish.

2.5 SHOP APPLIED COATINGS AND PROTECTION

- .1 Preparation
 - .1 As per SSPC2 Hand Tool Clean and SSPC1 Solvent Clean, clean welds by wire brushing and wash down with clean water, to remove the chemical residues left by the electrodes, prior to painting.
 - .2 Prepare steel as per SSPC-3 Power Tool Cleaning for Interior or SSPC-6 Commercial Blast Cleaning for exterior members. Remove rust, mill scale, oil, dirt, and other foreign matter before commencing shop painting.
- .2 Priming
 - .1 Apply shop coat of primer to all surfaces except areas requiring field welding. Apply by brush, working paint well into surfaces, interstices and cavities. Primer to be zinc rich for exterior applications.

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

3 Execution

3.1 GENERAL

- .1 Verify at site that the Work to receive the work of this Section is free of irregularities detrimental to the installation and performance of the work and that it is located correctly and at proper levels before delivery and installation.
- .2 Erection: To meet specified requirements of CAN/CSA-S16.
- .3 Bearing Plates and Anchors: Standard.
- .4 Anchors: Anchors to structural concrete shall be approved inserts set into concrete or approved self-drilling expansion insets drilled and placed afterwards.

3.2 INSTALLATION

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

3.3 SCHEDULES

- .1 Where items are required to be built into masonry, concrete or other work, supply such items to respective Sections with all anchors and accessories for building in.
- .2 Itemized List: Supply and install metal work listed below unless specifically designated to be supplied only. Each item shall be as shown on drawings and as detailed on reviewed shop drawings.
- .3 Miscellaneous Steel Framing, Channels, Angles, Plates and Brackets: As required and indicated on drawings.
- .4 Steel L-Angle support complete with mounting plates at either end for support at light shelf at windows W1 & W3.
- .5 **Guardrails and Handrails:**
 - .1 **Guardrail (G1) at interior ramp:**
 - .1 Steel guardrail, complete with flat bar top/bottom rails with vertical bar pickets, flat bar vertical balusters, 43mm diameter handrail on 10mm diameter bar stand offs.
 - .2 Intermediate baluster to be welded to site installed mounting plate cast into concrete.
 - .3 Flat plate upstand below bottom rail to be clad in stainless steel.
 - .4 Finish: site painted as per Specification 09 90 00.
 - .2 **Handrail (H1) at interior ramp:**
 - .1 43mm diameter steel handrail on 10mm diameter stand offs complete with mounting plate at masonry wall attachment locations.

- .2 Height of stand-offs varies as per drawings/details.
- .3 Finish: site painted as per Specification 09 90 00.
- .6 Loose Lintels:
 - .1 Provide and install loose lintels if not by structural steel.
 - .2 Finish: Hot-dip galvanized after fabrication.
- .7 Masonry Lateral Supports:
 - .1 Install deflection space and lateral support for non-load-bearing masonry walls and partitions in accordance with specified requirements of CAN/ULC-S304-M, where not provided on Structural Drawings.
 - .2 At walls with concealed tops:
 - .1 3" x 2" x 1/4" angles 8" long on both sides of walls. Anchor to structure above wall.
 - .3 At walls with tops exposed to view:
 - .1 3" x 2" x 1/4" angles, continuous on both sides of wall. Anchor to structure above wall.
 - .4 Finish: Prime paint.
- .8 Other Miscellaneous Metal Components:
 - .1 As required and indicated on drawings.
 - .2 Finish: Prime paint for interior components, ready for finishing by Section 09 90 00 and hot-dip galvanized after fabrication for exterior components.

END OF SECTION

1 General

1.1 SUMMARY

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

1.2 REFERENCE STANDARDS

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

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

1.3 DELIVERY, STORAGE, HANDLING AND PROTECTION

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

2 Products

2.1 MATERIALS

- .1 Framing Lumber:
 - .1 Lumber for structural components shall be of species and grade specified, well seasoned, processed and stamped at same mill with appropriate grade markings.
 - .2 Conform to requirements of Standard Grading Rules for Canadian Lumber of National Lumber Grades Authority the (NLGA) with latest supplements, approved by the Canadian Lumber Standards Administrative Board.
- .2 Framing, Furring, Strapping, Blocking:
 - .1 Spruce, 122c, "Standard" light framing, except as otherwise specified.
- .3 Plywood Sheathing:
 - .1 Shall be 19mm (3/4") thick and/or thickness as indicated on drawings, exterior grade at exterior locations; Douglas Fir plywood, veneer core.
 - .2 Select Sheathing; Tight Face, un-sanded, "B" faces and conforming to CSA 0121-08.
- .4 Rough Hardware:
 - .1 Provide rough hardware such as nails, spikes, staples, H-clips, bolts, nuts, washers, screws, clips, strap iron and including hardware for temporary enclosures.
 - .2 Nails for plywood shall be annular or spiral type, all other nails shall be spiral type. All nails, spikes and staples shall conform to CSA B111.
 - .3 All rough hardware shall be galvanized unless otherwise noted. Galvanizing shall conform to CAN/CSA-G164.
- .5 All Other Materials and Hardware:
 - .1 Shall be as noted on drawings.

2.2 PRESERVATIVE TREATED MATERIALS

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

2.3 PRESSURE FIRE RETARDANT TREATED MATERIALS

- .1 Treat by pressure impregnation with fire-retardant chemicals in accordance with CSA O80 Series -08 to provide classification for flame spread of not more than 25, smoke developed of not more than 75 in accordance with CAN/ULC S102.
- .2 All fire retardant wood must comply with the requirements in AWPA Standard C20 for lumber and C27 for plywood.
 - .1 AWPA C20: Structural Lumber, Fire-Retardant Pressure Treatment, lumber materials shall only be of species listed. After treatment, lumber 50 mm or less in thickness shall be kiln dried to moisture content of 8% or less.
 - .2 AWPA C27: Plywood, Fire-Retardant Pressure Treatment, plywood or laminated materials shall be manufactured with exterior grade adhesives. After treatment, plywood shall be kiln dried to moisture content of 8% or less.
 - .3 All species to comply with CAN/ULC S102 for surface-burning characteristics and shall bear identification showing classification and type of fire retardant.
- .3 Each piece or bundle of fire-retardant treated material or panel to bear ULC inspection label or stamp attesting to FRS rating indicating flame spread, smoke developed, and fuel contributed classification meeting AWPA standard C20 and C27 for Type A Use.
- .4 Fire retardant chemicals used to treat lumber must comply with FR-1 of AWPA Standard P17 and shall be free of halogens, sulphates and ammonium phosphate.

- .5 Acceptable materials: Plywood and lumber materials treated by licensed applicators with fire retardant materials from the following:
 - .1 Dricon FRTW by Hickson Corporation.
 - .2 Pyro-Guard by Hoover Treated Wood Products Inc.
 - .3 D-Blaze by Chemical Specialties Inc.
 - .4 Or approved equivalent.

3 Execution

3.1 INSTALLATION - GENERAL

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

3.2 WOOD BLOCKING, CANTS AND NAILERS

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

3.3 PLYWOOD PANELS

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

3.4 PRESSURE PRESERVATIVE TREATED WOOD INSTALLATION

- .1 Comply with AWWA M4.
- .2 Re-treat surfaces exposed by cutting, trimming or boring with liberal brush application of preservative before installation. Allow first coating to fully soak into grain before applying second coating in accordance with manufacturer's instructions.
- .3 Remove with fine sandpaper, chemical deposits on treated wood to receive applied finish.
- .4 Use only hot-dipped galvanized, corrosion resistant nail or screw fasteners. Staples are not acceptable for installation of preservative treated materials.

- .5 Use water-borne preservative treated wood for:
 - .1 Wood in contact with masonry or concrete;
 - .2 Wood within 457mm (18") of grade;
 - .3 Wood decking and fence boards;
 - .4 Wood in contact with flashings;
 - .5 Wood in contact with waterproofing membranes, confirm compatibility with membrane manufacturer prior to application.
- .6 Use oil-borne preservative treated wood for:
 - .1 Wood in contact with the ground;
 - .2 Wood in contact with freshwater;
 - .3 Landscaping timbers;
 - .4 Retaining walls;
 - .5 Piers or docks;
 - .6 Pilings;
 - .7 Bases of utility poles;
 - .8 Bases of fence posts.

3.5 PRESSURE FIRE RETARDANT TREATED WOOD INSTALLATION

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

END OF SECTION

1 General

1.1 SUMMARY

.1 Supply all labour, materials, equipment, services and perform all operations required to complete all finish carpentry, millwork and fitment installation including but not limited to the following:

- .1 Interior millwork
- .2 High pressure decorative laminate
- .3 Millwork finishing hardware and accessories.
- .4 Stainless Steel Countertops (See Division 12)

1.2 REFERENCE STANDARDS

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

- .1 ASTM A307-04e1, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength
- .2 ASTM D6007-02, Standard Test Method for Determining Formaldehyde Concentration in Air from Wood Products Using a Small Scale Chamber
- .3 ASTM D6330-98(2003), Standard Practice for Determination of Volatile Organic Compounds (Excluding Formaldehyde) Emissions from Wood-Based Panels Using Small Environmental Chambers Under Defined Test Conditions
- .4 ASTM E1333-96(2002), Standard Test Method for Determining Formaldehyde Concentrations in Air and Emission Rates from Wood Products Using a Large Chamber

.2 Underwriters Laboratories of Canada (ULC):

- .1 CAN/ULC S102-18, Standard Method of Test for Surface Burning Characteristics of building Materials and Assemblies

.3 Canadian Standards Association (CSA):

- .1 CSA B111-1974 (R2003), Wire Nails, Spikes and Staples
- .2 CSA G164-M92 (R2003), Hot Dip Galvanizing of Irregularly Shaped Articles
- .3 CAN/CSA O80 Series-97 (R2002), Wood Preservation
- .4 CSA O86-01, Engineering Design in Wood
- .5 CSA O112 Series-M1977(R2001), Adhesives for Wood
- .6 CSA O121-M1978 (R2003), Douglas Fir Plywood
- .7 CAN/CSA-O141-M91(R1999), Softwood Lumber.
- .8 CSA O151-M1978(R2003), Canadian Softwood Plywood.
- .9 CSA O325.0-92(R2003), Construction Sheathing
- .10 CSA O437 Series 93 (R2003) OSB and Waferboard
- .11 CSA O452 Series 94 (R2001), Design Rated OSB

.4 National Lumber Grading Association (NLGA):

- .1 NLGA Canadian Lumber Grading Rules

1.3 QUALITY ASSURANCE

.1 Contractor executing work of this section shall have a minimum of five (5) years continuous experience in successful manufacture/fabrication and installation of work of

type and quality shown and specified. Submit proof of experience upon Consultant's request.

- .2 Follow applicable requirements of The Architectural Woodwork Manufacturer's Association of Canada (AWMAC) Standard for Millwork latest edition, including supplements and modifications.
- .3 Unless otherwise indicated on drawings, all millwork shall be Custom Grade, in accordance with AWMAC standards.
- .4 Supplements and modifications to the above standards as indicated on the drawings or as specified herein shall govern work of this section.

1.4 SUBMITTALS

- .1 Provide submittals in accordance with Division 01.
- .2 Samples for Verification: Submit two (2) samples prior to fabrication of millwork as follows; accepted samples will form the standard of acceptance for the remainder of the work:
 - .1 High pressure decorative laminate for finishing of millwork.
 - .2 Solid surface countertops.
 - .3 Wood trim with applied opaque Finish: 12" long lumber for each finish system and colour.
 - .4 Exposed Fasteners, Hardware and Accessories: One unit for each type and finish.
- .3 Shop Drawings:
 - .1 Submit detailed shop drawings of all shop fabricated finish carpentry components.

1.5 ADMINISTRATIVE REQUIREMENTS

- .1 Coordination: Coordinate sizes and locations of framing, blocking, furring, and reinforcements provided by work that is specified in other Sections is complete before starting work of this Section.
- .2 Pre-Construction Conference: Arrange a site meeting, to coincide with regular bi-weekly site meetings, attended by the Contractor, the Subcontractor's representative and foreman for this project, the Consultant, materials supplier(s), and other relevant personal before commencement of work for this Section. Topics for discussion include but are not limited to the following:
 - .1 Installation requirements;
 - .2 Special surface effects and finishing;
 - .3 Coordination of work with adjacent finishes;
 - .4 Protection of finishes;
 - .5 Acceptability of substrates and quality of materials being used for the project.

1.6 DELIVERY, STORAGE, HANDLING & PROTECTION

- .1 Do not permit delivery of work of this section to site until area is sufficiently dry so that woodwork will not be damage by excessive changes in moisture content.
- .2 Coordinate deliveries to comply with construction schedules and arrange ahead for under cover storage location.
- .3 Materials shall be carefully checked, unloaded, stored and handled to prevent damage. Protect material with suitable non-staining waterproof coverings.
- .4 Store material in original, undamaged containers or wrappings.

- .5 Unsatisfactory materials shall be promptly removed from the site.
- .6 Adequately protect the structure and work of other sections during delivery, storage, handling and execution of the work of this section.
- .7 Provide tools, plant and other equipment required for the proper execution of the work of this section.

1.7 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.

1.8 WARRANTY

- .1 Warrant plastic laminate work of this Section against defects in materials and workmanship in accordance with General Conditions but for an extended period of two (2) years.
- .2 Solid Surface Countertop 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.
- .3 Agree to repair or replace faulty materials or work which appears during warranty period, without cost to the Owner.
- .4 Defects shall include but not be limited to, opening of joints, cracking, shrinkage, warpage, delamination of plastic laminate.

2 Products

2.1 MATERIALS

- .1 Framing Lumber:
 - .1 Lumber for structural components shall be of species and grade specified, well seasoned, and processed and stamped at same mill with appropriate grade markings. Conform to requirements of standard grading rule for Canadian lumber of Nation Lumber Grades Authority (NLGA) latest issue, approved by Canadian Lumber Standards Administrative Board, as follows:
 - .1 Rough Carpentry for built-in work: No. 2 select grade Ontario white pine.
 - .2 Blocking, Ground, Furring and Strapping, Bucks and Nailing Strips: C.L.A. No. 1 grade pine, kiln dried stock.
 - .3 Non-Exposed Softwood: Fabricator's option, meeting requirements of CAN/CSA O141-05(R2009), kiln dried for interior use to a moisture content of 4% to 8%, and 7% to 10% for exterior use; Surface 4 sides (S4S).

- .2 Panel Materials:
 - .1 Plywood: Douglas Fir veneer core plywood, 19mm (3/4") thick or thickness as indicated on drawings, Select Sheathing-Tight Face, good two sides, sanded "B" faces and conforms to CSA 0121.
 - .2 Particleboard: ANSI A208.1, 700 kg/m³ density.
 - .3 Medium density fibreboard (MDF): ANSI A208.2, density minimum 750 kg/m³, moisture resistant.
 - .1 Basis of Design Materials: Premier Plus MR MDF by Flakeboard, or approved equivalent.
 - .4 Fire-Rated (FR) Medium density fibreboard (MDF): ANSI A208.2, meeting CAN/ULC S102, FSC certified; Modulus of Rupture (MOR): 4000 psi, with face screw hold of 250lbs.
 - .1 Basis of Design Materials: TRUPAN Fire-Rated (FR) MDF by Arauco, or approved equivalent.
- .3 Glue: CSA 0112; Water-resistant urea-formaldehyde-free resin glue.
- .4 Plastic Laminate Covered Components (PLAM):
 - .1 Plastic laminate face sheets: High pressure, paper based, melamine surfaced, laminated plastic sheets, conforming to CAN/CSA-A172, with thickness tolerances in accordance with Table 1 of CAN/CSA-A172 and plastic laminate grades as follows:
 - .1 General Purpose Grade (GP): Minimum 1.27mm (0.050") thick.
 - .2 Post-forming Grade (PF): Minimum 1.06mm (0.042") thick.
 - .2 Plastic laminate face sheet colour, gloss and texture: Carry pricing for two colours, as selected by the Consultant, from the manufacturers standard product line.
 - .3 Plastic laminate backing and liner sheets: High pressure, paper based, melamine surfaced, laminated plastic backing sheets, conforming to CAN/CSA-A172, backing grade (BK), minimum 0.5mm (0.020") thick.
 - .4 Cores: Unless otherwise indicated, 19mm (3/4") thick veneer core plywood (hardwood with non-telegraphing grains)
 - .5 Laminating Adhesive: CSA-0112, water resistant type.
 - .6 Draw Bolt Fasteners: 'K&V 516' by Knape & Vogt Canada, or approved equivalent.
 - .7 Basis of Design: Wilsonart, Pionite, Nevamar or Formica.
 - .8 Plastic Laminate Countertops to have plywood core (exterior grade hardwood plywood core with non-telegraphic grain with type II adhesive meeting the requirements of AWMAC's Standards (NAAWS).
- .5 Wood Veneer (WV): plain sliced white birch with clearcoat finish.
- .6 Stainless Steel Countertops – See Specification 12 35 00
- .7 Rough Hardware:

- .1 Provide required rough hardware to frame and fix all finished carpentry and include for expansion shields, nails, spikes, screws, bolts, anchors, clips, plates, washers, rods, wires, wall brackets, chrome finishing trim, and other ironmongery which may be required. All wood screws shall be drill thread screws except at chipboard where self-tapping screws shall be used. All rough hardware shall be galvanized unless otherwise noted.
- .8 Millwork Finishing Hardware:
 - .1 As scheduled on drawings/details.

2.2 FABRICATION AND WORKMANSHIP

- .1 Work shall be executed by skilled carpenters under the supervision of a competent carpentry foreman. All items shall be shop assembled, insofar as is practical. Unless indicated otherwise comply with AWMAC Custom Grade requirements.
- .2 Make thorough examination of drawings and details, check anchorage, interfacing with work of other sections and other factors influencing the installation of the work, and be fully cognizant of requirements.
- .3 Finished woodwork shall be free from bruises, blemishes, mineral marks, knots, shakes and other defects and shall be selected for uniformity of colour, grain and texture.
- .4 Be responsible for methods of construction and for ensuring that materials are rigidly and securely attached and will not be loosened by the work of other sections.
- .5 Fabricate the work in a manner which will permit expansion and contraction of the materials without visible open joints.
- .6 Mitre exposed corners; no end grain shall be visible in completed installation.
- .7 Provide solid wood edging at exposed plywood edges.
- .8 Provide wood trim mouldings to profiles as indicated on drawings.
- .9 Jointing of shop assembled work shall be by means of mortise and tenons, dowels, stub tenons, dovetails, dadoes, lock joints as applicable for the jointing condition.
- .10 Accurately cut, mitre, fit and frame work together to produce tight hairline joints, rigidly secured together in a permanent manner using glue, blind screw fixing or nails. Use concealed glue blocks for additional strength where possible.
- .11 Finished woodwork shall be in one piece wherever possible and all trim shall be in long lengths. Where jointing is necessary in the length, the joints between pieces shall be scarfed, glued and properly fastened. The material being jointed shall match reasonably well for grain and colour where natural finish is specified. Joints between lengths where paint finish is to be applied may be finger jointed in lieu of scarfing. Trim shall be accurately cut and mitred at all corners, glued and properly fastened.
- .12 Machine dressed work shall be properly machine using sharp cutters, the finished work shall be free from drag, feathers, slivers or roughness of any kind. Remove machine marks by sanding.
- .13 Finished woodwork shall be carefully hand sanded after installation to remove roughness and planer marks. Sanding shall be done with the grain of the wood and finished with fine grit paper to leave a smooth scratch-free surface suitable to receive the paint or natural finishes to be applied over as specified in Section 09 90 00.
- .14 Nail heads in the finished surfaces shall be set with straight shank nail sets. Screw and bolt heads in finished surfaces shall be let into the work and capped with edge grain wood caps dressed and finished flush.

- .15 Provide cutouts for fixtures, fittings, inserts, outlet boxes, services, other mechanical and electrical items and appliances. Round corners, and chamfer edges. Where items for cutouts butt to underside or back of finished surface, finish exposed edge to match face. Where item covers cutout, and at all concealed cut edges of core material, apply uniform coating of seal to cut edges.
- .16 The finished work shall be of a high quality, with all corners having exact angles to ensure no swerve or twisting. All bends, crimps or angle parts shall be produced by professional equipment and tools for this purpose and if long runs or repeats are required, such shall be produced in the shop, or have proper equipment on site.
- .17 Counters, Cabinets, Window Sills and Fitments:
 - .1 Provide and install counters, cabinets, and fitments as indicated on drawings.
 - .2 Shop fabricate and finish countertops and cabinet work in as large a size as practical. Verify field dimensions and conditions prior to fabrication.
 - .3 Make each unit rigid and self-supporting, suitable for individual removal. Assemble components with dovetail connections, mortise and tenon or blind dado joints, and adequately glued and secured with screws.
 - .4 Construct cabinets of solid lumber framing, with 19mm (3/4") MDF gables. Provide 19mm (3/4") MDF bottoms. Provide minimum 6mm (1/4") thick MDF full width backs having joints concealed behind framing. Backs which support shelves, equipment, or other loads, shall be 19mm (3/4") thick MDF. Route backs into end gables.
 - .5 Fabricate cabinet base in wood, separately in height indicated or, if not indicated, to match flooring base.
 - .6 Fabricate cabinet doors of flush panels from 19mm (3/4") thick MDF framed with hardwood edging.
 - .7 Make drawer fronts of 19mm (3/4") finished MDF, and wide enough to cover slide space. Provide 13mm (1/2") drawer backs, 16mm (5/8") sides, 6mm (1/4") dividers, and 6mm (1/4") bottoms, all of finished MDF. Fasten sides to fronts with dovetail joints, and grooved and glued joints for backs. Groove and glue bottoms into fronts and sides.
 - .8 Drawers shall be supported and guided with side extension drawer slides.
 - .9 Where a locking drawer is located below another drawer, provide 6mm (1/4") thick MDF diaphragm in framing immediately above locking drawer.
 - .10 Fabricate shelving of 19mm (3/4") finished MDF. Route cabinet gables to receive fixed shelving where indicated and to receive recessed metal shelf standards flush with adjacent surfaces for adjustable shelving.
 - .11 Fabricate countertops to details shown of 13mm solid surfacing mounted to 19mm exterior grade waterproof Douglas Fir plywood.
 - .1 Fit corners and edges of countertops with solid stock. Extend side and backsplashes to heights indicated. Provide side returns to match backsplashes at all abutting fixed vertical surfaces.
- .18 Edging Treatment:
 - .1 Provide Self Edge Laminate: HPDL, colour matching cabinet work.
 - .2 Provide 3mm hardwood edging to match face veneer at WV casework.
- .19 Plastic Laminate Covered Components:
 - .1 Meet requirements of CAN/CSA-A172, Appendix A.
 - .2 Bond plastic laminate to core with adhesive using pressure. Provide balanced construction with plastic laminate face sheet on exposed sides of core and

- backer/liner sheet. Finish drawers with liner sheet on both sides of core for balanced construction.
- .3 Unless otherwise detailed, provide 19mm (3/4") thick core.
 - .4 Apply plastic laminate to core material in accordance with adhesive manufacturer's instructions. Provide same core and laminate profiles to provide continuous support and bond over entire surface.
 - .5 Use continuous lengths up to 2439mm (8'). Keep joints 610mm (2') from cutouts and in locations indicated on reviewed shop drawings.
 - .6 Locate joints, where required at 2439mm to 3048mm (8' to 10') O.C. At L-shaped corners mitre plastic laminate, to the outside corner. Accurately fit members together to provide tight and flush butt joints, in true planes. Provide 6mm (1/4") blind spline and approved type draw bolts; one draw bolt for widths up to 150mm (6") at maximum 457mm (18") centres for widths exceeding 150mm (6"). Colour-match adjoining units.
 - .7 Form shaped profiles and bends using postforming grade laminate to laminate manufacturer's instructions.
 - .8 Where curved or bent surfaces are required for counters, backsplashes and other areas, use postforming laminate.
 - .9 Self-edge straight-line-edging with general purpose laminate and radius corners with postforming laminate, of same colour and finish as facing sheet, to cover exposed edges of core material. Apply with same adhesive as facing sheet. Chamfer edges uniformly at approximately 20 deg using machine router. Do not mitre laminate edges.
 - .10 Fabricate horizontal wearing surfaces including counters, shelves, both sides of removable shelves, cabinet doors and drawer fronts, of general purpose laminate except where postforming is required.
 - .11 Use general purpose laminate for exposed vertical surfaces except where otherwise specified or indicated.
 - .12 Apply plastic laminate backing sheet to reverse side of core of plastic laminate finished work including under counter tops and concealed portions of plastic laminate faced work. Provide backing sheet of specified minimum thickness, increased as required to compensate stresses caused by facing sheet.
 - .13 Apply laminated plastic liner sheet to interior of cabinetry unless indicated otherwise.
 - .14 Assemble work, true and square. Arrange adjacent parts of continuous laminate work to match in colour and pattern.

2.3 MOISTURE CONTENT

- .1 Moisture content of interior woodwork shall be between 8% and 12%.

2.4 FINISHES

- .1 Finishes shall match approved finished samples of wood treatment submitted by this section for each species of wood required. Wood items provided under this section shall be finished as part of the work of this section.
- .2 Apply stain to items where scheduled, indicated or as directed Consultant, providing uniform required stain colour(s).

3 Execution

3.1 EXAMINATION

- .1 Inspect available spaces and check surfaces over which the work of this section is dependent for any irregularities detrimental to the application and performance of the work. Notify Consultant in writing of all conditions which are at variance with those on the Contract Documents and/or detrimental to the proper and timely installation of the work of this section. The decision regarding correct measures shall be obtained from the Consultant prior to proceeding with the affected work.
- .2 Check humidity in building with moisture reading instruments if doubt exists that building is sufficiently dry and ready to receive millwork. Do not proceed until unsatisfactory conditions are corrected.
- .3 Commencement of work indicates acceptance of surfaces and conditions.

3.2 INSTALLATION - GENERAL

- .1 Provide and fit in place all furring, strapping, battens, grounds and blocking required to provide adequate properly placed fixing for all finish carpentry work and as required for the work of other sections.
- .2 Refer to drawings and coordinate with drywall, the painting and floor covering sections to establish sequence of installation or execution of each others' work. Pay particular attention to areas where materials are supplied by others and installed under this Contract.
- .3 All nails where their use is permitted, shall be long enough so that at least half their length penetrates into the second member. Splitting of wood members shall be minimized by staggering the nails in the direction of the grain and by keeping nails well in from edges.
- .4 Unless otherwise permitted by Consultant, fasten finish carpentry components in concealed manner.
- .5 Plastic laminate work shall be free of cracks and chipped or broken edges. Replace damaged components.
- .6 Fitments shall be installed level, plumb and true and complete in all respects.
- .7 Fit small scribe moulds of same material as fitment to hide voids at junction of fitment to fitment and fitment to walls, partitions, ceilings, furrings.

3.3 PRIMING

- .1 Immediately in instances where primed work is cut (as for fitting), a coat of primer shall be applied to the resulting raw surfaces.

3.4 INSTALLATION - FINISHING HARDWARE

- .1 Take delivery of all finishing hardware and install. Check each item as received.
- .2 Set, fit and adjust hardware according to manufacturer's directions at heights directed by Consultant. Hardware shall operate freely. Protect installed hardware from damage and paint spotting.
- .3 Install all hardware for hollow metal doors including hinges.
- .4 Pre-drill kickplates and doors before attachment of plates. Apply with water-resistant adhesive and countersunk stainless steel screws.

END OF SECTION

PART 1: GENERAL

1.1 Summary

- .1 This Section includes requirements for supply and installation of a below grade damproofing membrane system, as required for complete and proper installation:
 - .1 Fluid Applied Damproof Membrane
 - .2 Fabric Reinforcement
 - .3 Flashing Membrane
 - .4 Flashing Membrane Adhesives
 - .5 Mastics & Termination Sealants
 - .6 Drainage Board
 - .7 Protection Board
 - .8 Auxiliary Materials

1.2 REFERENCES

- .1 Specification American Society for Testing and Materials (ASTM):
 - .1 ASTM D4479/D4479M, Standard Specification for Asphalt Roof Coatings – Asbestos Free
 - .2 ASTM E96, Standard Test Methods for Water Vapor Transmission of Materials
- .2 Canadian General Standards Board (CGSB):
 - .1 CAN/CGSB 37.2, Emulsified Asphalt, Mineral-Colloid Type, Unfilled, for Dampproofing and Waterproofing, and for Roof Coatings
 - .2 CAN/CGSB 37.16, Filled Cutback Asphalt for Dampproofing and Waterproofing
 - .3 CGSB 37-GP-6M, Asphalt, Cutback, Unfilled for Dampproofing

1.3 Submittals

- .1 Provide required information in accordance with Division 01.
- .2 Action Submittals: Provide the following submittals before starting any work of this Section:
- .3 Product Data: Submit manufacturer's data sheets covering the care and recommended maintenance procedures for incorporation into maintenance manuals.
- .4 Certifications:
- .5 Submit copies of manufacturers' current ISO 9001 certification. Fluid applied waterproofing membrane, adhesives and associated auxiliary materials shall be included.
- .6 Submit references clearly indicating that the fluid applied waterproofing membrane manufacturer has successfully completed projects on an annual basis of similar scope and nature for a minimum of fifteen (15) years. Submit references for a minimum of ten (10) projects.
- .7 Submit manufacturers' complete set of standard details for the fluid applied waterproofing membrane showing a continuous plane of water tightness below grade.
- .8 Provide material checklist complete with application rates and minimum thickness of adhesives and primers.

1.4 Quality Assurance

- .1 Damp proofing shall be carried out by applicators skilled in this Work in strict accordance with manufacturer's printed instruction. Submit proof of experience upon Consultant's request.

- .2 Perform Work in accordance with the printed requirements of the membrane manufacturer and this specification.
- .3 Maintain one copy of manufacturer instructions on site.
- .4 At the beginning of the Work and at all times during the execution of the Work, allow access to Work site by the membrane manufacturers' representative.
- .5 Components used in this section shall be sourced from one manufacturer, including sheet membrane, sealants, primers, mastics, and adhesives.

1.5 Delivery, Storage and Handling

- .1 Deliver materials to the job site in undamaged and original packaging indicating the name of the manufacturer and Product.
- .2 Store membrane at temperature of 5°C (40°F) and above to facilitate handling.
- .3 Membrane contain petroleum solvents and are flammable. Do not use near open flame.
- .4 Store roll materials horizontally in original packaging.
- .5 Store adhesives and primers at temperatures of 5°C and above to facilitate handling.
- .6 Keep solvents away from open flame or excessive heat.

1.6 Site Conditions

- .1 Environmental Requirements
 - .1 No installation Work shall be performed during rainy or inclement weather and on frost or wet covered surfaces.
- .2 Protection
 - .1 Provide adequate protection of materials and Work of this section from damage by weather backfilling operations and other causes.
 - .2 Protect Work of other trades from damage resulting from Work of this section. Make good such damage at own expense to satisfaction of the Consultant.

1.8 WARRANTY

- .1 Contractor Warranty: Warrant that the fluid applied dampproofing membrane and membrane flashings will stay in place and remain leak proof for two (2) years.
- .2 Manufacturer's Warranty: Fluid applied dampproofing membrane manufacturer must warranty the membrane and membrane flashings for leak coverage as a result of faulty materials for a period of five (5) years from the date of substantial completion.

PART 2: PRODUCTS

2.1 Fluid Applied Bituminous Dampproofing Membrane (RWP-01)

- .1 Coating for Temperatures above 5°C (40°F): Liquid applied, dampproofing emulsion composed of vacuum-reduced asphalt dispersed in a mineral colloid emulsifier, in compliance with CAN/CGSB 37.2.
 - .1 Colour: Black
 - .2 Solids by Volume: 57%
 - .3 Application Temperature: 5 deg C (40 deg F) minimum.

- .4 Maximum VOC: 0 g/L
 - .5 Water Vapour Permeance (ASTM E96): 8 ng/Pa.m².s., (0.14 perms)
 - .6 Basis of Design Product: 700-01 Dampproofing and Waterproofing Asphalt Emulsion by Henry Company; equivalents per Division 1.
- .2 Coating for Temperatures below 5°C (40°F): Liquid applied medium consistency, solvent type waterproofing and dampproofing compound of selected asphalts and fibres permitting application in thick films; in compliance with CAN/CGSB 37.16-M89.
- .1 Colour: Black
 - .2 Solids by Volume: 54%
 - .3 Application Temperature: Ambient (Thickens at low temperature).
 - .4 Water Vapour Permeance (ASTM E96): 2.9 ng/Pa.m².s., (0.05 perms)
 - .5 Basis of Design Product: 710-11 Dampproofing and Waterproofing Asphalt Coating by Henry Company; equivalent per Division 1.

2.2 Accessories

- .1 Asphalt Primer (for use with 2.1.2)
 - .1 Light bodied asphalt based material for priming surfaces for cold-applied dampproofing coatings, in compliance with CGSB 37-GP-9M.
 - .1 Colour: Black
 - .2 Solids by Volume: 37%
 - .3 Basis of Design Product: 910-01 Penetrating Asphalt Primer by Henry or equivalent.
 - .2 Insulation Adhesive
 - .1 Insulation, Drainage Board and Protection Board Adhesive: Synthetic rubber base compound having the following characteristics:
 - .1 Colour: Cream.
 - .2 Compatible with sheet applied waterproofing membrane, substrate and insulation materials.
 - .3 Long term flexibility: Pass CGSB 71-GP-24M.
 - .4 Chemical resistance: Alkalis, mild acid and salt solutions.
 - .5 Application Temperature: between -12 deg C and 40 deg C.
 - .6 Basis of Design Products: 230-21 Insulation Adhesive by Henry Company; equivalent per Division 1.
 - .3 Protection Board:
 - .1 Extruded flexible twin wall board made of polypropylene copolymer and having the following physical properties:
 - .1 Thickness 2mm (80 mils)
 - .2 Tensile Strength Yield Point: 32 kg/cm²
 - .3 Tensile Strength Point of Failure: 242 kg/cm²
 - .4 Elongation: 167%
 - .5 Compression Strength (ASTM D695): 0.54 kg/cm²
 - .6 Impact Strength at 0 degrees C (32 degrees F): 8.9 kg/cm
 - .7 Basis of Design Product: 990-31 Polypropylene Protection Board by Henry Company; equivalent per Division 1.
- .4 Drainage Boards:

- .1 Composite two-part prefabricated geo-composite drain board consisting of a formed polystyrene core covered on one side with a woven or non-woven polypropylene filter fabric.
 - .1 Vertical Applications: Designed for vertical installations requiring a high compressive strength and moderate flow capacity:
 - .2 Basis of Design Product: Bakor DB 6200 by Henry Company; equivalent per Division 1.
- .5 Auxiliary Materials:
 - .1 Insulation: Extruded Polystyrene rigid board as indicated in Section 07 20 00 Building Insulation.

PART 3: EXECUTION

3.1 EXAMINATION

- .1 Verification of Conditions:
 - .1 Examine substrates to receive work and surrounding adjacent surfaces for conditions affecting installation.
 - .2 Strike masonry joints flush. Concrete surfaces shall be smooth and without large voids, honeycombing, spalled areas or sharp protrusions.
 - .3 Notify Consultant in writing of any discrepancies. Commencement of the work or any parts thereof shall mean acceptance of the prepared substrate.
- .2 The installing contractor shall examine and determine that surfaces and conditions are ready to accept the Work of this section in accordance with published literature. Commencement of Work or any parts thereof shall mean installers acceptance of the substrate.

3.2 PREPARATION

- .1 All surfaces must be sound, clean and free of oil, grease, dirt, excess mortar or other contaminants.
- .2 Provide adequate protection of materials and work of this section from damage by weather, backfilling operations and other causes.
- .3 Protect adjacent surfaces and Work of other trades from damage resulting from Work of this section. Make good such damage at no additional cost to the Owner.
 - .1 Provide sound handling and installation procedures to prevent and protect against overspray of materials specified in this Section.

3.3 INSTALLATION

- .1 Fluid Applied Dampproofing Application (with 2.1.1):
 - .1 Preparation: Dry surfaces should be dampened with water prior to application.
 - .2 Dampproofing Application: Apply dampproofing coating at a rate of 1.5 l/m² (3.6 gal/100ft²) and let dry.
 - .3 Waterproofing Application:
 - .1 Priming: Apply dampproof coating, diluted 20% by volume with clean water at the rate of 0.5 l/m² and let dry. Priming is not required on insulated concrete forms (ICF) or preserved wood foundations (PWF).
 - .2 Apply fabric reinforcement into dampproof coating at not less than 1.0 l/m² (2.4 gal/100ft²).

- .3 Brush fabric reinforcement into place and eliminate wrinkles, air pockets or blisters and obtain full contact.
- .4 Overlap fabric reinforcement at least 50mm (2") at all joints.
- .5 At all corners, angles and junctions, reinforce with two (2) extra coats of dampproof coating and fabric reinforcement, at least 100mm (4") on each side of the junction.
- .6 Apply a seal coat of dampproof coating over the entire area at not less than 1.0 l/m² (2.4 gal/100ft²).
- .4 Fluid Applied Dampproofing Membrane Application (with 2.2.2):
 - .1 Primer: Apply penetrating asphalt primer at a rate of approximately 2 to 8m² (895 to 330ft²).and allow to cure.
 - .2 Dampproofing Application: Apply dampproofing coating at approximately 1.5 l/m² (3.6 gal/100ft²). Allow to dry thoroughly before applying board products and/or backfilling.
 - .3 Waterproofing Application:
 - .1 Apply fabric reinforcement into dampproof coating at not less than 1.0 l/m² (2.4 gal/100ft²).
 - .2 Brush fabric reinforcement into place and eliminate wrinkles, air pockets or blisters and obtain full contact.
 - .3 Overlap fabric reinforcement at least 50mm (2") at all joints.
 - .4 At all corners, angles and junctions, reinforce with two (2) extra coats of dampproof coating and fabric reinforcement, at least 100mm (4") on each side of the junction.
 - .5 Apply a seal coat of dampproof coating over the entire area at not less than 1.0 l/m² (2.4 gal/100ft²).
- .2 Protection Board Installation:
 - .1 Install protection board over the fluid applied dampproofing membrane to prevent damage from backfilling.
 - .2 Apply protection board adhesive in 13mm (1/2") wide strips spaced at 457mm (18") o/c to fluid applied dampproofing membrane.
 - .3 Immediately embed protection board and press into adhesive to ensure full contact.
 - .4 Backfill once protection board adhesive has fully cured.
- .3 Drainage Board Installation:
 - .1 Attach drainage board to surface using adhesive. Permanent fixing is achieved once backfilling operation is complete.
 - .2 Vertical Application: Place drainboard with fabric side outwards.
 - .1 Start at the top or bottom of the wall. Drain board may be applied horizontally or vertically.
 - .2 When installed horizontally, position edge of core with flange at the top. When installed vertically, align edge with flange at the upstream edge.
 - .3 Bottom panel should be placed behind the discharge pipe.
 - .3 Overlaps: Pull back loose fabric to expose core. Position core of second panel over the overlap flange of first level.

- .1 Overlap in direction of water flow and adhere the overlapped fabric with adhesive to prevent soils and/or concrete from entering core.
- .4 Corners: Bend drainage board for inside corners. Cut drainage board to reach corner, providing 100mm (4") of extra fabric to wrap around corner. Overlap fabric at joint.
- .4 Insulation Installation:
 - .1 Co-ordinate with Section 07 22 00 Building Insulation for insulating materials.

3.4 FIELD QUALITY CONTROL

- .1 Final Observation and Verification:
 - .1 Final inspection of fluid applied dampproofing membrane shall be carried out by the Owner's representative, and the contractor.
 - .2 Contact Manufacturer for warranty issuance requirements.
- .2 Fluid applied dampproofing membrane is not designed for permanent UV exposure. Apply protection board as soon as possible after installation of fluid applied dampproofing membrane. Refer to manufacturer published literature for product limitations.

3.5 CLEANING AND PROTECTION

- .1 Progress Cleaning: Leave work area clean at the end of each work day, ensuring safe movement of passing pedestrians.
- .2 Waste Management: Co-ordinate recycling of waste materials and packaging at appropriate facility, diverting waste from landfill. Certified installer shall be responsible for ensuring waste management efforts are practiced.

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

- .1 This Section includes requirements for supply and installation of the following:
 - .1 Rigid Foundation and Underslab Insulation Board
 - .2 Mineral Wool Cavity Wall Insulation Board at Exterior Rainscreen assemblies
 - .3 Rigid Insulation Board at Roof Assemblies (see Roofing Specification 07 52 00)
 - .4 Dual Density Mineral Wool Insulation Board at Roof Assemblies
 - .5 Mineral Fibre Batt Acoustic Insulation (at interior framing cavity)

1.2 REFERENCE STANDARDS

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

1.3 SUBMITTALS

- .1 Provide submittals in accordance with Division 01.
- .2 Affidavits:
 - .1 In lieu of samples and inspection procedures when required by CGSB and CAN/ULC Standards, submit affidavits, if requested, that materials supplied under these requirements meet CGSB and CAN/ULC Standards.
- .3 Safety Data Sheets:
 - .1 Submit WHMIS safety data sheets for inclusion with project record documents. Keep one copy of WHMIS safety data sheets on site for reference by workers.
- .4 Product Data Sheets.

1.4 SUSTAINABLE DESIGN REQUIREMENTS

- .1 The Passive House sustainable design requirements shall apply to all relevant Sections and Work for this Project, whether specifically indicated or not. Compliance with The Passive

House certification requirements indicated in Section 01 35 63, will be used as one criterion to evaluate requests for substitutions or alternates.

- .2 Field records including positive and negative pressure air change test results performed according to Section 01 83 16 Airtightness Testing Exterior Enclosure Requirements, construction progress documentation, inspections schedule and evidence of reviews. Refer to Section 01 32 33 Photographic Documentation.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Store insulation materials in dry areas, protected from wetting, sunlight and traffic. Store insulation board flat, on a flat surface, and to prevent edge damage and placing of materials on top of stored boards.
- .2 Ensure that insulation board and adhesives are stored at a minimum temperature of 4 deg C for twelve (12) hours before installation, and that freezable adhesives are stored only at temperatures above 0 deg C at all times.
- .3 Materials shall be delivered to the job in their original packages and containers bearing the manufacturer's labels intact and clearly visible.
- .4 Store materials in dry, watertight areas and protect to prevent damage by other trades.
- .5 Do not expose rigid insulation board to sunlight after installation. Protect it with black polyethylene or tarpaulin cover as recommended by manufacturer if permanent covering is not completed within twenty-four (24) hours.

PART 2 - PRODUCTS

2.1 BOARD INSULATION MATERIALS

- .1 INS-01 Foundation and Underslab Insulation Board: Closed-cell, high compressive strength graphite expanded polystyrene (GPS) rigid board insulation.
 - .1 Meeting CAN/ULC S701 Type III.
 - .1 Basis of Design Materials: CHROME GPS 3000 Rigid Insulation by Beaver Plastics Ltd., or approved equivalent.
 - .2 Provide underslab insulation board with shiplapped edges.
- .2 INS-02 Concrete Faced Perimeter Insulation Board.
 - .1 Perimeter Foundation Insulation: Extruded polystyrene board to ASTM C578 (CAN/ULC-S701) Type IV, rigid, closed cell, with integral high density skin, complete with integral 8mm (5/16") thick latex-modified concrete facing.
 - .2 Board Size: 610mm x 1220mm x 59mm (24" x 48" x 2-5/16").
 - .3 Edges: Tongue and groove sides, square edge ends.
 - .4 Thermal Resistance (ASTM C 518): Long term aged R-value of 5/1" (0.03 sm K/W / 1mm).
 - .5 Foam Compressive Strength: ASTM D1621, minimum: 35 psi (240 kPa).
 - .6 Compressive Strength Total: ASTM D1621, minimum 40 psi (275.6 kPa).
 - .7 Water Absorption (ASTM D2842): <0.1 (0.7% by volume maximum).
 - .8 Water Vapor Permeance (ASTM E96): 0.8 (50 ng/Pas m).
 - .9 Basis of Design Material: WallGUARD Concrete Faced Insulated Perimeter Wall Panels by T. Clear Corp.
- .4 INS-03 Exterior Cavity Mineral Wool Wall Insulation at Rainscreen Assemblies: Fibrous mineral wool insulation, unfaced, in accordance with CAN/ULC S702, Type 1, thermal resistance not less than RSI 0.76/25 mm; rated non-combustible in accordance with CAN/ULC S114 and having a

flame spread rating of 5 or less in accordance with CAN/ULC S102; density 72 kg/m³; square edges, board size 406 mm x 1220 mm x thickness indicated on the Drawings:

- .1 Density: To ASTM C303:
 - .1 Outer layer: 100 kg/m³
 - .2 Inner layer: 60 kg/m³
- .2 Water vapour permeance: 1555 ng/Pa.s.m².
- .3 Moisture sorption: 1 % maximum to ASTM C1104/C1104M.
- .4 Fungi resistance: Zero mould growth to ASTM C1338.
- .5 Basis of Design Material: CavityRock by ROCKWOOL Inc., or approved equivalent
- .5 INS-04a Rigid Polyiso Insulation at roof, refer to Spec 07 52 00.
- .6 INS-04b Dual Density Mineral Wool Insulation at roof, refer to Spec 07 52 00.

2.2 BLANKET INSULATION MATERIALS

- .1 INS-05 Mineral Fibre Batt Insulation:
 - .1 Unfaced, semi-rigid mineral slag batt insulation in accordance with CAN/ULC S702-09, Type 1; having a nominal RSI of 0.67/25 mm; rated non-combustible in accordance with CAN/ULC S114-05 and having a flame spread rating of 5 or less in accordance with CAN/ULC S102; density 32 kg/m³; square edges, thickness as required to meet design insulation values indicated on drawings or as required to fill insulated spaces where not indicated.
 - .2 Basis of Design Materials:
 - .1 ROCKWOOL Inc., COMFORTBATT
 - .2 Thermafiber, SAFB (2.5 pcf Density)
 - .3 Or approved equivalent.

2.3 INSULATION FASTENERS AND CLIPS

- .1 Insulation Fasteners: Heat treated carbon steel pin with HPDE washer with 2-3/8" Holding Diameter
 - .1 Length of Fastener: shaft length to suit insulation thickness and substrate, as recommended by the Insulation Fastener Manufacturer.
 - .2 Basis of Design Material: Insulfast T4 I-F by Ramset, or approved equivalent.
- .2 Concrete Faced Perimeter Insulation Fasteners: Manufacturer's standard concealed fasteners with groove mounting plate and fastening spline.
- .3 Thermally Broken Insulation Clips: Stainless steel, adjustable clips, complete with a thermal break pad at the back (insulation/moisture barrier interface). Clips include cut-outs that represent 15% to 20% of the clip volume, reducing quantity of conductive material, further reducing the effects of thermal bridging in wall systems.
 - .1 Adjustable clips are a two-piece design; Stainless steel pieces, "L" shaped. The inner piece of the clip fits inside the outer piece, allowing the exact depth of the clip to be adjusted on-site by the installers.
 - .2 Basis of Design Materials: ACS-A Thermal Clip by Soprema, or approved equivalent.
 - .3 Size: Required to suit depth of Insulation, allowing fastening to structural support.

2.4 ACCESSORIES

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

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 BLANKET INSULATION INSTALLATION

- .1 Install insulation to maintain continuity of thermal protection to building elements and spaces.
- .2 Cut insulation to fit around electrical boxes, pipes, ducts, openings, corners and all protruding obstructions occurring on the surface to be insulated and seal with adhesive.
- .3 Keep insulation minimum of 75mm (3") away from heat emitting devices.
- .4 Trim and cut insulation neatly to fit spaces. Butt joints tightly, offsetting vertical joints. In multiple layer application, offset both vertical and horizontal joints.
- .5 Install batt insulation in locations and thicknesses shown. Seal joints to prevent transfer of moisture.
- .6 Apply foamed-in-place insulation at exterior walls, around penetrations through walls and where indicated. Apply foamed-in-place insulation with suitable equipment in accordance with the manufacturer's written instructions. Fill all joints completely, leaving no voids or gaps and trim excess material.

3.3 BOARD INSULATION 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.
 - .2 Maintain continuous thermal insulation, vapour barrier and air tightness for building spaces and elements, and as follows:
 - .1 Saw cut and trim insulation neatly to fit spaces; fill voids with foamed-in-place insulation compatible with installed insulation.
 - .2 Butt edges and ends tight
 - .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 insulation fasteners spaced in accordance with manufacturers recommended spacing and pattern.
 - .7 Drill a drill hole through the insulation material and push/hammer the insulation fastener in drilled hole.
 - .8 Progressively screw in, preventing damage to the insulation and/or plug. Screw with double thread allows for quick installation.

- .2 Leave insulation joints unbonded over line of expansion and control joints; bond a continuous 150mm (6") wide strip of primary vapour membrane over expansion and control joints using compatible adhesive
- .3 Protect insulation from damage until it is covered; replace any broken, sunburned, crushed or dented insulation immediately prior to covering; coordinate with back-filling operations
- .4 Board Insulation: Install board insulation to vertical surfaces with adhesive applied in accordance with manufacturer's written instructions, and as follows:
 - .1 Exterior Application: Extend boards as indicated on Drawings to top of footing, installed on exterior face of perimeter foundation wall.
 - .2 Install insulation fasteners as indicated above.
 - .3 Protect below grade insulation on vertical surfaces from damage during backfilling by applying protection board; set in adhesive according to insulation manufacturer's written instructions.
- .5 Foundation and Under Slab Insulation: Extend boards a minimum of 1220mm (4') in from perimeter foundation wall, unless otherwise indicated on Drawings, and as follows:
 - .1 Lay boards on level compacted fill.
 - .2 Insulate structural slabs at entrances with insulation placed horizontally underneath the concrete, and insulate surrounding slabs on grade in the same way for a distance of 1220mm (4') in every direction from the perimeter of the structural slab; omit perimeter insulation on adjacent foundations for the width of the structural slab.
- .7 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 3mm (1/8") thick when wet and bed the insulation into adhesive before adhesive loses its tack or skins-over.
 - .2 Apply insulation fasteners following manufacturer's written instructions.
 - .3 Install insulation clips to walls before sheet membrane air barriers are applied.

3.4 ADJUSTING & CLEANING

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

3.5 PROTECTION

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

END OF SECTION

1 General

1.1 SUMMARY

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

1.2 REFERENCE STANDARDS

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

1.3 ADMINISTRATIVE REQUIREMENTS

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

1.4 SUBMITTALS

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

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

1.5 QUALITY ASSURANCE

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

1.6 MOCK-UP

- .1 Provide mock-ups in accordance with Division 01.
- .2 Construct mock-ups for each form of construction and finish required to verify selections made under sample submittals and to demonstrate aesthetic effects and qualities of materials and execution before installing materials indicated in this Section.
- .3 Build mock-ups using exposed and concealed materials indicated for the completed Work, and as follows:
 - .1 Locate mock-ups in the location and of the size indicated or, if not indicated, as directed by Consultant.
 - .2 Notify Consultant 7 days in advance of the dates and times when mock-ups will be constructed.
 - .3 Demonstrate the proposed range of aesthetic effects and workmanship.

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

1.7 ENVIRONMENTAL CONDITIONS

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

1.8 DELIVERY, STORAGE, HANDLING AND PROTECTION

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

1.9 WARRANTY

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

2 Products

2.1 MANUFACTURERS

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

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

2.2 MATERIALS

- .1 Vapor permeable water-resistive barrier with highly tear-resistant thermo-bonded non-woven polyester substrate, and waterproof acrylic highly UV resistant coating.
 - .1 Include factory applied self-adhesive strip at longitudinal edges of barrier membrane.
- .2 Design Criteria:
 - .1 Water Vapor Permeance: To ASTM E96 (Procedure A), 204 perms minimum.
 - .2 Water Impact Penetration Resistance: To AATCC 42, no water passing.
 - .3 Air Permeance: To ASTM E2178, 0.9 L/(s x m²) @ 75 Pa.
 - .4 Tear Resistance: To ASTM D 1922, 1916 g minimum.
 - .5 Dry Tensile Strength: To ASTM D882, MD 47.4 lb/in², CD 28.7 lb/in² minimum.
 - .6 Elongation at Break: To ASTM D882, MD 40 %, CD 45 % minimum.
 - .7 Fire Rating Characteristics to ASTM E84:
 - .1 Rating: NFPA Class A, IBC Class A minimum.
 - .2 Flame Spread: 10 maximum.
 - .3 Smoke Developed: 145 maximum.
- .3 Water-resistive Barrier for Walls: Vapor permeable water-resistive barrier with tear-resistant thermo-bonded, non-woven polyester substrate and waterproof acrylic polymeric coating stabilized against oxidation and UV degradation and factory applied adhesive edge strips.
 - .1 Service Life Expectancy: Twenty-five (25) years.
 - .2 Weight: 5.5 lb/100 ft², 270 g/m², 44 lb/roll nominal.
 - .3 Colour: Black.
 - .4 Basis of Design Materials:
 - .1 Dörken Systems Inc., DELTA®-FASSADE S
 - .2 Solitex Fronta WA Connect
 - .3 Equivalent products as per Specification 01 25 00.
- .4 Accessories:
 - .1 Seam tape: In accordance with water-resistive barrier manufacturer's written recommendations.
 - .1 Basis of Design Materials: Dörken Systems Inc., DELTA®-FASSADE TAPE (or approved equivalent).
 - .2 Flashings: Self-adhering, water-resistive flashing membrane in accordance with water-resistive barrier manufacturer's written recommendations.
 - .1 Basis of Design Materials: Dörken Systems Inc., DELTA®-FASSADE FLASHING (or approved equivalent).

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

3 Execution

3.1 EXAMINATION

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

3.2 PREPARATION

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

3.3 INSTALLATION

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

- .2 Ensure water-resistive barrier is installed with textured side facing substrate.
- .4 Start installation of water-resistive barrier at building corner, leaving 150mm to 305mm (6" to 12") of membrane extended beyond corner.
- .5 Install horizontally starting at bottom of wall.
 - .1 Overlap water-resistive barrier membrane as follows:
 - .1 Exterior Corners: 305mm (12") minimum.
 - .2 Vertical and horizontal seems: 150mm (6") minimum.
 - .3 Other seams, joints or at protrusions and penetrations: 150mm (6") minimum.
- .6 Attachment of Water-resistive Barrier Membrane to Substrate:
 - .1 Attach water-resistive barrier to steel studs through exterior sheathing with mechanical fasteners, and elastomeric adhesive in accordance with manufacturer's written recommendations.
 - .1 Secure using fasteners and custom caps spaced 157mm (18") maximum vertically on center along stud line and 610mm (24") maximum on center, horizontally.
 - .2 Ensure fasteners penetrate securely through metal studs 19mm (¾") minimum.
 - .3 Install fasteners 150mm (6") from sill and frame of window and door openings.
 - .4 Ensure fasteners are installed 229mm (9") minimum from window or door head.

3.4 SITE QUALITY CONTROL

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

3.5 CLEANING AND PROTECTION

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

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

END OF SECTION

1 General

1.1 SUMMARY

.1 This section includes requirements for supply and installation of under-slab vapour retarder required for the following:

.1 Below slab on grade Areas.

1.2 SUBMITTALS

.1 Provide submittals in accordance with Division 01.

.2 Action Submittals:

.1 Samples: Submit samples of materials to Consultant for review and acceptance as follows:

.1 305 mm x 305 mm (12" x 12") sample for review and acceptance.

.2 Data Sheets: Manufacturer's descriptive literature and recommended method of installation.

.3 Certificates: Manufacturer's certificates attesting that products meet specification requirements.

.3 Informational Submittals:

.1 Product Data: Submit manufacturer's product literature for each product listed including manufacturer's recommended installation procedures and any modifications required to suit installation conditions.

1.3 SUSTAINABLE DESIGN REQUIREMENTS

.1 The Passive House sustainable design requirements shall apply to all relevant Sections and Work for this Project, whether specifically indicated or not. Compliance with The Passive House certification requirements indicated in Section 01 35 63, will be used as one criterion to evaluate requests for substitutions or alternates.

.2 Field records including positive and negative pressure air change test results performed according to Section 01 83 16 Airtightness Testing Exterior Enclosure Requirements, construction progress documentation, inspections schedule and evidence of reviews. Refer to Section 01 32 33 Photographic Documentation.

1.4 QUALITY ASSURANCE

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

.2 The below-grade vapour retarder shall be inspected by the Consultant prior to concrete work.

1.5 STORAGE, DELIVERY, HANDLING AND PROTECTION

.1 Deliver materials on manufacturer's original skids, or in original unopened protective packing.

.2 Protect materials during transportation, storage and installation to avoid physical damage.

2 Products

2.1 MATERIALS

.1 Below Grade Vapour Retarder (VB-01)

- .1 Membrane shall be a seven layer co-extruded barrier manufactured from polyethylene and ethylene vinyl alcohol (EVOH) resins, meeting the shall meet the following minimum performance requirements:
 - .1 Maximum Water Vapour Permeance (ASTM E154 Sections 7, 8, 11, 12, 13, by ASTM E96, Method B, or ASTM F1249)
 - .1 As received: 0.0098 perms.
 - .2 After Wetting and Drying: 0.0079 perms.
 - .3 Resistance to Plastic Flow and Temperature: 0.0079 perms.
 - .4 Effect Low Temperature and Flexibility: 0.0097 perms.
 - .5 Resistance to Deterioration from Organisms and Substances in Contacting Soil: 0.0113 perms.
 - .2 Puncture Resistance, ASTM D1709: 2,600 grams.
 - .3 Tensile Strength, ASTM E154, Section 9: 102 N (58 Lb. Force/Inch).
 - .4 Radon Diffusion Coefficient, k124/02/95: $<1.1 \times 10^{-13} \text{ m}^2/\text{s}$.
 - .5 Methane Permeance, ASTM D1434: $3.68 \times 10^{-12} \text{ m/s}$ (GTR).
 - .6 Aqueous Phase Film Permeance
 - .1 Benzene Permeance: $1.57 \times 10^{-10} \text{ m/s}$.
 - .2 Toluene Permeance: $2.18 \times 10^{-10} \text{ m/s}$.
 - .3 Ethylbenzene Permeance: $1.71 \times 10^{-10} \text{ m/s}$.
 - .4 M & P Xylenes Permeance: $1.62 \times 10^{-10} \text{ m/s}$.
 - .5 O Xylene Permeance: $1.53 \times 10^{-10} \text{ m/s}$.
- .2 Acceptable Material:
 - .1 Perminator EVOH by W.R. Meadows, or equivalent per 01 25 00.

2.2 ACCESSORIES

- .1 Double Sided Seam Tape
 - .1 Double sided butyl tape for overlap sealing in gas barrier installations. Minimum width 50 mm (2").
 - .2 Acceptable Product: PERMINATOR EVOH BUTYL TAPE by W. R. MEADOWS or equivalent.
- .2 Pipe Collars
 - .1 Construct pipe collars from gas barrier material and pressure sensitive tape per manufacturer's instructions.

3 Execution

3.1 INSPECTION

- .1 Check graded subgrade for conformity with elevations and cross-sections before placing material.
- .2 Check for unstable areas and areas requiring additional compaction.
- .3 Level, tamp or roll granular material below slab.
- .4 Notify Consultant of unsatisfactory surfaces and conditions.
- .5 Do not begin installation of material until deficiencies have been corrected.

3.2 INSTALLATION

- .1 Install the gas barrier membrane in accordance with manufacturer's instructions and ASTM E1643.
- .2 Unroll gas barrier membrane with the longest dimension parallel with the direction of the pour.
- .3 Lap gas barrier over the footing and seal to foundation walls with 50 mm (2") double sided butyl tape and roll press into place with rubber roller.
- .4 Apply gas barrier seam tape to the terminated edge of the gas barrier membrane and onto the concrete foundation.
- .5 Roll press into place.
- .6 Joint Overlap
 - .1 Apply double sided butyl tape 150 mm (6") from the termination of the gas barrier membrane and press into place.
 - .2 Overlap the next layer of gas barrier membrane 300 mm (12") and roll press into place.
 - .3 Apply gas barrier seam tape centered over the joint and roll press into place.
- .7 Repair of Damaged Areas
 - .1 Cut out damaged area of gas barrier membrane allowing for an overlap of 300 mm (12") in all directions.
 - .2 Apply double sided butyl tape 150 mm (6") from the cut edges of the gas barrier membrane in all directions and press into place.
 - .3 Place the new piece of gas barrier membrane overlapping the existing areas a minimum of 300 mm (12") and roll press into place.
 - .4 Apply 100 mm (4") gas barrier seam tape centered over the joint in all directions and roll press into place.

3.3 PROTECTION

- .1 Take extreme care during trenching operations, installation of materials and backfilling not to damage or displace materials or other utilities.

END OF SECTION

1 General

1.1 SUMMARY

- .1 Supply labour, materials, plant, tools and equipment to complete the Work as shown on the Drawings and as specified herein, including, but not limited to the following:
 - .1 Compatible fluid applied/sheet applied vapour permeable air barrier (AB) membranes, complete with all associated primers and accessories necessary for complete system installation.
 - .2 Materials and installation methods to bridge and seal the following air leakage pathways and gaps:
 - .1 Connections of the walls to the roof air barrier.
 - .2 Connections of the walls to the foundations, seismic and expansion points, openings and penetrations of window frames, store front, and other envelope systems, door frames, piping, conduit, duct and similar penetrations, masonry ties, screws, bolts and similar penetrations.
 - .3 All other leakage pathways in the building envelope.

1.2 PERFORMANCE REQUIREMENTS

- .1 Provide a vapour permeable air barrier constructed to perform as a continuous air and vapour barrier, and as liquid water drainage plane flashed to discharge any incidental condensation or water penetration.
- .2 The air barrier shall be joined in an airtight and flexible manner to the air barrier material of adjacent systems, allowing for the relative movement of systems due to thermal and moisture variations and creep. Connection shall be made between:
 - .1 Foundations and walls.
 - .2 Walls and windows or doors.
 - .3 Different wall systems.
 - .4 Wall and roof.
 - .5 Wall and roof over unconditioned space.
 - .6 Walls, floor and roof across construction, control and expansion joints.
 - .7 Walls, floors and roof to utility, pipe and duct penetrations.
 - .8 All penetrations of the air barrier and paths of air infiltration/exfiltration shall be made airtight.

1.3 QUALITY ASSURANCE

- .1 Work in this Section is to be carried out by a skilled applicator approved by manufacturer and in strict accordance with manufacturer's printed instructions. Upon request, provide written confirmation or certification from the vapour permeable air barrier manufacturer that the installer has been trained and is recognized by the manufacturer as suitable for the execution of the work.
- .2 Perform Work in accordance with the manufacturer's written instructions of the air barrier membrane and this specification.
- .3 Maintain one (1) copy of the manufacturer's written instructions on site.
- .4 Compounds used in this section shall be sourced from one (1) manufacturer, including sheet membrane, air barrier sealants, primers, mastics and adhesives.

- .5 Pre-Installation Conference:
- .1 Convene a pre-installation conference two (2) weeks prior to commencing work of this section. Require attendance of parties directly affecting work of this section, including, but not limited to, the Owner's representative, Consultant, General Contractor, vapour permeable air barrier membrane contractor, vapour permeable air barrier membrane manufacturer's representative and substrate installer.
 - .2 Pre-Installation conference to be scheduled to coincide with regularly scheduled, on-site project progress meeting.
 - .3 Review preparation and installation procedures and co-ordinating and scheduling required with related work.
 - .4 Record discussions of conference and decisions and agreements (or disagreements) reached, and furnish copy of record to each party attending. Review foreseeable methods and procedures related to the vapour permeable air barrier membrane, including the following:
 - .1 Tour, inspect and discuss condition of substrate, penetrations and preparatory work performed by other trades.
 - .2 Review surface preparation, minimum curing period and installation procedures.
 - .3 Review special details and flashings.
 - .4 Review required submittals, both completed and yet to be completed.
 - .5 Review and finalize construction schedule related to work and verify availability of materials, installer's personnel, equipment and facilities needed to make progress and avoid delays.
 - .6 Review required inspections, testing, protection and repair procedures.
 - .7 Review weather and forecasted weather conditions, and procedures for coping with unfavourable conditions.
 - .8 Post the following warning in a prominent location at all building entrances and top of each stair in red – 1" letter height minimum. (available by request from www.foursevenfive.com)

AIRTIGHT BUILDING PROJECT

This is an airtight building; DO NOT PENETRATE the insulated envelope and airtight layer without prior permission of the Superintendent

- .6 Arrange for a Manufacturer's Representative to:
- .1 Visit the site and discuss any special requirements, procedures and unique conditions, prior to commencement of work.
 - .2 Inspect substrate surfaces and recommend solutions to accommodate requirements for surface preparation of the existing coating and any adverse conditions.
 - .3 Periodically visit and inspect the installation and report unsatisfactory conditions to the Contractor.
 - .4 Attend final inspection and to submit written certification that the products, systems and assemblies have been installed in accordance with the manufacturer's requirements.
- .7 Inspection and Testing:

- .1 Cooperate and coordinate with the Owner's inspection and testing agency. Do not cover any installed vapour permeable air barrier membrane until any required inspections, testing approvals have been completed.
- .2 Contractor and membrane manufacturer's representative shall conduct at least three ASTM D4541 Adhesion test at random mock-up locations, demonstrating membrane achieves minimum pull strength of 16 PSI.

1.4 SUBMITTALS

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

1.5 MOCK-UP

- .1 Provide mock-ups in accordance with Division 01.
- .2 Construct mock-ups for each form of construction and finish required to verify selections made under sample submittals and to demonstrate aesthetic effects and qualities of materials and execution before installing materials indicated in this Section.

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

1.6 ENVIRONMENTAL CONDITIONS

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

1.7 DELIVERY, STORAGE, HANDLING AND PROTECTION

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

the membrane has cured, protect vapour permeable air barrier membrane from damage by work of other Sections.

1.8 WARRANTY

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

2 Products

2.1 MATERIALS

- .1 Fluid-applied, Vapour Permeable Air Barrier (AVB-01): a high-quality, water-based acrylic dispersion air barrier. Apply with airless sprayer, paint brush or roller to air seal CMU, concrete, wood, joist bays, and weather resistant barriers. The liquid-applied acrylic membrane shall form a seamless, elastic air and vapor variable membrane once cured.
 - .1 Basis of Design Product: VISCONN by Pro Clima as distributed by FourSevenFive, or approved equivalent.
 - .1 Materials: Aqueous acrylic dispersion - Color: Blue (wet) and Navy Blue/Black (dry) or White (wet and dry states).
 - .2 Coverage: 2.46 oz/sf (750 g/m² on smooth substrate) (wet) [dependent on the roughness of the substrate, the thickness and the application method]
 - .3 Surface Weight: 0.66 oz/sf (200 g/m²) (EN 1849-2) (dried) [dependent on the roughness of the substrate, the thickness and the application method]
 - .4 Application Thickness: 8-39 mils (0.2 – 1.0mm) (wet film) – dependent on substrate
 - .5 Airtight material: 0.000000 L/(Pa·m²·s) ASTM E2178
 - .6 WRB per IBC 1403.2/IRC R703 Passed modified ASTM E331 at 299Pa
 - .7 Vapor Permeance: Sd-value 0.13 – 10 m (EN 12572)
0.9 perms (dry cup ASTM E96)
 - .8 Weather/UV-exposure: Minimize the exposure to direct sunlight. Maximum exposure 3 months
 - .9 Water column: over 6'.7" (2m) under AATCC 127
 - .10 Temperature resistance: -40 °C/-40 °F to +80 °C/176 °F
 - .11 Application temperature: 41°F – 95°F (5°C-35°C)
 - .12 Drying: approx. 12 - 48 hours (at 20 °C, 65% rel. humidity) depending on subsurface and applied thickness
 - .2 Flexible Air Barrier Membrane Flashing Tape (AVB-02) Transition Tape:
 - .1 Vapour-open fabric (5 perms), PP backing fleece, single-sided adhesive with release strips for easy application, solid acrylic adhesive for connection to masonry/concrete substrates without need for primer.
 - .1 Basis of Design Product: Contega Solido by Clima as distributed by FourSevenFive, or approved equivalent.

- .3 Reinforcing Sealant:
 - .1 Water-based acrylic dispersion air barrier, brush applied to fill gaps up to 3/4" to CMU, concrete, wood, joist bays. Fully compatible with AB-01 and can be covered with spray-on liquid film to form a seamless, elastic air and vapour retarding protective layer when fully installed.
 - .1 Basis of Design Product: VISCONN FIBRE by Clima as distributed by FourSevenFive, or approved equivalent.
- .4 Substrate Cleaners:
 - .1 Compatible cleaner as recommended by manufacturer.
- .5 Packing Insulation:
 - .1 Loose, glass fibre or mineral fibre insulation, 1.0 lbs./cu.ft. density, and conforming to CAN/CGSB-51.11.

3 Execution

3.1 EXAMINATION

- .1 The installer shall examine conditions of substrates, areas and other conditions under which the vapour permeable air barrier system will be applied for compliance with requirements.
- .2 Verify that surfaces and conditions are ready to accept the Work of this section. Surfaces shall be sound, dry, even and free of oil, grease, dirt, excess mortar or other contaminants. Concrete surfaces shall be cured and dry, smooth without large voids, spalled areas or sharp protrusions. Masonry joints shall be flush and completely filled with mortar, and all excess mortar sitting on masonry ties shall have been removed. Verify substrate is visibly dry and free of moisture.
- .3 Notify the Consultant in writing of any discrepancies. Commencement of work or any parts thereof shall mean acceptance of the prepared substrate.
- .4 Do not proceed with application of vapour permeable air barrier membrane when rain is expected within 16-hours.

3.2 GENERAL

- .1 Ensure continuity of the air seal throughout the scope of this section.
- .2 Components and membrane materials must be obtained as a single-source from the membrane manufacturer to ensure total system compatibility and integrity.
- .3 Install all materials in accordance with the manufacturer's written directions, unless otherwise specified herein.

3.3 SURFACE PREPARATION

- .1 Clean, prepare and treat substrates according to manufacturer's written instructions. Surfaces to be coated must be smooth, clean, dry, firm to the touch and free from oil, grease, dirt, excess mortar and other contaminants.
 - .1 Brushing and/or scraping of substrates may be required to adequately prepare surface.
 - .2 Remove all poorly bonded, existing surface coating prior to installing work of this Section.
 - .3 Thoroughly wash metal surfaces with mineral spirits or xylol and wipe dry with clean rags.
- .2 Vapour permeable air barrier membrane is not to be applied over lightweight, cast-in-place concrete containing high moisture or certain curing compounds. Cast-in-place

concrete should be cured for a minimum of two (2) weeks prior to application of vapour permeable air barrier membrane.

- .3 Concrete surfaces shall be free of large voids and spalled areas. Fill all spalled concrete areas, form-tie holes/voids and open mortar joints in concrete block with mortar to produce a smooth, even surface. Allow to cure properly before proceeding.

3.4 JOINT AND PROTRUSION TREATMENTS

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

3.5 APPLICATION - AIR BARRIER MEMBRANE FLASHINGS

- .1 Apply primer to all substrate areas where flexible air barrier membrane flashings are to be applied. Apply primer using lambs wool roller at rate 100 sq.ft. to 300 sq.ft./gallon (2.044 to 6.131 sq.m./gallon) depending on porosity of substrates. Allow primer to "tack up" for approximately 30-minutes prior to application of flexible air barrier membrane flashings.
- .2 Do not use solvent-based primer where it may be in contact with polystyrene insulation.
- .3 Install flexible air barrier membrane flashings in strict accordance with the manufacturer's written instructions unless otherwise specified herein.
- .4 Ensure a uniform, continuous air barrier effect. Where air barrier membranes are to be provided under other Sections, co-ordinate the work such that air barrier membrane continuity is achieved.
- .5 Provide air tight seals at penetrations in flexible air barrier membrane flashings.
- .6 Apply flexible air barrier membrane flashings to extend air barrier membrane at peripheries of the installation as required to facilitate joining and sealing of the air barrier provided in adjacent construction, lapping joints minimum of 75mm (3"), extending membrane onto adjacent concrete/metal substrates not less than 150mm (6"), centred over joints.
- .7 Apply continuous flexible air barrier membrane flashings at expansion and deflection joints within framing members, lapping joints minimum of 75mm (3"), extending

membrane onto adjacent concrete/metal substrates which have no applied air barrier not less than 150mm (6"), centred over joints.

- .8 Flexible Weather Barriers:
 - .1 Provide continuous 457mm (18") side flexible weather barrier membrane in exterior masonry cavity walls at expansion joints.
 - .2 Install flexible weather barrier membrane to substrate with adhesive, in strict accordance with manufacturer's instructions.
 - .3 Loop down flexible weather barrier into expansion/control joints approximately two (2) times the width. Lap joints minimum 150mm (6") and seal. Ensure that flexible weather barrier lap joints which are looped into expansion /control joints are sealed with adhesive. Seal tops and bottoms of membrane barrier at change in construction to present continuous, uninterrupted flexible weather barrier.
 - .4 Pack joint with loose batt insulation with face of insulation down two (2) times the width of expansion from face interior wythe.

3.6 APPLICATION - VAPOUR PERMEABLE AIR BARRIER MEMBRANE - LIQUID APPLIED

- .1 Areas to receive vapour permeable air barrier membrane are as follows:
 - .1 On all new / existing substrates, behind all rainscreen cladding.
 - .2 Prepare only enough vapour permeable air barrier membrane compound as can be used within compound's usable pot life. Mix vapour permeable air barrier membrane with a double blade agitator attached to a 13mm (1/2") drill in strict accordance with the manufacturer's written instructions.
 - .3 Apply vapour permeable air barrier membrane to substrates in a continuous coating at a rate of 27 - 45 litres/9.29 sq.m. (6 to 10 gal./100 sq.ft.) by roller, spray or trowel methods, producing a minimum wet film thickness of 70 wet mils (1.5mm).
 - .4 Ensure that application of vapour permeable air barrier membrane overlaps all flexible air barrier membrane flashings, dampproof course/thru-wall flashings a minimum of 75mm (3").
 - .5 Where masonry anchors pass through the air barrier membrane, ensure continuity of air barrier by applying vapour permeable air barrier membrane all around/over masonry anchors.

3.7 PROTECTION AND CLEAN-UP

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

END OF SECTION

1.0 GENERAL

1.1 GENERAL REQUIREMENTS

- .1 This section of the Specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.

1.2 DESCRIPTION OF WORK

- .1 This sub trade is responsible for the supply and installation of the following items, including all related labour and materials necessary to successfully complete the installation of same whether or not in the Contract Documents:
 - .1 Fiber reinforced composite cladding panels
 - .2 Fastening system
 - .3 Continuous Weather Barrier membrane
 - .4 Closures and related trim
 - .5 Caulking and sealants
 - .6 Other related Work as indicated on Drawings, Details and Specifications

1.3 SUBMITTALS

- 1. Submit Engineered Stamped Shop Drawings of panel installation, material, panel layout, and accessories in accordance with Division 1. No Work shall be fabricated before Shop Drawings have been reviewed/ returned. **Submitting the Architect's Drawings for this purpose is not acceptable.**
- .2 Indicate on Shop Drawings all information required to fabricate and install the components of this system. This shall include dimensions, connection and jointing details, gauges, finishes, etc. Ensure that plan and section details of interior and exterior corners, horizontal and vertical joints, fascias and soffits, cut-outs, miscellaneous trim, fastening methods etc are shown at a minimum scale of 1:5.
- .3 Shop Drawings indicating connection and support of cladding panels shall be sealed by a qualified professional engineer licensed to design structures and registered in Ontario.
- .4 Submit 100mm x 150mm sample of proposed color for review.
- .5 Submit samples of accessories if requested by the architect.
- .6 Submit manufacturer's data sheets covering the care and recommended maintenance procedures of siding for incorporation into maintenance manuals.
- .7 Submit copies of manufacturer's warranties.

1.4 MOCK-UP

- .1 Provide mock-ups in accordance with Division 01.
- .2 Construct mock-ups for each form of construction and finish required to verify selections made under sample submittals and to demonstrate aesthetic effects and qualities of materials and execution before installing materials indicated in this Section.

- .3 Build mock-ups using exposed and concealed materials indicated for the completed Work, and as follows:
 - .1 Locate mock-ups in the location and of the size indicated or, if not indicated, as directed by Consultant.
 - .2 Review of mock-ups to be coordinated with times of regularly scheduled progress meetings.
 - .3 Demonstrate the proposed range of aesthetic effects and workmanship.
 - .4 Include examples of window frame, door frame, interior corner, exterior corner and common protrusions or penetrations of membranes.
 - .5 Obtain Consultant's acceptance of mock-ups before proceeding with construction of work of this Section.
 - .6 Maintain mock-ups during construction in an undisturbed condition, as a standard for judging the completed Work.
 - .7 Accepted mock-ups may form a part of the completed Work.

1.5 QUALITY ASSURANCE

- 1. Installers shall have a minimum of ten (10) years of proven experience in the installation of similar products specified on projects of a similar size and scope.
- 2. Install a mockup on the building in a location as directed by the architect. Mockup shall incorporate panels, and all required finishing accessories and adjacent materials including flashing, windows, doors and trim. Mock up may form part of the work.

1.6 DELIVERY, STORAGE AND HANDLING

- 1. Deliver, store and handle materials in accordance with the site and environmental conditions prescribed by the manufacturer.
- 2. Remove damaged materials from the site.

1.7 COORDINATION WITH OTHER TRADES

- 1. All penetrations through the siding for the work of other trades shall be fitted with a watertight sleeve.

1.8 WARRANTY

- 1. Provide manufacturer's ten (10) year warranty from date of production to maintain the mechanical qualities, water tightness and frost resistance with exception of a gradual change caused by normal wear (aging), provided the panels are correctly installed on a ventilated construction according to the installation prescriptions of the producer.
- 2. The following will be deemed as defective Work; leakage, failure to stay in place, undue cracking, chipping or adjacent deformations, panel deformation, buckling, spalling, deterioration of surface. Failure of 15% of surface area of panels shall be deemed a total failure of the installation requiring complete re-application of panels.

2.0 PRODUCTS

2.1 GFRC CLADDING PANEL MATERIALS

1. GFRC panels to be manufactured from a homogeneous mixture of Portland cement, reinforcement fibres, additives and water. This mixture is transmitted in thin layers under constant pressure to a format roller by means of a sieve cylinder machine (Hatschek) until the required panel thickness is obtained. After the pressing process the panels are autoclaved.
- .2 GFRC Panels are to be through coloured and finished with a transparent impregnation making the panels hydrophobic.
- .3 GFRC Panels to adhere to the following:
 - .1 Density - oven dry: min. 1.600 kg/m³
 - .2 Bending strength: class 5 (min. 24 MPa)
 - .3 Modulus of Elasticity (wet): 12.000 MPa
 - .4 Moisture movement (30-90 %)⊥: 0,7 mm/m
 - .5 Moisture movement (30-90 %)∥: 0,8 mm/m
 - .6 Durability: Class A
 - .7 Water impermeability: complies with the norm
 - .8 Resistance to frost: complies with the norm
 - .9 Reaction to fire: class A2-s1, d0 (EN 13501-1)
 - .10 Weight ± 14,4 kg/m²
- .4 Glass Reinforced Concrete (FRC)
 - .1 Panel Dimensions:
 - .1 1220mm W x 2500/3050mm H, cut to suit layout indicated
 - .2 Edge profile: square
 - .3 Thickness: 8mm
 - .2 Finish: Sanded face finish resulting in the appearance of a slight superficial vertical line pattern.
 - .3 Colour: as selected by Consultant from manufacturers standard colour range (allow for 1 field colour).
 - .4 Basis of Design:
 - .1 Colormat Scripto as manufactured by SVK and distributed by Sound Solutions;
 - .2 Tectiva by Equitone
 - .3 Equivalent per Specification 01 25 00.

1.2 CLADDING SUPPORT FRAMING

- .1 Girts, sub-girts, Z bars, clips brackets shall be of the required base steel nominal thickness to meet design requirements. Thermal clips shall be slotted to minimize thru-metal conductivity; horizontal or vertical orientation to suit panel layout/engineered shop drawings.

- .2 Clip System: 38mm (1-1/2") wide, die cut aluminum extruded clip, adjustable to plumb structure, minimum 1.2mm (18 gauge) thick galvanized zinc-coated steel to ASTM A653. System to provide compliance to ASHRAE 90.1 and thermally broken façade requirements of the building code.
 - .1 Adaptable horizontal framing members.
 - .2 Clip Depth: Based on depth of the cavity insulation, as indicated on the Drawings.
 - .3 Vertical Clip Spacing: As recommended by clip manufacturer, and indicated on stamped Shop Drawings.
 - .4 Basis of Design Product: EA RVRS TClip and Girt, by Engineered Assemblies, ACS Thermal Clips by Soprema or equivalent per Specification 01 25 00.
- .3 Fasteners:
 - .1 Colour matched stainless steel rivets, as per clip manufacturer recommendations. No dissimilar materials allowed, in selection of fasteners.
- 2.3 CONTINUOUS WEATHER BARRIER MEMBRANE WRB-01
 - .1 Refer to Specification 07 25 00.
- 2.5 SEALANTS
 - .1 Refer to Specification 07 92 00 Building Envelope Sealants.
- 2.6 FLASHING
 - .1 Reference: ASTM A653/A653M, "Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process".
 - .2 Submittals: Product Data: Submit manufacturer's specifications, application instructions, details and maintenance instructions.
 - .3 Materials: Prepainted sheet steel: ASTM A653/A653M; Classification LFQ, Grade A, Z275 zinc coating designation, 0.60 mm minimum base steel thickness, commercial quality, prefinished with 8,000+ Series coating system by U.S. Steel Canada, Pre-Coat 8000+ by Dofasco Inc. or Colourite WeatherX by Vicwest Steel. Colour: Colour as selected by Consultant.
 - .4 Execution:
 - .1 Form work neatly to size, shape and dimensions shown or required for the work. Make angles and lines in true alignment. Erect work straight, sharp, plumb and level in true plan, free of bulges and waves. Verify dimensions at the building. After soldering, remove flux or acid with neutralizing chemical, wash surface with water and then let dry, ready installation as applicable. Where welding is employed or indicated, employ mechanics skilled in welding metal being worked; grind exposed welds smooth to match adjacent surfaces and remove slag and splatter before priming. Use concealed fastenings except where approved before installation.
 - .2 Make allowances for expansion and contraction for material being used. Shop form, lap and solder or weld corners and angles into one piece 450 mm (1'-6") minimum each way from corner or angle. Hem drip legs of copings and flashings at 45 degrees and secure drips with nailed or screwed concealed continuous

edge strips of same gauge and material. Use concealed fastenings wherever possible. Make "S-lock" type seams or "Standing" type seams. Make joints with opening away from prevailing winds. Install with joints and seams which will be permanently weatherproof.

3.0 **EXECUTION**

3.1 INSPECTION

1. Inspect the Work and notify the architect of any conditions that would affect the installation or performance of the Work.

3.2 PREPARATION

1. Verify site dimensions prior to commencement of the Work,
2. Clean and prepare to existing substrate to provide a surface free of frost, loose nails, dirt, debris or other contaminants that would adversely affect the installation of the breathable underlayment.
3. Seal all penetrations using a combination of tapes, self adhered membranes and other compatible sealants and products. Ensure all laps and details allow water to flow to the exterior
4. Starting at base of wall, unroll sheathing membrane horizontally across wall. Extend 6" over starting corner. Fasten at top and bottom of roll within 2" of edge 12 "on centre and at a maximum of 2' 0" on centre in field. Do not place vertical laps above windows.

3.3 INSTALLATION

- .1 Erect GFRC cladding panels and accessories in strict accordance with reviewed shop and erection drawings and manufacturer's instructions to give a complete and weatherproof system.
- .2 Install thermally broken clips, girts, sub-girts, cleats and retention clips and other attachment members necessary to complete the work of this Section.
 - .1 Co-operate with other trades to ensure proper installation and anchorage of work of this Section. Install steel bracing and framing and continuous clip angles and secure plumb and in line.
 - .2 Damaged, bent or dished sheets will be rejected.
- .3 Install exterior rainscreen insulation snugly between cladding clips, temporarily hold in place with adhesive as necessary.
- .4 Install continuous Weather Resistant Barrier (WRB-01) to hold insulation permanently in place, prior to installation of secondary sub girt framing.
- .5 Place GFRC panels against supporting substrate and adjust to final position before permanently securing. Bring each unit to bear evenly on framing.
- .6 Align units to provide accurate fit with corresponding sections parallel and straight. Ensure complete nesting of interlocking and sealed side lap joint and fasten sheets to structural supports.
- .7 Fasten GFRC panels to sub-girts, using colour matching fasteners, where indicated.

- .8 Install necessary closure and trim or neoprene closures at openings and penetrations, fastening at 12" O.C. Make cut-outs neatly by saw cutting.
 - .9 Where field cutting or scratches have been made, field coat such areas with touch-up paint after thoroughly cleaning affected surfaces.
 - .10 Seals:
 - .1 Fit flexible seals, tapes, formed gaskets and the like at locations required to provide air/vapour barriers and weathertight junctions. Ensure that end joints, between lengths of material have been properly sealed.
 - .2 Caulk junctions of preformed metal siding system components to themselves and work of other Sections with sealant in accordance with the requirements of Section 07 92 00, to maintain continuity of air/vapour and weather barriers.
 - .11 Rigidly connect all prefinished flashing pieces with specified colour matching fasteners at 12" O.C. along length. Use preformed corner pieces and erect with ample allowance for thermal movement.
 - .12 Furnish adequate quantity of prefinished flat stock flashing sheet to Section 07 62 00 for forming and installation. Trim members in this category are cap flashing, base flashing and those specifically shown on drawings as being prefinished and in close proximity to roofing. Flashing pieces entirely remote from roofing flashing and the like are furnished in place under work of this Section.
 - .13 Install work of this Section only during period of no rain, fog, sleet or snow, or upon surfaces covered with dust, water, dew, ice, frost or snow.
- 3.4 CLEAN UP
- 1. Remove any concrete dust from cutting/drilling panels with clean water and a compressor hose or brush.
 - 2. Upon completion of Work remove all equipment, tools, surplus materials and garbage.
 - 3. Panel installation site shall be left in a clean condition free from construction debris.

END OF SECTION

1 General

1.1 SUMMARY

- .1 This Section includes requirements for the supply and installation of cold applied SBS modified bituminous membrane roofing system (R-1 and R-2).
- .2 Section includes:
 - .1 Preparation of Metal Deck Surface
 - .2 Self Adhesive Vapour Retarder
 - .3 Roof Insulation Boards in adhesive
 - .4 Composite panel of asphaltic board and Base Sheet in adhesive
 - .5 Self-adhesive Base Sheet Flashing
 - .6 Cap Sheet Membrane and Cap Sheet Flashing in cold adhesive
 - .7 Accessories

1.2 REFERENCE STANDARDS

- .1 Canadian Roofing Contractors Association (CRCA):
 - .1 Roofing Specification Manual
- .2 American Society for Testing and Materials (ASTM):
 - .1 ASTM C1002-04, Steel Drill Screws for the Application of Gypsum Board
 - .2 ASTM C1396/C1396M-06a, Standard Specification for Gypsum Board
- .3 Canadian General Standards Board (CGSB):
 - .1 CGSB 37-GP-56M, Membrane, Modified, Bituminous, Prefabricated and Reinforced for Roofing
 - .2 CGSB 37-GP-64M, Mat Reinforcing, Fibrous Glass, for Membrane Waterproofing Systems and Built-up Roofing
 - .3 CAN/CGSB-37.5-M89, Cutback Asphalt Plastic Cement
 - .4 CAN/CGSB-37.28-M89, Reinforced, Mineral Colloid Type, Emulsified Asphalt for Roof Coatings and Waterproofing
 - .5 CGSB 37-GP-9Ma, Primer, Asphalt, Unfilled, for Asphalt Roofing, Dampproofing or Waterproofing
- .4 Canadian Standards Association (CSA):
 - .1 CSA A123.4-04, Bitumen for Use in Construction of Built-up Roof Coverings and Dampproofing and Waterproofing Systems
 - .2 CSA B111-1974 (R2003), Wires, Nails, Spikes and Staples
 - .3 CSA O151-M1978 (R2003), Canadian Softwood Plywood
- .5 Underwriters Laboratories Canada (ULC):
 - .1 CAN/ULC S107-03, Standard Methods of Fire Tests of Roof Coverings
 - .2 CAN/ULC S701-05, Thermal Insulation, Polystyrene, Boards and Pipe Covering
 - .3 CAN/ULC S702-97, Thermal Insulation, Mineral Fibre, Boards for Buildings and ULC S702.2-03, Mineral Fibre Thermal Installation for Buildings, Part 2: Application Guidelines

- .4 CAN/ULC S704-03, Standard for Thermal Insulation, Polyurethane and Polyisocyanurate, Boards, Faced
- .5 CAN/ULC S770-2000, Determination of Long-Term Thermal Resistance of Closed-Cell Thermal Insulating Foams

1.3 SUBMITTALS

- .1 Provide required information in accordance with Division 01.
- .2 Action Submittals: Provide the following submittals before starting any work of this Section:
 - .1 Product Data: Submit copies of membrane manufacturers current technical data sheets describing the physical properties and recommended installation procedures.
 - .2 Shop Drawings:
 - .1 Submit roof plan showing layout of sloped insulation, slopes to drains, location of drains, and scuppers at the edges of the building. Sloped insulation layout drawings to be reviewed by Consultant and stamped by Manufacturer, prior to installation.
 - .2 Submit membrane manufacturer's standard details that will be used for this project, indicate changes that must be made to make the details project specific for review by the Consultant.
 - .3 Informational Submittals:
 - .1 Certificates: Provide roofing system materials that are compatible with building vapour retarders specified in Division 07; submit a written declaration to the Consultant that roofing materials and components are compatible with wall air and vapour retarder membranes when requested by Consultant.
 - .2 Submit a report, certifying that the specified roofing system was tested in accordance with CSA A123.21-10, Standard test method for the dynamic wind uplift resistance of membrane-roofing systems. Test results shall demonstrate that the roofing system provides a Dynamic Uplift Resistance (DUR) of:
 - .1 Corner: -2.8kPa;
 - .2 Edge: -1.3kPa;
 - .3 Field: -0.9kPa.

1.4 MOCK-UPS

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

1.5 QUALITY ASSURANCE

- .1 Obtain roofing membrane materials through one source from a single manufacturer and install using workers who are trained and approved by the roofing membrane manufacturer; maintain a full time experienced journeyman roofer, and at least one apprentice per crew on the Work at all times.

- .2 Roofing and sheet metal work will be performed in conformance with the roofing manufacturer's written recommendations using materials that meet the requirements of CAN/ULC S107 to obtain a Class A fire resistance rating; submit proof that roofing materials meet required performance when requested by the Consultant.
- .3 Conform to Roofing Specifications as published by Canadian Roofing Contractors Association (CRCA) as a reference.
- .4 Execute work of this section using an applicator approved by the membrane manufacturer, and capable of issuing a 10 year Performance Warranty.
- .5 Pre-installation Conference:
 - .1 Convene a pre-installation conference at the site, one week prior to commencing work of this Section to review preparation and installation procedures and coordinating and scheduling required with related work.
 - .2 Require attendance of parties directly affecting work of this Section, including, but not limited to, the Owner's representative, Consultant, Contractor, Roofing Applicator and job foreman and Roofing Manufacturer's Representative.
 - .3 Contact Consultant two weeks prior to pre-installation conference to confirm schedule.
 - .4 Record discussions of conference and decisions and agreements (or disagreements) reached, and furnish copy of record to each party attending. Review foreseeable methods and procedures related to roofing work, including the following:
 - .1 Tour, inspect and discuss condition of substrate, roof drains, roof drain final locations, curbs, penetrations and other preparatory work performed by other trades.
 - .2 Review structural loading limitations of deck and inspect deck for loss of flatness and for required mechanical fastening.
 - .3 Review roofing system requirements (drawings, specifications and other contract documents).
 - .4 Review required submittals, both completed and yet to be completed.
 - .5 Review and finalize construction schedule related to roofing work and verify availability of materials, installer's personnel, equipment and facilities needed to make progress and avoid delays.
 - .6 Review required inspections, testing, certifying and material usage accounting procedures.
 - .7 Review weather and forecasted weather conditions, and procedures for coping with unfavourable conditions, including possibility of temporary roofing (if not a mandatory requirement).

1.6 DELIVERY, STORAGE AND HANDLING

- .1 All materials will be delivered and stored in conformance with manufacturers written requirements; they must remain in their original packaging, displaying the manufacturer's name, product name, weight, and reference standards, as well as all other indications or references considered standard.
- .2 Store materials in a dry and properly ventilated area, away from any welding flame or spark and sheltered from the elements or any harmful substance. Only materials destined for same-day use can be removed from this storage area. In cold weather, store materials in a heated area at a minimum temperature of +10 degree C and removed prior to application. If rolls cannot be stored in a heated environment, they may be pre-conditioned before installation, refer to manufacturers written recommendations on membrane application procedures.

- .3 Store adhesives and emulsion-based waterproofing mastics at a minimum +5 degree C. Store adhesives and solvent-based mastics at sufficiently high temperatures to ensure ease of application.
- .4 Materials delivered in rolls will be carefully stored upright; flashing will be stored to avoid creasing, buckling, scratches or any other possible damage.
- .5 Avoid material overloads which may affect the structural integrity of specific roof areas.
- .6 Place plywood runways over the Work to enable the movement of materials and other traffic during construction of roofing.
- .7 Protect surrounding surfaces against damage from roofing work. Where hoisting is necessary, hang tarpaulins to protect walls during delivery of materials from ground to roof.
- .8 Materials will be rejected and be replaced at no extra cost to the Owner where materials are damaged by the elements, improper handling or other causes; remove rejected materials promptly from the site.
- .9 Protect exposed surfaces of finished walls with tarp to prevent damage during roofing work, repair any damage caused to adjacent materials and finishes caused by roofing installation.

1.7 SITE CONDITIONS

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

1.8 WARRANTY

- .1 Roofing Membrane Manufacturer: Provide manufacturer's warranty stating that they will repair or replace defective roofing (including labor) and base flashing materials that do not remain watertight, that splits, tears, or separates at the seams or from the substrate within the specified warranty period and as follows:
 - .1 Warranty Period: Ten (10) years Standard Warranty, starting from Substantial Performance for the Project.

2 Products

2.1 MANUFACTURERS

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

2.2 PERFORMANCE REQUIREMENTS

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

2.3 MATERIALS

- .1 Primer: Manufacturers recommended primers specifically formulated for installation of materials outlined below, contributing to the wind uplift resistance rating indicated in this Section.
- .2 Vapour Retarder (VB-02):
 - .1 Self-adhesive membrane composed of SBS modified bitumen, with a surface screen made of high-density polyethylene laminated between two layers of polyethylene films.
 - .2 Resistance to water vapour transmission: 2.5 ng/Pa.s.m² (0.04 perm).
 - .3 Basis of Design Product: SOPRAVAP'R by Soprema Inc. (or approved equivalent).
- .3 Carpentry: Wood roof materials shall be as specified in Section 06 10 00. Do not use pressure treated materials where SBS membrane materials are to be adhered to wood fabrications.
- .4 Adhesive:
 - .1 Low-rise two-part urethane adhesive with no solvent content.
 - .2 Specified product: DUOTACK INSULATION ADHESIVE by Soprema or equivalent per Specification 01 25 00.
- .5 Insulation INS-04a – Flat (Bottom Layer):
 - .1 CAN/ULC S704, ASTM C1289 Closed cell polyisocyanurate foam core between organic facers reinforced with glass fibres, suitable for use with adhesives.
 - .2 Thermal Resistance per 25mm (1"): R-5.7
 - .3 Compressive Strength – 138 kPa (20 psi).
 - .4 Linear Stability: < 5%
 - .5 Density: 32 kg/m³ (2.0 lb/ft³)
 - .6 Basis of Design Product: SOPRA-ISO by Soprema Inc. (or approved equivalent).
- .6 Insulation INS-04a – (Tapered Layer):

- .1 CAN/ULC S704, ASTM C1289 Closed cell polyisocyanurate foam core between organic facers reinforced with glass fibres, suitable for use with adhesives.
- .2 Compressive Strength – 138 kPa (20 psi).
- .3 Linear Stability: < 5%
- .4 Density: 32 kg/m³ (2.0 lb/ft³)
- .5 Basis of Design Product: SOPRA-ISO TAPERED by Soprema Inc. (or equivalent per Specification 01 25 00).
- .7 Insulation INS-4b (Top Layer)
 - .1 ASTM C726, Type I, class 1 Dual-density mineral wool insulation board with a rigid upper layer, impregnated with bitumen layer, compatible with mechanical fastening and adhesive applied membranes.
 - .2 Mineral wool boards made from basalt rock and steel slag, resulting in a non-combustible insulation.
 - .3 Thermal Resistance per 25mm (1"): R-3.8
 - .4 Compressive Strength – Top Layer at 25%: 37psi.
 - .5 Density – Top Layer: 220 kg/m³
 - .6 Density – Bottom Layer: 160 kg/m³
 - .7 Basis of Design Product: SOPRAROCK DD PLUS by Soprema Inc. (or approved equivalent).
- .8 Asphaltic Overlay Board with Laminated Base Sheet Membrane
 - .1 CSA A123.23, SBS modified base sheet membrane and polyester reinforcement, factory-laminated on asphaltic board. Top surface sanded. Side laps 60% self-adhesive and 40% thermofusible. 7 mm total thickness.
 - .2 Specified product: 2-1 SOPRASMART BOARD SANDED by Soprema or equivalent per Specification 01 25 00.
- .9 Cover Strip
 - .1 CSA A123.23, Membrane strip of 330 mm (13 in) made of SBS modified bitumen with a composite reinforcement. Top surface sanded, underface self-adhesive. The strip ensures watertightness in the end laps.
 - .2 Specified product: SOPRALAP STICK by Soprema or equivalent per Specification 01 25 00.
- .10 Membranes
 - .1 Base Sheet Membrane Flashing:
 - .1 CGSB 37-GP-56M, Type 2, Class C, Grade 2 (CSA A123.23, Type C, Grade 3)
 - .2 Roofing membrane with glass and polyester reinforcement and SBS modified bitumen. Top face sanded, under side self-adhesive. Top face marked with three (3) distinctive blue chalk lines to ensure proper roll alignment.
 - .1 Thickness: 3mm
 - .2 Mass: 3.3 kg/m³
 - .3 Specified product: SOPRAPLY STICK DUO by Soprema or equivalent per Specification 01 25 00.
- .11 Cap Sheet Field Membrane and Cap Flashing:

- .1 Membrane composed of SBS modified bitumen and composite reinforcement.
- .2 Surface: Covered and protected by coloured granules; Underside: Fine mineral aggregate for cold adhesive applications.
 - .1 Thickness: 3.5mm
 - .2 Mass: 4.3 kg/m³
 - .3 Colour of Granules: As selected by the Consultant from the manufacturer's standard product line.
- .3 Basis of Design Product: COLPLY TRAFFIC CAP by Soprema Inc. (or equivalent per Specification 01 25 00).
- .12 Jointing Mastic / Caulking: SOPRAMASTIC by Soprema Inc. (or approved equivalent).
- .13 Metal Flashings: As indicated in Section 07 62 00.

3 Execution

3.1 EXAMINATION

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

3.2 PREPARATION

- .1 Protect finished work to avoid damage during roof installation and material transportation.
- .2 Install protective boardwalks to enable passage of personnel and materials without causing damage to installed roofing materials.
- .3 Mount mechanical application devices on pneumatic tired wheels; use devices designed and maintained to operate without damaging insulation, roofing membrane or structural components.
- .4 Flame heated equipment is prohibited.
- .5 Thoroughly clean all surfaces which are to receive the roofing and flashings by whatever means necessary to remove laitance, frost, snow, ice, water, debris, extraneous matter and other substances which could affect the proper performance of the work of this Section.
- .6 Prime vertical surfaces with asphalt primer commencing at the top of the cant strip to the reglet or highest point as detailed. Allow sufficient time for the asphalt primer to cure and ensure that primer does not run into the building or stain wall faces.

3.3 INSTALLATION

- .1 Prepare surfaces and complete roofing work specified in this Section in accordance with manufacturer's written instructions and guidelines.

- .2 Install roofing elements on clean and dry surfaces; in a continuous operation when substrates are ready and as weather conditions permit.
- .3 Seal seams in base sheets that are not covered by a cap sheet membrane in the same day; do not install cap sheet if any moisture is present at or within base sheet seams.
- .4 Protect work of other sections during installation of work of this Section; repair or compensate other sections for damage caused by this Section.
- .5 Vapour Retarder (VB-02):
 - .1 Install self-adhering vapour barrier membrane VB-02 by unrolling vapour barrier membrane onto deck sheathing board substrate, starting at bottom of slope without removing silicone release sheet, and as follows:
 - .1 Align roll parallel to sheathing board supporting membrane.
 - .2 Peel back one end of silicone release sheet and adhere membrane to substrate; peel remaining release sheet at a 45 deg angle to avoid wrinkles in membrane.
 - .3 Cut roll and start again where membrane is not properly aligned to deck sheathing board; re-align membrane and overlap end of misaligned piece by 150mm (6").
 - .4 Overlap adjacent membranes by 75mm (3"); overlap end laps by 150mm (6"); stagger end laps by 305mm (12"); place thin sheet of metal under end lap of membrane to provide structural support to lapped membranes.
 - .2 Overlap roof vapour barrier to wall air/vapour barrier using compatible continuity strip to provide continuity of building envelope.
 - .3 Install vapour barrier at insulation perimeters and around each element piercing insulation to provide sealed connections with base sheet at up-stands.
- .6 Insulation:
 - .1 Adhere insulation INS-04a to vapour barrier using manufacturer's recommended adhesive applied at rate recommended by manufacturer; adhere insulation at locations where roof deck will be visible in final installation.
 - .2 Insulation may be mechanically fastened into top flutes of steel deck in accordance with manufacturer's written recommendations only where fasteners will not be visible from underside of deck in final installation.
 - .3 Install tapered insulation panels INS-04a in conformance with manufacturers instructions and layout indicated on reviewed shop drawings
 - .4 Install secondary insulation INS-04b as the top layer, followed by installation of overlay board.
 - .5 Stagger vertical joints between primary insulation boards and secondary insulation modules and between two rows of insulation board.
 - .6 Install only as much insulation as can be covered by roof membranes in the same day.
- .7 ASPHALTIC OVERLAY BOARD WITH LAMINATED BASE SHEET MEMBRANE
 - .1 Install composite board with adhesive in continuous strips spaced 30 cm (12 in) on the field. Decrease the spacing between ribbons to a minimum of 15 cm (6") at the perimeter and 10 cm (4") at the corners.
 - .2 Adhere the first 60 mm (2.5 in) of the self-adhesive side and end laps by removing the silicone release paper and using a membrane roller, then heat-weld the last 40 mm (1.5 in) (self-adhesive, heat-welded side laps).

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

- .6 Starting from the chalk line on the field surface to the bottom edge of the flashing or parapet, as well as on the granulated vertical surfaces to be overlapped, apply adhesive for first 125mm (5") of end laps using steel trowel with 5mm (3/16") notches.
- .7 Use electric hot-air torch on all side laps and last 25mm (1") of end laps, rolling with membrane roller to apply pressure and complete the installation.
- .8 Avoid the formation of wrinkles, swellings or fishmouths.
- .9 During installation, be careful not to overheat the membrane and its reinforcements.

3.4 WATERPROOFING OF PENETRATIONS

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

3.5 FIELD QUALITY CONTROL

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

END OF SECTION

1 General

1.1 SUMMARY

- .1 This Section includes requirements for the supply and installation of cold applied SBS modified bituminous membrane roofing system (R-1).
- .2 Section includes:
 - .1 Preparation of Metal Deck Surface
 - .2 Vapour Retarder
 - .3 Roof Insulation & Insulation Overlay Board
 - .4 Base Sheet Membrane
 - .5 Base Sheet Flashing
 - .6 Cap Sheet Membrane
 - .7 Cap Sheet Flashing
 - .8 Accessories

1.2 REFERENCE STANDARDS

- .1 Canadian Roofing Contractors Association (CRCA):
 - .1 Roofing Specification Manual
- .2 American Society for Testing and Materials (ASTM):
 - .1 ASTM C1002-04, Steel Drill Screws for the Application of Gypsum Board
 - .2 ASTM C1396/C1396M-06a, Standard Specification for Gypsum Board
- .3 Canadian General Standards Board (CGSB):
 - .1 CGSB 37-GP-56M, Membrane, Modified, Bituminous, Prefabricated and Reinforced for Roofing
 - .2 CGSB 37-GP-64M, Mat Reinforcing, Fibrous Glass, for Membrane Waterproofing Systems and Built-up Roofing
 - .3 CAN/CGSB-37.5-M89, Cutback Asphalt Plastic Cement
 - .4 CAN/CGSB-37.28-M89, Reinforced, Mineral Colloid Type, Emulsified Asphalt for Roof Coatings and Waterproofing
 - .5 CGSB 37-GP-9Ma, Primer, Asphalt, Unfilled, for Asphalt Roofing, Dampproofing or Waterproofing
- .4 Canadian Standards Association (CSA):
 - .1 CSA A123.4-04, Bitumen for Use in Construction of Built-up Roof Coverings and Dampproofing and Waterproofing Systems
 - .2 CSA B111-1974 (R2003), Wires, Nails, Spikes and Staples
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1.3 SUBMITTALS

- .1 Provide required information in accordance with Division 01.
- .2 Action Submittals: Provide the following submittals before starting any work of this Section:
 - .1 Product Data: Submit copies of membrane manufacturers current technical data sheets describing the physical properties and recommended installation procedures.
 - .2 Shop Drawings:
 - .1 Submit sloped insulation manufacturer's proposed roofing diagrams and layouts for review by the Consultant.
 - .2 Submit membrane manufacturer's standard details that will be used for this project, indicate changes that must be made to make the details project specific for review by the Consultant.
 - .3 Informational Submittals:
 - .1 Certificates: Provide roofing system materials that are compatible with building vapour retarders specified in Division 07; submit a written declaration to the Consultant that roofing materials and components are compatible with wall air and vapour retarder membranes when requested by Consultant.

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- .1 Provide mock-ups in accordance with Section 01 43 39.
- .2 Construct mock-ups for each form of construction and finish required to verify selections made under sample submittals and to demonstrate aesthetic effects and qualities of materials and execution before installing materials indicated in this Section.
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- .4 Mock-up must demonstrate air barrier continuity between roof assembly and adjacent wall/parapet assembly.

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- .1 Obtain roofing membrane materials through one source from a single manufacturer and install using workers who are trained and approved by the roofing membrane manufacturer; maintain a full time experienced journeyman roofer, and at least one apprentice per crew on the Work at all times.
- .2 Roofing and sheet metal work will be performed in conformance with the roofing manufacturer's written recommendations using materials that meet the requirements of CAN/ULC S107 to obtain a Class A fire resistance rating; submit proof that roofing materials meet required performance when requested by the Consultant.
- .3 Conform to Roofing Specifications as published by Canadian Roofing Contractors Association (CRCA) as a reference.
- .4 Execute work of this section using an applicator approved by the membrane manufacturer, and capable of issuing a 10 year Performance Warranty.
- .5 Pre-installation Conference:

- .1 Convene a pre-installation conference at the site, one week prior to commencing work of this Section to review preparation and installation procedures and coordinating and scheduling required with related work.
- .2 Require attendance of parties directly affecting work of this Section, including, but not limited to, the Owner's representative, Consultant, Contractor, Roofing Applicator and job foreman and Roofing Manufacturer's Representative.
- .3 Contact Consultant two weeks prior to pre-installation conference to confirm schedule.
- .4 Record discussions of conference and decisions and agreements (or disagreements) reached, and furnish copy of record to each party attending. Review foreseeable methods and procedures related to roofing work, including the following:
 - .1 Tour, inspect and discuss condition of substrate, roof drains, roof drain final locations, curbs, penetrations and other preparatory work performed by other trades.
 - .2 Review structural loading limitations of deck and inspect deck for loss of flatness and for required mechanical fastening.
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- .2 Store materials in a dry and properly ventilated area, away from any welding flame or spark and sheltered from the elements or any harmful substance. Only materials destined for same-day use can be removed from this storage area. In cold weather, store materials in a heated area at a minimum temperature of +10 degree C and removed prior to application. If rolls cannot be stored in a heated environment, they may be pre-conditioned before installation, refer to manufacturers written recommendations on membrane application procedures.
- .3 Store adhesives and emulsion-based waterproofing mastics at a minimum +5 degree C. Store adhesives and solvent-based mastics at sufficiently high temperatures to ensure ease of application.
- .4 Materials delivered in rolls will be carefully stored upright; flashing will be stored to avoid creasing, buckling, scratches or any other possible damage.
- .5 Avoid material overloads which may affect the structural integrity of specific roof areas.
- .6 Place plywood runways over the Work to enable the movement of materials and other traffic during construction of roofing.

- .7 Protect surrounding surfaces against damage from roofing work. Where hoisting is necessary, hang tarpaulins to protect walls during delivery of materials from ground to roof.
- .8 Materials will be rejected and be replaced at no extra cost to the Owner where materials are damaged by the elements, improper handling or other causes; remove rejected materials promptly from the site.
- .9 Protect exposed surfaces of finished walls with tarp to prevent damage during roofing work, repair any damage caused to adjacent materials and finishes caused by roofing installation.

1.7 SITE CONDITIONS

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

1.8 WARRANTY

- .1 Roofing Membrane Manufacturer: Provide manufacturer's warranty stating that they will repair or replace defective roofing (including labor) and base flashing materials that do not remain watertight, that splits, tears, or separates at the seams or from the substrate within the specified warranty period and as follows:
 - .1 Warranty Period: Ten (10) years Standard Warranty, starting from Substantial Performance for the Project.

2 Products

2.1 MANUFACTURERS

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

2.2 PERFORMANCE REQUIREMENTS

- .1 Design and construct roof so that completed installation will not leak.
- .2 Structural Design Performance:
 - .1 Design Roof System to Resist:
 - .1 Maximum deflection not to exceed $l/180$ under system's own weight plus wind load (positive and negative) loads acting normal to the plane in accordance with the Building Code Climatic Data, wind load 1:50 years.

- .1 Design roofing membrane to resist the following site specific dynamic wind uplift:
 - .1 Corner: -2.5kPa;
 - .2 Edge: -1.3kPa;
 - .3 Field: -1.0kPa.
- .2 Design the systems so that there is no air or water infiltration under the positive and negative forces imposed by wind and gravity loads.
- .2 Thermal movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, overstressing of components, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime sky heat loss.
 - .1 Temperature change (range): 20 deg C; Ambient: 40 deg C, material surfaces.

2.3 MATERIALS

- .1 Adhesives: Manufacturers recommended adhesives specifically formulated for installation of materials outlined below, meeting the wind resistance rating indicated in this Section.
- .2 Vapour Barrier (VB-02):
 - .1 Self-adhesive membrane composed of SBS modified bitumen, with a surface screen made of high-density polyethylene laminated between two layers of polyethylene films.
 - .2 Resistance to water vapour transmission: 0.92 ng/Pa.s.m² (0.016 Perm).
 - .3 Basis of Design Product: SOPRAVAP'R by Soprema Inc. (or approved equivalent).
- .3 Carpentry: Wood roof materials shall be as specified in Section 06 10 00. Do not use pressure treated materials where SBS membrane materials are to be adhered to wood fabrications.
- .4 Insulation INS-04a – Flat (Lower Layer):
 - .1 Closed cell polyisocyanurate foam core between organic facers reinforced with glass fibres, suitable for use with adhesives.
 - .2 Thermal Resistance per 25mm (1"): R-5.7
 - .3 Compressive Strength – 138 kPa (20 psi).
 - .4 Linear Stability: < 5%
 - .5 Density: 32 kg/m³ (2.0 lb/ft³)
 - .6 Basis of Design Product: SOPRA-ISO by Soprema Inc. (or approved equivalent).
- .5 Insulation INS-04b – Flat and Tapered Mineral wool (Upper Layer):
 - .1 Dual-density mineral wool insulation board with a rigid upper layer, impregnated with bitumen layer, compatible with mechanical fastening and adhesive applied membranes.
 - .2 Mineral wool boards made from basalt rock and steel slag, resulting in a non-combustible insulation.
 - .3 Thermal Resistance per 25mm (1"): R-3.8
 - .4 Compressive Strength – Top Layer at 25%: 37psi.
 - .5 Density – Top Layer: 220 kg/m³

- .6 Density – Bottom Layer: 160 kg/m³
- .7 Basis of Design Product: SOPRAROCK DD PLUS by Soprema Inc. (or approved equivalent).
- .6 Base Sheet Membrane (Adhered):
 - .1 A high performance base sheet membrane composed of SBS modified bitumen and a composite reinforcement. Both sides are sanded
 - .2 Basis of Design Product: COLDPLY BASE 410 by Soprema Inc. (or approved equivalent).
 - .3 Adhesive: As recommended by membrane manufacturer.
- .7 Base Sheet Membrane Flashing:
 - .1 Membrane composed of SBS modified bitumen and non-woven polyester mat reinforcement.
 - .2 Surface: Fine mineral aggregate for cold adhesive applications; Underside: High tack, self-adhesive layer, protected by polyefin release film.
 - .3 Basis of Design Product: SOPRALENE STICK by Soprema Inc. (or approved equivalent).
- .8 Cap Sheet Field Membrane and Cap Flashing:
 - .1 Membrane composed of SBS modified bitumen and composite reinforcement.
 - .2 Thickness: 3.5mm
 - .3 Surface: Covered and protected by coloured granules; Underside: Fine mineral aggregate for cold adhesive applications.
 - .1 Colour of Granules: As selected by the Consultant from the manufacturer's standard product line.
 - .4 Basis of Design Product: COLPLY TRAFFIC CAP 460 by Soprema Inc. (or approved equivalent).
- .9 Jointing Mastic / Caulking: SOPRAMASTIC by Soprema Inc. (or approved equivalent).
- .10 Metal Flashings: As indicated in Section 07 62 00.

3 Execution

3.1 EXAMINATION

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

3.2 PREPARATION

- .1 Protect finished work to avoid damage during roof installation and material transportation.
- .2 Install protective boardwalks to enable passage of personnel and materials without causing damage to installed roofing materials.
- .3 Mount mechanical application devices on pneumatic tired wheels; use devices designed and maintained to operate without damaging insulation, roofing membrane or structural components.
- .4 Flame heated equipment is prohibited.
- .5 Thoroughly clean all surfaces which are to receive the roofing and flashings by whatever means necessary to remove laitance, frost, snow, ice, water, debris, extraneous matter and other substances which could affect the proper performance of the work of this Section.
- .6 Prime vertical surfaces with asphalt primer commencing at the top of the cant strip to the reglet or highest point as detailed. Allow sufficient time for the asphalt primer to cure and ensure that primer does not run into the building or stain wall faces.

3.3 INSTALLATION

- .1 Prepare surfaces and complete roofing work specified in this Section in accordance with manufacturer's written instructions and guidelines.
- .2 Install roofing elements on clean and dry surfaces; in a continuous operation when substrates are ready and as weather conditions permit.
- .3 Seal seams in base sheets that are not covered by a cap sheet membrane in the same day; do not install cap sheet if any moisture is present at or within base sheet seams.
- .4 Protect work of other sections during installation of work of this Section; repair or compensate other sections for damage caused by this Section.
- .5 Vapour Retarder (VB-02):
 - .1 Install self-adhering vapour barrier membrane VB-02 by unrolling vapour barrier membrane onto deck sheathing board substrate, starting at bottom of slope without removing silicone release sheet, and as follows:
 - .1 Align roll parallel to sheathing board supporting membrane.
 - .2 Peel back one end of silicone release sheet and adhere membrane to substrate; peel remaining release sheet at a 45 deg angle to avoid wrinkles in membrane.
 - .3 Cut roll and start again where membrane is not properly aligned to deck sheathing board; re-align membrane and overlap end of misaligned piece by 150mm (6").
 - .4 Overlap adjacent membranes by 75mm (3"); overlap end laps by 150mm (6"); stagger end laps by 305mm (12"); place thin sheet of metal under end lap of membrane to provide structural support to lapped membranes.
 - .2 Overlap roof vapour barrier to wall air/vapour barrier using compatible continuity strip to provide continuity of building envelope.
 - .3 Install vapour barrier at insulation perimeters and around each element piercing insulation to provide sealed connections with base sheet at up-stands.
- .6 Insulation:
 - .1 Adhere insulation INS-04a to vapour barrier using manufacturer's recommended adhesive applied at rate recommended by manufacturer; adhere insulation at locations where roof deck will be visible in final installation.

- .2 Insulation may be mechanically fastened into top flutes of steel deck in accordance with manufacturer's written recommendations only where fasteners will not be visible from underside of deck in final installation.
- .3 Install secondary insulation INS-04b as the first layer, followed by installation of manufacturer's required primary flat insulation ready for installation of cold adhesive applied membrane roofing.
- .4 Stagger vertical joints between primary insulation boards and secondary insulation modules and between two rows of insulation board.
- .5 Install only as much insulation as can be covered by roof membranes in the same day.
- .6 Install tapered insulation panels INS-04b in conformance with manufacturers instructions and layout indicated on reviewed shop drawings.
- .7 Cold Adhesive Applied Field Base Sheet Installation:
 - .1 Install membrane base sheet in full bed of adhesive applied at rate recommended by roofing membrane manufacturer using a notched 5mm (3/16") neoprene squeegee starting at drain and perpendicular to slope.
 - .2 Apply base sheet in parallel strips, butting board joints up and covering the joints with self-adhesive strip attached to adjacent board.
 - .3 Roll surface installed membrane using a 30 kg steel roller to smooth membrane and to provide continuous and uniform adhesion to insulation.
 - .4 Seal lap joints of base sheet at end each workday; perform work without interruption to avoid tears and formation of fish mouths, air pockets or wrinkles.
 - .5 Cut off corners at end laps being covered by next roll.
 - .6 Terminate base sheet at top of cant or at perimeter.
- .8 Self-Adhere Base Sheet Flashing:
 - .1 Apply base sheet flashing when primer coat is dry and in accordance with manufacturer's written instructions.
 - .2 Position pre-cut membrane pieces; peel back 100mm to 150mm (4" to 6") of silicone release paper to hold the membrane in place at the top of the parapet, then gradually peel back remaining silicone release paper, pressing down on the membrane with aluminum applicator to provide good adhesion and to provide smooth transition between up-stand and field surface; smooth entire membrane surface with a roller for full adhesion.
 - .3 Cut off corners at end laps being covered by next roll.
 - .4 Seal overlaps at the end of each workday.
- .9 Installation of Cap Sheet (Field):
 - .1 Starting at drain, unroll membrane on base sheet, taking care to align the edge of the first selvage with the edge of the roof.
 - .2 Cut off corners at end laps at areas to be covered by the next roll.
 - .3 Each selvage will overlap the previous one along lines provided for this purpose, and will overlap by 150mm (6") at ends. Space end laps a minimum of 305mm (12").
 - .4 Apply adhesive to base sheet membrane for first 125mm (5") of end laps using steel trowel with 5mm (3/16") notches.

- .5 Use electric hot-air torch on all side laps and last 25mm (1") of end laps, rolling with membrane roller to adhere cap sheet membrane to base sheet, as recommended by the membrane manufacturer.
- .6 During installation, be careful not to overheat the membrane or its reinforcements.
- .7 Avoid the formation of wrinkles, swellings or fishmouths.
- .8 Avoid walking over finished surfaces until adhesive has cured; use rigid protective walkways as needed.
- .10 Cold Applied Cap Sheet Flashings:
 - .1 Install cap sheet flashings in 1000mm (3.25') wide strips.
 - .2 Each selvedge will overlap the previous one laterally along lines provided for this purpose, and will overlap by 150mm (6") the field surface.
 - .3 Space flashing membranes a minimum 100mm (4") with respect to the cap sheet membranes on the field surface, to avoid areas of excessive membrane thickness.
 - .4 Cut off corners at end laps on areas to be covered by the next roll.
 - .5 Use a chalk line to draw a straight line on the field surface, 150mm (6") from flashings and parapets.
 - .6 Starting from the chalk line on the field surface to the bottom edge of the flashing or parapet, as well as on the granulated vertical surfaces to be overlapped, apply adhesive for first 125mm (5") of end laps using steel trowel with 5mm (3/16") notches.
 - .7 Use electric hot-air torch on all side laps and last 25mm (1") of end laps, rolling with membrane roller to apply pressure and complete the installation.
 - .8 Avoid the formation of wrinkles, swellings or fishmouths.
 - .9 During installation, be careful not to overheat the membrane and its reinforcements.

3.4 FIELD QUALITY CONTROL

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

END OF SECTION

1 General

1.1 SUMMARY

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

1.2 REFERENCE STANDARDS

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

1.3 SUBMITTALS

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

1.4 QUALITY ASSURANCE

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

1.5 DELIVERY, STORAGE AND HANDLING

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

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

1.6 WARRANTY

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

2 Products

2.1 MATERIALS

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

2.2 FABRICATION

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

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

2.3 FINISHING

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

3 Execution

3.1 EXAMINATION

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

3.2 INSTALLATION

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

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

3.3 CLEANING

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

END OF SECTION

1 General

1.1 SUMMARY

- .1 Supply and install materials in accordance with published 'Through-Penetration Firestop Systems' in UL's Fire Resistance Directory or the publication of another approved independent laboratory.

1.2 REFERENCE STANDARDS

- .1 Underwriters Laboratories of Canada (ULC):
 - .1 CAN/ULC S115-05, Standard Method of Fire Tests and Firestop Systems
- .2 American Society for Testing and Materials (ASTM):
 - .1 ASTM E814-11a, Standard Test Method for Fire Tests of Penetration Firestop Systems

1.3 SUBMITTALS

- .1 Provide submittals in accordance with Division 01.
- .2 Shop Drawings:
 - .1 Provide details indicating all reinforcing, anchorages, fastening and proposed method of installation for the various conditions within the project.
- .3 Samples:
 - .1 Submit samples of each type of firestop and smoke seal material and accessory.

1.4 QUALITY ASSURANCE

- .1 Applicator shall be licensed by the manufacturer of fireproofing materials.
- .2 Conform to flame and temperature ratings established by CAN/ULC-S115-05 and ASTM E814-11a.
- .3 Submit manufacturer's certification that materials meet or exceed specified requirements.
- .4 Maintain flame and temperature ratings equal to surrounding materials.

1.5 DELIVERY, STORAGE, HANDLING AND PROTECTION

- .1 Deliver materials in original, unopened packages bearing name of manufacturer and product identification.
- .2 Store materials off ground, under cover, and away from damp surfaces.

1.6 SITE CONDITIONS

- .1 Do not apply materials when temperature of substrate material is below 4 deg C and surrounding air temperature is below 4 deg C, for 24 hours prior to application.

2 Products

2.1 MATERIALS

- .1 Bears UL, ULC or Warnock Hersey label and confirmation of compliance with ASTM E814-11a or CAN/ULC-S115.
- .2 Provide fire stopping and smoke sealing systems in accordance with CAN/ULC-S115-M and shall also conform to special requirements in part 3.5 of the Building Code.
- .3 Fire-resistant rating of fire stopping material assemblies must meet or exceed the fire-resistance rating of the floor or wall section being penetrated.

- .4 Fire stopping and smoke seals at openings around penetrations for pipes, ductwork and other mechanical items requiring sound and vibration control shall be elastomeric seal type. Do not use a cementitious, or rigid seal at such locations.
- .5 Primers shall be to manufacturer's recommendation for specific material, substrate, and end use.
- .6 Damming and backup materials, supports and anchoring devices shall be to manufacturer's recommendations, and in strict accordance with tested assembly being installed as acceptable to authorities having jurisdiction.
- .7 Sealants for vertical joints, shall be non-sagging type.

3 Execution

3.1 PROTECTION

- .1 Mask adjacent work of other Sections as necessary to avoid spillage onto adjoining surfaces. Remove stains on adjacent surfaces as required.

3.2 PREPARATION

- .1 Examine sizes and conditions to establish correct thickness and installation of backup materials. Ensure surfaces are dry and frost free.
- .2 Clean bonding surfaces of deleterious substances including dust, paint, rust, oil, grease and other foreign matter which may otherwise impair effective bonding.
- .3 Do not apply firestops and smoke seals to surfaces previously painted or treated with sealer, curing compound, water repellent, or other coatings unless tests have been performed to ensure compatibility of materials. Remove coatings as required.
- .4 Prepare surfaces in accordance with manufacturer's instructions.
- .5 Priming and Sealing: Prime surfaces in accordance with manufacturer's instructions.

3.3 APPLICATION

- .1 Mix materials in accordance with manufacturers' written instructions.
- .2 Apply in strict accordance with ULC certification and manufacturer's recommendations to provide a temperature and flame rated seal equal as a minimum to the rating of the wall or floor surrounding.
- .3 Seal all holes or voids made by penetrations to ensure an air and water resistant seal.
- .4 Seal all joints to ensure an air and water resistant seal, capable to withstand compression due to thermal, wind or seismic joint movement.
- .5 Consult with Mechanical Engineer and project manager prior to installation of UL firestop systems that might hamper the performance of fire dampers as it pertains to duct work.
- .6 Apply to mechanical and electrical service through-penetrations, to formed, sleeved, or cored openings in smoke and fire rated masonry, or gypsum wallboard stud walls and structural floors and ceilings.
 - .1 Coordinate with plumbing, HVAC and electrical contractors to ensure proper firestopping application, providing smoke seal around penetrations through fire rated assemblies. Ensure that end joints between lengths of firestopping material have been properly sealed.
- .7 Apply to head of smoke and fire rated gypsum wallboard stud wall abutting underside of structure (concrete or steel deck).
- .8 Apply to control joints in rated stud walls.

- .9 Apply to penetrations for passage of duct, cable, cable tray, conduit, piping, electrical busways and raceways through fire rated vertical barriers (walls and partitions), horizontal beams (floor/ceiling assemblies) and vertical service shaft walls and partitions.
- .10 Apply to safing slots gaps between edge of floor slabs and curtain walls.
- .11 Apply to openings between structurally separate sections of walls and floors.
- .12 Apply to gaps between tops of walls and ceiling or roof assemblies.
- .13 Apply to expansion joints in fire rated walls and floors.
- .14 Apply to openings and penetrations in fire rated partitions or walls containing fire doors.
- .15 Apply to openings around structural members which penetrate fire rated floors or walls.
- .16 Apply firestop and smoke seal materials in accordance with manufacturer's directions, with sufficient pressure to properly fill and seal openings.
- .17 Tool or trowel exposed surfaces.
- .18 Remove excess compounds promptly as work of this Section progresses and upon completion of work of this Section.

3.4 CURING

- .1 Cure materials in accordance with manufacturer's instructions.
- .2 Do not cover up materials until proper curing has taken place.

3.5 IDENTIFICATION

- .1 Identify through-penetration firestop systems with pressure-sensitive, self-adhesive, preprinted vinyl labels. Attach labels permanently to surfaces of penetrated construction on both sides of each firestop system installation where labels will be visible to anyone seeking to remove penetrating items or firestop systems. Include the following information on labels:
 - .1 The words: "Warning: Through-Penetration Firestop System - Do Not Disturb"
 - .2 Contractor's name, address and telephone number.
 - .3 Designation of applicable testing and inspection agency.
 - .4 Date of installation.
 - .5 Manufacturer's name for firestop materials.

3.6 CLEAN UP AND REPAIRS

- .1 Clean adjacent surfaces immediately and leave work neat and clean.
- .2 Remove excess materials using recommended procedures, as work progresses.
- .3 Remove dams after initial set of firestops and smoke seals as required.
- .4 Correct staining and discolouring of adjacent surfaces as directed by Consultant.
- .5 Remove all debris and excess materials entirely from the site and leave the work in a neat and tidy condition.
- .6 Perform one simulated smoke test for each penetration type once per day. Simulate smoke at a rate of four seconds/100 cubic feet (2.8 cubic metres) and maintain the fog density until inspection is complete.
- .7 After inspection is complete, repair all defective firestopping and smoke seals and test again. Continue this procedure until all firestopping and smoke seals passes test.

END OF SECTION

1 General

1.1 SUMMARY

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

1.2 REFERENCE STANDARDS

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

1.3 SUBMITTALS

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

1.4 QUALITY ASSURANCE

- .1 Adhere to Manufacturer's recommendations for mixing or preparation of materials listed in this Section.
- .2 Pot life or installation times shall not be exceeded.
- .3 Integral materials which compose a joint detail shall be compatible.

- .4 Component parts, where possible, shall have the same manufacturer.
- .5 A representative of sealant material manufacturer shall visit the site during application to ensure that all Work is carried out according to the manufacturer's printed instructions.

1.5 SITE CONDITIONS

- .1 Apply sealants only to completely dry surfaces, and at air, substrate and material temperatures above minimum established by manufacturer's written specifications.

1.6 DELIVERY, STORAGE HANDLING AND PROTECTION

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

1.7 WARRANTY

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

2 Products

2.1 MATERIALS

- .1 Joint Cleaner:
 - .1 Non-corrosive solvents as recommended by sealant manufacturer for applicable substrate material(s).
- .2 Primer:
 - .1 Non-staining type as recommended by sealant manufacturer, for use on substrate conditions outlined, and compatible with specified sealant being applied.
- .3 Joint Back-Up – Backer Rod:
 - .1 Round, closed cell, reticulated foam, 50% compression, compatible with sealant and primer, non-adhering to sealant.
- .4 Bond Breaker:
 - .1 Pressure sensitive plastic tape, not bondable to sealant as recommended by sealant manufacturer.
- .5 Sealant Type "A" – Joints around Interior Door Frames, Windows and Under Exterior Thresholds:
 - .1 One-part, low or medium modulus, neutral curing 100% silicone joint sealant, conforming to ASTM C920-11, Type S, Grade NS, Class 35.
 - .1 DC CWS by Dow Corning.
 - .2 SWS by GE
 - .3 SikaSil WS-305CN by Sika
 - .4 Or approved equivalent.

OR

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- .2 One component, low modulus, moisture curing, polyurethane joint sealant, conforming to ASTM C920-11, Type S, Grade NS, Class 25.
 - .1 Dymonic FC by Tremco Ltd., division of RPM Company.
 - .2 Sikaflex 1A by Sika Canada Inc.
 - .3 Sonolastic NP1 by BASF.
 - .4 Pourthane NS by W.R MEADOWS
 - .5 Or approved equivalent.
 - .6 Sealant Type "B" – Exterior Wall Joints; Control Joints; Expansion Joints:
 - .1 One-part, ultra low modulus, non-staining neutral curing 100% silicone joint sealant, conforming to ASTM C920-11, Type S, Grade NS, Class 50.
 - .1 DC 790 by Dow Corning.
 - .2 Spectrem 1 by Tremco
 - .3 SCS2700 SilPruf LM by GE
 - .4 SikaSil WS-290 by Sika
 - .5 Or approved equivalent.
 - .7 Sealant Type "C" – Floor Control Joints:
 - .1 Multi-component, chemical curing, self-levelling, polyurethane joint sealant, conforming to ASTM C920-11, Type M, Grade P, Class 25.
 - .1 THC-900 by Tremco (Canada) Ltd., division of RPM Company.
 - .2 Sonolastic SL2 by Sonneborn Building Products, division of BASF Building Systems.
 - .3 Sikaflex 2c SL by Sika Canada Inc.
 - .4 Or approved equivalent.
 - .8 Sealant Type "E" – Mould and Mildew Resistant:
 - .1 Mould and mildew resistant, Shore A Hardness 15-25, conforming to ASTM C920-11, Type S, Grade NS, Class 25, use NT, G, and A:
 - .1 SCS1700 by GE
 - .2 DC 786 by Dow Corning
 - .3 Tremsil 200 by Tremco
 - .4 Omni Plus by Sonneborn
 - .5 SikaSil –GP by Sika
 - .6 Or approved equivalent.
 - .9 Sealant Type "F" – Glazing Joints:
 - .1 Silicone Sealant: Butt glazing, one part, moisture curing, shore A hardness 15-25, conforming to CAN/CGSB-19.13-M, Classification C-1-40-B-N and C-1-25-B-N and ASTM C920-11, Type S, Grade NS, Class 25, use NT, G, A, O; Colour: clear (translucent):
 - .1 DC 795 by Dow Corning
 - .2 SCS2000 by GE.
 - .3 Multiseal by Chemtron.
 - .4 Spectrum 2 by Tremco

- .5 SikaSil WS-295 by Sika
- .6 Or approved equivalent.
- .10 Sealant Type "H" – Saw Cut Sealant:
 - .1 Multi-component, self-levelling, conforming to ASTM D2240-05(2010):
 - .1 Tremco Control Joint Sealant
 - .2 BASF Masterfill 300
 - .3 Sika Loadflex
 - .4 Rezi-Weld Flex by W.R MEADOWS
 - .5 Or approved equivalent.
- .11 Sealant Type "I" – HVAC Sealant:
 - .1 One-part, RTV, acetoxycure silicone sealant for heating, ventilation, air conditioning and refrigeration applications:
 - .1 Dow Corning HVAC Silicone Sealant
 - .2 Or approved equivalent.
- .12 Sealant Type "J" – Electrical Sealant:
 - .1 One-part, white, non-flowing moisture cure adhesive for electrical applications:
 - .1 Dow Corning 738 Electrical Sealant
 - .2 Or approved equivalent.
- .13 Sealant Type "K" - Interior Acoustical Sealant:
 - .1 Non-skinning, non-hardening, single component synthetic rubber sealant, conforming to CAN/CGSB-19.21-M:
 - .1 Tremco Acoustic Sealant
 - .2 Chemtron Metaseal
 - .3 Or approved equivalent.
- .14 Preformed Compression Seal:
 - .1 Compartmental open cell neoprene extrusion type conforming to ASTM C509-06(2011), complete with liquid lubricant adhesive recommended by manufacturer.

3 Execution

3.1 INSPECTION

- .1 Verify at site that joints and surfaces conditions provided will not adversely affect execution, performance or quality of completed work.
- .2 Ensure masonry and concrete have cured 28 days minimum.
- .3 Ascertain that sealers and coatings applied to substrates are compatible with sealant used and that full bond of the sealant and substrate is attained. Request samples of the sealed or coated substrate from their fabricators for testing of compatibility and adhesion, if necessary.
- .4 Verify that specified recommended environmental conditions are present before commencing work.
- .5 Defective work resulting from application to unsatisfactory joint conditions will be considered the responsibility of those performing the work of this section.

- .6 Do not start work of this Section until conditions are satisfactory.

3.2 PREPARATION

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

3.3 APPLICATION

- .1 Apply sealant in accordance with manufacturer's directions, using a gun with proper nozzle size, ensuring to fill voids and joints completely, to leave a weathertight, airtight installation. Superficial pointing with skin bead is not acceptable.
- .2 Neatly tool surface to a slight concave profile. Surface of sealant shall be smooth, free from ridges, wrinkles, sags, air pockets and embedded impurities.
- .3 Clean adjacent surfaces immediately and leave Work neat and clean. Remove excess sealant and droppings, using recommended cleaners as Work progresses. Remove masking tape after tooling of joints.

3.4 CLEANING AND PROTECTION

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

END OF SECTION

PART 1 - GENERAL

1.1 Work Included

As detailed or scheduled in the contract documents, supply of:

- .1 Steel frame products including frames, transom frames (glazed or paneled), sidelight and window assemblies, fire-rated and non-rated.
- .2 Steel doors, swing type, flush, with or without embossed face sheets, with or without glazed or louvered openings, fire-rated, with or without temperature rise ratings, and non-rated.

1.2 References

- .1 ANSI/NFPA 80-1999, Standard for Fire Doors and Fire Windows
- .2 ASTM A653/A653M-05a, Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process
- .3 ASTM C553-02, Specification for Mineral Fiber Blanket Insulation for Commercial and Industrial Applications
- .4 ASTM C578-05, Specification for Rigid, Cellular Polystyrene Thermal Insulation
- .5 ASTM C591-01, Specification for Un-Faced Pre-formed Rigid Cellular Polyisocyanurate Thermal Insulation
- .6 ASTM C592-04, Specification for Mineral Fiber Batt and Blanket Thermal Insulation for Light Frame Construction
- .7 ASTM C1289-05a, Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board
- .8 CAN4-S104-M80, Standard Method for Fire Tests of Door Assemblies
- .9 CAN4-S106-M80, Standard Method for Fire Tests of Window and Glass Block Assemblies
- .10 CGSB 41-GP-19MA (1984), Rigid Vinyl Extrusions for Windows and Doors
- .11 CSA W59-2003, Welded Steel Construction (Metal Arc Welding)
- .12 CSDMA, Recommended Dimensional Standards for Commercial Steel Doors and Frames, 2000
- .13 CSDMA, Selection and Usage Guide for Steel Doors and Frames, 1990
- .14 CSDMA, Recommended Specifications for Commercial Steel Door and Frame Products – 08 11 00, 2006

1.3 Submittals

- .1 Submit shop drawings in accordance with Section 01 33 00.
- .2 Indicate each type of door, frame, steel, construction and core.
- .3 Indicate material thickness, mortises, reinforcements, anchorages, locations of exposed fasteners, openings (glazed, paneled or louvered) and arrangement of standard hardware.
- .4 Include schedule identifying each unit, with door marks and numbers relating to numbering on drawings and door schedule of the Architect.
- .5 Contractor responsible for coordination and installation of products provided under this Section shall;
 - .1 Verify and provide to the contractor responsible for the supply of steel door and frame products, actual opening sizes and field conditions by field measurement before fabrication. Submittal drawings shall reflect measurements and conditions provided, and product

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- manufactured accordingly. Coordinate field measurements with fabrication and construction schedules to avoid delays.
 - .2 Verify that substrate conditions, whether existing or installed under other Sections, are as detailed in the Architect's drawings, and are acceptable for product installation in accordance with the manufacturer's instructions.
 - .6 Manufacturer shall not proceed with fabrication without receipt of approved submittal drawings and approved hardware schedule.
- 1.6 Warranty
- .1 Materials and workmanship shall be warranted by the manufacturer for a period of one (1) year from date of substantial performance.

PART 2 - PRODUCTS

2.1 Materials

- .1 Acceptable Materials: Steel doors and frame product manufactured in accordance with this Specification by CSDMA members, are eligible for use on this project.
- .2 Steel: Commercial grade steel to ASTM A653, CS, Type B, Coating Designation ZF75 (A25) minimum. Minimum steel thicknesses shall be in accordance with Appendix 1 of the CSDMA, "Recommended Specifications for Commercial Steel Door and Frame Products".
- .3 Door Core Materials
 - .1 Honeycomb (Interior Doors). Structural small cell 25.4 mm (1") maximum kraft paper 'honeycomb'. Weight: 36.3 kg (80lb.) per ream minimum, density: 16.5 kg/m³ (1.03 pcf) minimum, sanded to required thickness.
 - .2 Polyisocyanurate (Exterior Doors). Rigid, modified polyisocyanurate, closed cell board. Density; 32 kg/m³ (2.0 pcf) minimum, thermal values; RSI 1.9 (R 11.0) minimum, in accordance with ASTM C591 (un-faced) or C 1289 (faced).
- .4 Primers
 - .1 Rust inhibitive touch-up only.
- .5 Miscellaneous
 - .1 Door Silencers. Single stud rubber/neoprene type.
 - .2 Exterior Top Caps. Rigid polyvinylchloride extrusion conforming to CGSB 41-GP-19MA.
 - .3 Frame Thermal Breaks. Rigid polyvinylchloride extrusion conforming to CGSB 41-GP-19MA.

2.2 Fabrication - Frame Products

- .1 Exterior frame product shall be 14 gauge. Exterior frames shall be welded type construction, thermally broken. Exterior transom frames, sidelight and window assemblies shall be welded type construction, thermally broken. Interior frame product shall be 16 gauge. Interior frames and window assemblies shall be welded type construction. Interior transom frames shall be welded type construction. Interior sidelight assemblies shall be welded type construction.
 - .1 All interior frames shall be wrap around type; throat dimension to suit partition width as scheduled.
- .2 Frame product shall be mortised, blanked, reinforced, drilled and tapped at the factory for templated hardware only, in accordance with the approved hardware schedule and templates provided by the hardware supplier.
- .3 Mortised cutouts shall be protected with steel guard boxes (may be omitted on dry wall applications).

- .4 Frame product shall be reinforced only, where required, for surface mounted hardware, anchor hinges, thrust pivots, pivot reinforced hinges, or non-templated hardware. Drilling and tapping is by others, on site, at time of installation.
- .5 Provide anchorage appropriate to floor, wall and frame construction. Each wall anchor shall be located immediately above or below each hinge reinforcement on the hinge jamb and directly opposite on the strike jamb. For rebate opening heights up to and including 1520 mm (60") provide two (2) anchors, and an additional anchor for each additional 760 mm (30") of height or fraction thereof, except as indicated below. Frames in previously placed concrete, masonry or structural steel shall be provided with anchors located not more than 150 mm (6") from the top and bottom of each jamb, and intermediate anchors at 660 mm (26") on centre maximum. Fasteners for such anchors shall be provided by others.
- .6 Minimum reinforcing, anchor and other component gauges shall be in accordance with Table 1 of the CSDMA, "Recommended Specifications for Commercial Steel Door and Frame Products".
- .7 Each door opening shall be prepared for single stud rubber door silencers, three (3) for single door openings, two (2) for double door openings, except on gasketed frame product.
- .8 Provide factory-applied touch up primer at areas where zinc coating has been removed during fabrication.
- .9 Fire-rated frame products shall be provided for those openings requiring fire protection as determined and scheduled by the Architect. Frames, transom and sidelight assemblies shall be listed for conformance with CAN4-S104. Window assemblies shall be listed for conformance with CAN4-S106. All fire-rated frame products shall bear the label of, and be listed by a nationally recognized testing agency having a factory inspection service. Labeling shall be in accordance with NFPA 80, the listing authority's policies and label materials, and shall identify the manufacturer. Fire-rated frame products shall be constructed as listed for labeling in the Follow-Up Service Procedures/Factory Inspection Manuals issued by the listing agency to individual manufacturers
- .10 Provide grout guards fabricated from not less than 0.016 in. (0.4 mm) thick steel at all hardware mortises on frame product to be grouted.

2.3 Welded Type Frames

- .1 Frame product shall be accurately mitered or mechanically jointed.
- .2 As defined in Appendix 2 of the CSDMA, "Recommended Specifications for Commercial Steel Door and Frame Products", frame product perimeter corner joints shall be:
 - .1 Face welded; continuously welded on the profile faces, with exposed faces filled and ground to a smooth, uniform, seamless surface.
- .3 Joints at mullions, sills and center rails shall:
 - .1 Be coped accurately, butted and tightly fitted.
 - .2 At intersecting flush profile faces, be securely welded, filled and ground to a smooth, uniform, seamless surface.
 - .3 At intersecting recessed profile faces, be securely welded to concealed reinforcements, with exposed hairline face seams.
 - .4 At all other intersecting profile elements, have exposed hairline face seams.
- .4 Welding shall conform to CSA W59.
- .5 Where frame product is to be installed prior to the adjacent partition, a floor anchor shall be securely attached to the inside of each jamb profile. Each floor anchor shall be provided with two (2) holes for securing to the floor. For conditions that do not permit the use of a floor anchor, an additional wall anchor, located within 150 mm (6") of the base of the jamb, shall be substituted.
- .6 Weld in two (2) temporary jamb spreaders per door opening to maintain proper alignment during shipment and handling, which shall not be used for installation.

- .7 Glazing stops shall be formed steel channel, minimum 16 mm (0.625") height, accurately fitted, butted at corners and fastened to frame sections with counter-sunk oval head sheet metal screws.
- .8 When required due to site access, when advised by the contractor responsible for coordination or installation, as specified on the Architect's drawings or due to shipping limitations, frame product for large openings shall be fabricated in sections as designated on the approved submittal drawings, with splice joints for field assembly and welding by others.
- .9 Prior to shipment, mark each frame product with an identification number as shown on the approved submittal drawings.

2.4 Fabrication – Doors

.1 General

- .1 Exterior doors shall be laminated core construction.
- .2 Interior doors shall be welded stiffener construction.
- .3 Longitudinal edges shall be continuously welded, filled and sanded with no visible edge seams.
- .4 Doors shall be mortised, blanked, reinforced, drilled and tapped at the factory for template hardware only, in accordance with the approved hardware schedule and templates provided by the hardware supplier.
- .5 Holes 12.7 mm (0.5") diameter and larger shall be factory prepared, except mounting and through-bolt holes, which are by others, on site, at time of hardware installation. Holes less than 12.7 mm (0.5") diameter shall be factory prepared only when required for the function of the device (for knob, lever, cylinder, thumb or turn pieces) or when these holes over-lap function holes.
- .6 Doors shall be reinforced only, where required, for surface mounted hardware, anchor hinges, thrust pivots, pivot reinforced hinges, or non-templated hardware. Drilling and tapping is by others, on site, at time of installation.
- .7 Top and bottom of doors shall be provided with inverted, recessed, welded steel channels. Exterior doors, and where otherwise scheduled by the Architect, shall be provided with flush steel top caps.
- .8 Minimum reinforcing and component gauges shall be in accordance with Table 1 of the CSDMA, "Recommended Specifications for Commercial Steel Door and Frame Products".
- .9 Provide factory-applied touch-up primer at areas where zinc coating has been removed during fabrication.
- .10 Fire-rated doors shall be provided for those openings requiring fire protection and temperature rise ratings, as determined and scheduled by the Architect. Such products shall be listed for conformance with CAN4-S104. All fire-rated doors shall bear the label of, and be listed by a nationally recognized testing agency having a factory inspection service. Labeling shall be in accordance with NFPA 80, the listing authority's policies and label materials, and shall identify the manufacturer. Fire-rated doors shall be constructed as listed for labeling in the Follow-Up Service Procedures/Factory Inspection Manuals issued by the listing agency to individual manufacturers.
- .11 Prior to shipment, mark each door with an identification number as shown on the approved submittal drawings.

.2 Laminated Core Construction

- .1 Both face sheets for exterior doors shall be formed from a sheet of 16 gauge (1.34 mm) steel with polyisocyanurate core, laminated under pressure to face sheets.
- .2 Both face sheets for interior doors shall be formed from a sheet of 16 gauge (1.34 mm) steel with honeycomb core laminated under pressure to face sheets.

PART 3 - EXECUTION

- .1 Site Storage and Protection of Materials
 - .1 Doors and frame product shall be removed from their wrappings or coverings upon receipt on site, be stored in a vertical position, and be spaced with blocking to permit air circulation between them.
 - .2 All materials shall be thoroughly inspected upon receipt and all discrepancies, deficiencies and/or damages shall be immediately reported, in writing, to the supplier.
 - .3 All damages incurred during shipment shall be immediately reported, in writing, to the supplier.
 - .4 Any scratches or disfigurement of doors or frame product caused by shipping or handling shall be promptly cleaned and touched-up with a zinc-rich primer.

- .2 Installation
 - .1 Prior to installation, remove temporary shipping spreaders.
 - .2 Prior to installation, the area of floor on which the frame is to be installed, and within the path of the door swing, shall be checked and corrected for flatness.
 - .3 Door and frame product shall be checked for correct size, swing, rating and opening number.
 - .4 Caulk perimeter of frames between frame and adjacent material.
 - .5 Set frames plumb, square, level and at correct elevation.
 - .6 Fire-rated door and frame product shall be installed in accordance with the terms of their listings, NFPA-80, or the local Authority Having Jurisdiction (AHJ).
 - .7 Secure anchorages and connections to adjacent construction.
 - .8 Brace frames rigidly in position while building-in. Install wood spreaders at third points of frame rebate height to maintain frame width. Provide vertical support at centre of head for openings exceeding 1200 mm (48") in width.
 - .9 During the setting of frame product, check and correct as necessary for opening width, opening height, square, alignment, twist and plumb, in accordance with the CSDMA, "Recommended Dimensional Standards for Commercial Steel Doors and Frames".
 - .10 Grout guards and junction boxes are intended to protect hardware mortises and tapped holes from masonry grout of 4 in. (101 mm) maximum slump consistency that is hand troweled in place.
 - .11 Frame products are not intended or designed to act as forms for grout or concrete. Grout hollow metal sections in "lifts" or take precautions otherwise to ensure that frames are not deformed or damaged by the hydraulic forces that occur during this process.
 - .12 Keep hollow metal surfaces free of grout, tar, and/or other bonding materials or sealers. Promptly clean grout, tar, and/or other bonding materials or sealers off of frame product and doors.
 - .13 Remove wood spreaders after frames have been built-in.
 - .14 Make allowance for deflection to ensure structural loads are not transmitted to frame product.
 - .15 Install doors, and hardware in accordance with hardware templates and manufacturer's instructions.
 - .16 Adjust operable parts for correct clearances and function.
 - .17 Install louvers, glazing and door silencers.
 - .18 Finish paint in accordance with Section 09 90 00.

END OF SECTION

1 General

1.1 SUMMARY

- .1 Supply and install door hardware listed in the Hardware Schedule, establishes the quality standards, finishes, manufacturers and functions, and meets all current barrier free design standards required by authorities having jurisdiction.

1.2 ADMINISTRATIVE REQUIREMENTS

- .1 Submission of Substitutions: Materials other than the named products for the Project may be acceptable to the Consultant, subject to Specification 01 25 00.
- .2 Pre-installation Conference: Arrange a preconstruction meeting in accordance with Division 01 to discuss the following:
 - .1 Keying Conference: Conduct keying conference between the Owner, the Contractor and manufacturer to review and finalize requirements, at the Project site and incorporate decisions into final keying schedule after reviewing door hardware keying system.
 - .2 Electrified Hardware Conference: Conduct pre-installation conference at Project site and review methods and procedures related to electrified door hardware.
- .3 Coordination: Obtain and distribute templates for doors, frames, and other work specified to be factory prepared for installing door hardware. Coordinate with shop drawings of other work to confirm that adequate provisions are made for locating and installing door hardware.

1.3 SUBMITTALS

- .1 Provide required information in accordance with Division 01.
- .2 Action Submittals: Provide the following submittals before starting any work of this Section:
 - .1 Product Data: Submit 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, but not limited to, the following:
 - .1 Wiring Diagrams: Detail wiring for power, signal, and control systems and differentiate between manufacturer installed and site installed wiring.
 - .3 Samples:
 - .1 Submit samples of complete line of hardware and finishes, if and when requested, to accompany any proposal for substitution. Fully label each sample as to manufacture, type, size and location for use proposed.
 - .4 Hardware Schedule: Submit door hardware schedule prepared by Architectural Hardware Consultant (AHC), detailing fabrication and assembly of door hardware, including make, model, material, function, size, finish, and other pertinent information.
- .3 Do not order hardware from manufacturers until samples have been approved. Hardware and finishes supplied shall be identical with approved samples.

1.4 PROJECT CLOSEOUT SUBMISSION

- .1 Operation and Maintenance Data: Provide operations and maintenance information in accordance with Division 01.
- .2 Spare Parts and Tools: Submit unique parts and tools for maintaining hardware system in accordance with Division 01.

1.5 DELIVERY, HANDLING AND PROTECTION

- .1 Pack hardware in suitable wrappings and containers to protect from injury during shipping and storage. Enclose accessories, fastening devices and other loose items with each item. Mark packages for easy identification as indicated on approved delivery schedule. Hand over hardware to designated installer.

1.6 WARRANTY

- .1 Warrant door closers to remain free from defects in materials and workmanship in accordance with the General Conditions, but for a period of five (5) years, and locks and locksets for two (2) years. Agree to promptly make good defects which become apparent within warranty periods without cost to Owner.

2 Products

2.1 GENERAL

- .1 Supply to the job site all items of finishing hardware as indicated in the Hardware Scheduled appended to this Section. All items to be supplied with complete and adequate fixing and anchoring devices necessary for satisfactory installation into or upon the various surfaces to which it is to be affixed.
- .2 Cooperate with all trades using hardware supplied under this Section.
- .3 Render a complete service to the metal fabrication contractor wherein full cooperation is assured them of the supply of hardware information, and templates as requested.
- .4 Supply for installation by others where specified, as scheduled or indicated on the drawings.
- .5 Provide six, (6) copies of the hardware specification for field construction and office use.
- .6 All hardware shall be of the best quality and design, construction and finish, free from all defects.
- .7 All blank strikes shall be ASA with no lip.
- .8 Lock strikes shall be ASA with lip.
- .9 All deadlock strikes shall be ASA with no lip.
- .10 Where door pulls are scheduled on one side of door and a push plate on the other side, the contractor shall be responsible for fixing, so that the pull shall be secured through the door from the reverse side and the push plate installed to cover the thru bolts which will be countersunk flush with door.
- .11 All door closers shall be non sized and where possible non handed. They shall be sized and adjusted by the installer to suit the site conditions.
- .12 Panic sets are to be of style specified and completely plated.
- .13 Before installing any hardware, carefully check all architectural drawings of Work requiring hardware, verify door swings, door and frame material and operating conditions. Ensure hardware will fit Work.
- .14 Provide ULC approved hardware to ULC labelled doors.
- .15 Check shop drawings and frame and door lists affecting hardware type and installation. Certify to correctness or advise Consultant in writing of required revisions.
- .16 Templates:
 - .1 Check hardware schedule, drawings and specifications. Furnish promptly to applicable trades any patterns, templates, template information and manufacturer's literature required for proper preparation for and application of hardware, in ample time to facilitate progress of Work.

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- .2 Exposed screws for installing hardware shall have Phillips or Robertson heads.
 - .3 All door closers shall have back-checking features and shall be of proper size to operate door efficiently.
 - .4 Use no wall stops on drywall.
 - .5 Rim Panic Device strikes shall be mortise type application. Equip panic devices with hex bolts.
- .17 Hinges
- .1 Provide mortise type hinges, steel based for interior doors and stainless steel or brass for exterior doors or interior doors exposed to moisture.
 - .2 Provide hinges with stainless steel pins; non removable for exterior and public interior exposure, non rising for non security exposure.
 - .3 Provide full length continuous geared hinges, continuous pin and barrel hinges or full mortise type heavy weight butt hinges on all high frequency use or extreme weighted doors.
 - .4 Where doors are required to swing 180 degrees, provide ball bearing type swing clear hinges sufficient to clear trim.
- .18 Locks, Cylinders, Latches and Bolts
- .1 Locks are to be ANSI Grade 1 mortise type unless specified otherwise.
 - .2 Equip all locks with anti-friction latches with auxiliary latch guard. All fire rated doors must have a minimum latch throw as indicated on the fire door label.
 - .3 Where lever trim is required, provide levers containing concealed mounting and constructed of solid cast or forged material.
 - .4 Locks must be lever type.
 - .5 Provide locks in accordance with current barrier free accessibility requirements as set out by the OBC or by the jurisdiction having authority, when located in the barrier free path of travel.
 - .6 Strikes shall be ANSI standard size with curved lip strikes for latch bolts and no lip strikes for deadlocks. Provide complete with wrought iron boxes finished to match strike.
 - .7 Provide Cylinders and thumb turns with the correct cam or tailpiece to operate hardware correctly. Coordinate with Section 08 44 13 Glazed Aluminum Curtain Wall when applicable.
 - .8 Automatic flush bolts are to be equipped on all fire rated pairs of doors with regular use. Provide a coordinator in conjunction with automatic flush bolts.
 - .9 Provide a filler bar when using coordinators for a clean architectural appearance.
- .19 Keying
- .1 Supply the following:
 - .1 1 key cabinet with the required capacity plus 30%.
 - .2 3 keys per lock.
 - .3 10 copies of each master key and sub-master key.
 - .4 Construction keys as required.
 - .5 1 extractor key.
 - .6 List of keys.
 - .7 Code chart of keys and cylinders.

-
- .2 Coding of keys used for this project will be the first code of each master key. Codes not used in this project will be used later by the Owner.
 - .3 All permanent keys, including master keys, list of keys, the key code chart, the blank keys and all pinning shall be delivered directly from the manufacturer to the Owner, at the time of installation of the permanent cylinders, in clearly identified envelopes. Tag all keys.
- .20 Exit Device
- .1 All exit devices installed on labelled fire doors shall carry a ULC or Warnock Hersey Label.
 - .2 Coordinate exit devices with astragals, coordinators, carry open bars and thresholds for correct and safe operation.
 - .3 All exit devices shall have exposed metal to match architectural finishes used on other hardware.
 - .4 Exit devices are push pad style only.
 - .5 Provide non-fire rated exit devices with hex key dogging feature (Cylinder dogging may be required in lieu of hex key dogging).
 - .6 Provide Power supplies of same manufacturer when using electrified exit devices.
 - .7 Match style and finish of trims on exit devices for locksets used.
- .21 Closers
- .1 All closers shall be hydraulically controlled and full rack and pinion in operation.
 - .2 All closers shall be fully adjustable including the following features: back check, speed control, and latch speed control.
 - .3 Provide mounting plates where required on special frame applications.
 - .4 Install all necessary attaching brackets, mounting channels, and cover plates where necessary for correct application of door closers.
 - .5 Supply to the Owner any special keys and wrenches as usually packed with door closers.
 - .6 Closers complete with a cover unless specified otherwise by the Consultant. Provide cover of matching architectural finish to the other hardware used in the project.
 - .7 Coordinate closers with overhead stops & holders.
- .22 Push Plates and Door Pulls
- .1 Provide and install stainless steel plates in type #304 stainless steel and install secure with screw fastening.
 - .2 Length of kick plates shall be 1-1/2" less than door width for single doors and 1" less than door width for doors in pairs.
 - .3 All stainless steel plates are 0.050" thick, free of rough or sharp edges. Corners and edges to have slight radiuses. Install kick plates and armor plates on both sides of the door with 3M tape or counter sunk screws as specified.
 - .4 Where door pulls are scheduled on one side of door and push plates on other side, issue installations instructions to ensure that the pull is secured through door from reverse side and countersunk flush with door installation of push plate. Locate push plate to cover fasteners for door pulls.

- .23 Door Stops and Holders
 - .1 Wall stops are only to be used on wall conditions such as block or masonry. If necessary to mount on drywall, provide proper backing to ensure no damage to the wall.
 - .2 Supply floor stops of sufficient height to suit floor conditions and the undercut of the door.
 - .3 Provide gray rubber exposed resilient parts.
 - .4 Surface mount overhead door stops may be used unless they conflict with the door closer. All overhead stops are to be set to 90 degree opening unless stated otherwise.
 - .5 All door stops shall be heavy duty and of high quality.
- .24 Door Seals and Thresholds
 - .1 Perimeter seals must be provided that fully seal all gaps between the floor, door and frame. Perimeter seal must protect against weather, smoke and sound.
 - .2 Frame gasketing must be constructed of neoprene. The aluminum housing must have a rib to prevent against distortion during installation.
 - .3 Provide aluminum frames with felt inserts by door supplier.
 - .4 Install Thresholds in a manner that ensures the door bottom comes in full contact.
 - .5 All thresholds shall be aluminum and installed with lead shields and stainless steel screws.
 - .6 Cut ends of thresholds to follow exactly the door frame profile.
 - .7 Provide barrier-free thresholds to all units identified as barrier free (BF) on balcony doors.

3 Execution

3.1 INSTALLATION

- .1 Subcontractor installing the hardware shall carefully follow manufacturers' instructions for installation of all finish hardware.
- .2 For mounting heights of various hardware items refer to the following, unless otherwise indicated on the Drawings:
 - .1 Locksets: 1024mm (40-5/16") from centre of lever to finished floor.
 - .2 Deadlocks: 1220mm (48") from centre of cylinder to finished floor.
 - .3 Mortise Night Latches: 1024mm (40-5/16") from centre of cylinder to finished floor.
 - .4 Panic Bolts: 1024mm (40-5/16") from centre of crossbar to finished floor.
 - .5 Push Plates: 1143mm 45" from centre of plate to finished floor.
 - .6 Guard Bars: 1024mm (40-5/16") from centre of bar to finished floor.
 - .7 Door Pulls: 1067mm (42") from centre of pull to finished floor.
 - .8 Blank Strike: 1024mm (40-5/16") from centre of strike to finished floor.
 - .9 Blank Fronts: 1024mm (40-5/16") from centre of strike to finished floor.

3.2 PERFORMANCE

- .1 Adjustment and Cleaning:
 - .1 Provide services of competent mechanic without additional cost to Owner. Mechanic shall inspect installation of all hardware furnished under this Section and supervise all adjustments (by trades responsible for fixing) necessary to leave hardware in perfect working order.

3.3 HARDWARE SCHEDULE

- .1 Refer to attached Schedule of Finishing Hardware.

Hardware Group No. 01

For use on Door #(s):

DA1-101AB

Provide each PR door(s) with the following:





QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
1	EA	CONT. HINGE	112XY/ 027XY EPT TO SUIT		628	IVE
2	EA	POWER TRANSFER	EPT10 CON		↗ 689	VON
1	EA	FIXED MULLION	BY FRAME SUPPLIER			UNK
1	EA	ELEC PANIC HARDWARE	RX-QEL-35A-EO-4'-299-CON 24 VDC		↗ 626	VON
1	EA	ELEC PANIC HARDWARE	RX-QEL-35A-NL-OP-4'-388-CON 24 VDC		↗ 626	VON
1	EA	RIM CYLINDER	20-057 ICX		626	SCH
1	EA	PRIMUS CORE	20-740-XP EV29 T		626	SCH
2	EA	45 DEGREE OFFSET PULL	8145EZHD 305MM O		630	IVE
1	EA	OH STOP	100S		630	GLY
1	EA	OH STOP	100S ADJ		630	GLY
1	EA	SURFACE CLOSER	4040XP TOP JAMB		689	LCN
1	EA	SURF. AUTO OPERATOR	9542 MS AS REQ (120/240 VAC)		↗ ANCLR	LCN
1	EA	FLUSH CEILNG MTG PLT	4040XP-18G		689	LCN
1	EA	KEYSWITCH	8310-806K		↗	LCN
2	EA	ACTUATOR, TOUCH	8310-852T		630	LCN
2	EA	ESCUTCHEON	8310-876		↗ 689	LCN
1	EA	MOUNTING PLATE	9540-18		689	LCN
2	EA	PERIMETER SEAL	BY ALUMINUM DOOR SUPPLIER			
2	EA	THRESHOLD	CT__ x FROST INSERT x CT__ X REQ. WIDTH/DEPTH TO MATCH FRAME PROFILE / SITE CONDITIONS		AL	KNC
2	EA	DOOR SWEEP	8192AA X DR WIDTH		AA	ZER
2	EA	WIRE HARNESS	CON-__ TO SUIT		↗	SCH
2	EA	WIRE HARNESS	CON-6W		↗	SCH
1	EA	INTERCOM	BY DIV 26			UNK
2	EA	DOOR CONTACT	BY SECURITY		↗	UNK
1	EA	POWER SUPPLY	PS902 900-4RL-FA KL900 120/240 VAC		↗ LGR	SCE
1	EA	CARD READER	BY SECURITY		↗	UNK
1	EA	REQUEST TO EXIT(REX)	BY DIV 28		↗	UNK

Hardware Group No. 02

For use on Door #(s):

DA1-102

Provide each SGL door(s) with the following:







QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1HW 127X114MM		652	IVE
1	EA	STOREROOM LOCK	ND80TD SPA		626	SCH
1	EA	PRIMUS CORE	20-740-XP EV29 T		626	SCH
1	EA	ELECTRIC STRIKE	6211 FSE CON 12/16/24/28 VAC/VDC		↗ 630	VON
1	EA	MOUNTING PLATE	9530-18		↗ 689	LCN
1	EA	SURF. AUTO OPERATOR	9531 AS REQ (120/240 VAC)		↗ ANCLR	LCN
2	EA	ACTUATOR, TOUCH	8310-852T		630	LCN
2	EA	ESCUTCHEON	8310-876		↗ 689	LCN
1	EA	KICK PLATE	8400 205MM X 40MM LDW		630	IVE
1	EA	WALL STOP	WS406/407CVX		630	IVE
1	EA	GASKETING	188S-BK (1XW 2XH)		BK	ZER
1	EA	WIRE HARNESS	CON-6W		↗	SCH
1	EA	INTERFACE RELAY	CX-12		↗	CAM
1	EA	CARD READER	BY DIV. 28		↗	UNK
1	EA	INTERCOM	BY DIV 28			UNK
1	EA	REQUEST TO EXIT(REX)	BY DIV 28		↗	UNK
1	EA	DOOR CONTACT	BY DIV 28		↗	

Hardware Group No. 03

For use on Door #(s):

DA1-103

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 127X114MM		652	IVE
1	EA	ENTRANCE/OFFICE LOCK	ND50TD SPA		626	SCH
1	EA	PRIMUS CORE	20-740-XP EV29 T		626	SCH
1	EA	SURFACE CLOSER	1461 REG		689	LCN
1	EA	KICK PLATE	8400 200MM X LDW B-CS		630	IVE
1	EA	WALL STOP	WS406/407CVX		630	IVE

Hardware Group No. 04

For use on Door #(s):

DA1-104

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 127X114MM		652	IVE
1	EA	STOREROOM LOCK	ND80TD SPA		626	SCH
1	EA	INTERFACE BOX	JB7		↗	VON
1	EA	PRIMUS CORE	20-740-XP EV29 T		626	SCH
1	EA	ELECTRIC STRIKE	6211 FS CON 12/16/24/28 VAC/VDC		↗ 630	VON
1	EA	MOUNTING PLATE	9530-18		↗ 689	LCN
1	EA	SURF. AUTO OPERATOR	9531 AS REQ (120/240 VAC)		↗ ANCLR	LCN
2	EA	ILLUMINATED ACTUATOR	CM-46/4/GRF/SFE1			CAM
1	EA	AURA PUSH TO LOCK	CM-46/8/GRF/SFE1			CAM
1	EA	EMERGENCY CALL KIT	CX-WEC10K2		↗	CAM
1	EA	KICK PLATE	8400 205MM X LDW B-CS		630	IVE
1	EA	WALL STOP	WS406/407CVX		630	IVE
1	EA	ADVANCED LOGIC RELAY	CX-33			CAM
1	EA	WIRE HARNESS	CON-___ TO SUIT		↗	SCH
1	EA	WIRE HARNESS	CON-6W		↗	SCH
1	EA	DOOR CONTACT	679-05 TO SUIT DOOR MATERIAL		↗ BLK	SCE
1	EA	POWER SUPPLY	PS902 120/240 VAC		↗ LGR	SCE

OPERATIONAL DESCRIPTION: DOOR NORMALLY CLOSED AND UNLOCKED. ON INGRESS, PRESS OUTSIDE ACTUATOR TO ACTIVATE DOOR OPERATOR OR PUSH ON LOCKSET LEVER. ONCE DOOR IS CLOSED AND LATCHED OCCUPANT DEPRESSES "PUSH TO LOCK" BUTTON TO SECURE OUTSIDE OF DOOR; DISABLING OUTSIDE ACTUATOR AND ELECTRIC STRIKE. MECHANICAL KEY OVERRIDE PROVIDES ACCESS. IF OCCUPANT IS IN DISTRESS, ACTIVATING THE EMERGENCY CALL SYSTEM DEVICE ACTIVATES AN AUDIBLE AND VISUAL SIGNAL DEVICES INSIDE AND OUTSIDE THE WASHROOM AND DDSB EMERGENCY PA CALL SYSTEM. EGRESS IS FREE AT ALL TIMES. OCCUPANT DEPRESSES INSIDE ACTUATOR TO ACTIVATE OPERATOR OR USES INSIDE LOCKSET LEVER. UPON EGRESS DOOR IS UNLOCKED, OUTSIDE ACTUATOR IS ENABLED AND ELECTRIC STRIKE IS UNSECURE.

Hardware Group No. 05

For use on Door #(s):

DA1-105 DA1-106

Provide each SGL door(s) with the following:








QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 127X114MM		652	IVE
1	EA	CLASSROOM LOCK	ND70TD SPA		626	SCH
1	EA	PRIMUS CORE	20-740-XP EV29 T		626	SCH
1	EA	SURFACE CLOSER	1461 DEL REG OR PA AS REQ STD		689	LCN
1	EA	KICK PLATE	8400 205MM X 40MM LDW		630	IVE
1	EA	WALL STOP	WS406/407CVX		630	IVE

Hardware Group No. 06

For use on Door #(s):

DA1-107

Provide each SGL door(s) with the following:






QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 127X114MM		652	IVE
1	EA	STOREROOM LOCK	ND80TD SPA		626	SCH
1	EA	PRIMUS CORE	20-740-XP EV29 T		626	SCH
1	EA	SURFACE CLOSER	1461 REG		689	LCN
1	EA	KICK PLATE	8400 205MM X 40MM LDW		630	IVE
1	EA	WALL STOP	WS406/407CVX		630	IVE
1	EA	GASKETING	188S-BK (1XW 2XH)		BK	ZER

Hardware Group No. 07

For use on Door #(s):

DA1-108 DA1-111

Provide each SGL door(s) with the following:






QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 127X114MM		652	IVE
1	EA	CLASSROOM LOCK	ND70TD SPA		626	SCH
1	EA	PRIMUS CORE	20-740-XP EV29 T		626	SCH
1	EA	OH STOP	90S		630	GLY
1	EA	KICK PLATE	8400 205MM X 40MM LDW		630	IVE
1	EA	FINGER GUARD	MK1A X DR HT			FIN
1	EA	FINGER GUARD	MK1B X DR HT			FIN

Hardware Group No. 08

For use on Door #(s):

DA1-109

Provide each SGL door(s) with the following:





QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 127X114MM NRP		652	IVE
1	EA	CLASSROOM LOCK	ND70TD SPA		626	SCH
1	EA	PRIMUS CORE	20-740-XP EV29 T		626	SCH
1	EA	OH STOP & HOLDER	90H		630	GLY
1	EA	KICK PLATE	8400 205MM X 40MM LDW		630	IVE
1	EA	FINGER GUARD	MK1A X DR HT			FIN
1	EA	FINGER GUARD	MK1B X DR HT			FIN

Hardware Group No. 09

For use on Door #(s):

DA1-110A DA1-110B

Provide each SGL door(s) with the following:







QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 127X114MM		652	IVE
1	EA	PASSAGE SET	ND10S SPA		626	SCH
1	EA	KICK PLATE	8400 205MM X 40MM LDW		630	IVE
1	EA	WALL STOP	WS406/407CVX		630	IVE
1	EA	FINGER GUARD	MK1A X DR HT			FIN
1	EA	FINGER GUARD	MK1B X DR HT			FIN

Hardware Group No. 10

For use on Door #(s):

DA1-112

Provide each SGL door(s) with the following:






QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 127X114MM NRP		652	IVE
1	EA	STOREROOM LOCK	ND80TD SPA		626	SCH
1	EA	PRIMUS CORE	20-740-XP EV29 T		626	SCH
1	EA	SURFACE CLOSER	1461 DEL CUSH		689	LCN
1	EA	KICK PLATE	8400 205MM X 40MM LDW		630	IVE
1	EA	GASKETING	188S-BK (1XW 2XH)		BK	ZER

Hardware Group No. 11

For use on Door #(s):

DA1-114 DA1-115

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 127X114MM		652	IVE
1	EA	CLASSROOM LOCK	ND70TD SPA		626	SCH
1	EA	PRIMUS CORE	20-740-XP EV29 T		626	SCH
1	EA	KICK PLATE	8400 205MM X 40MM LDW		630	IVE
1	EA	WALL STOP	WS406/407CVX		630	IVE
1	EA	FINGER GUARD	MK1A X DR HT			FIN
1	EA	FINGER GUARD	MK1B X DR HT			FIN

Hardware Group No. 12

For use on Door #(s):

DA1-116

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 127X114MM NRP		652	IVE
1	EA	CLASSROOM LOCK	ND70TD SPA		626	SCH
1	EA	PRIMUS CORE	20-740-XP EV29 T		626	SCH
1	EA	OH STOP	90S		630	GLY
1	EA	KICK PLATE	8400 205MM X 40MM LDW		630	IVE
1	EA	FINGER GUARD	MK1A X DR HT			FIN
1	EA	FINGER GUARD	MK1B X DR HT			FIN

Hardware Group No. 13

For use on Door #(s):

DA1-118

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 114X102MM NRP		652	IVE
1	EA	STOREROOM LOCK	ND80TD SPA		626	SCH
1	EA	PRIMUS CORE	20-740-XP EV29 T		626	SCH
1	EA	WALL STOP	WS406/407CVX		630	IVE

Hardware Group No. 14

For use on Door #(s):

DA1-122

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
6	EA	HINGE	5BB1 127X114MM NRP		652	IVE
1	SET	AUTO FLUSH BOLT	FB31P		630	IVE
1	EA	DUST PROOF STRIKE	DP1		626	IVE
1	EA	STOREROOM LOCK	ND80TD SPA 14-042		626	SCH
1	EA	PRIMUS CORE	20-740-XP EV29 T		626	SCH
1	EA	ELECTRIC STRIKE	6223 FSE CON 12/16/24/28 VAC/VDC		630	VON
1	EA	COORDINATOR	COR X FL		628	IVE
2	EA	MOUNTING BRACKET	MB1/MB2		689	IVE
2	EA	SURFACE CLOSER	4040XP SCUSH		689	LCN
2	EA	KICK PLATE	8400 205MM X LDW B-CS		630	IVE
1	EA	GASKETING	188S-BK (1XW 2XH)		BK	ZER
2	SET	MEETING STILE	328BK-S		BK	ZER
1	EA	WIRE HARNESS	CON-____ (SIZE TO SUIT)	⚡		SCH
1	EA	WIRE HARNESS	CON-6W	⚡		SCH
2	EA	DOOR CONTACT	BY SECURITY	⚡		UNK
1	EA	POWER SUPPLY	BY DIV. 28	⚡		
1	EA	CARD READER	BY SECURITY	⚡		UNK

Hardware Group No. 15

For use on Door #(s):

DA1-123

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
1	EA	CONT. HINGE	112XY/ 027XY EPT TO SUIT		628	IVE
1	EA	POWER TRANSFER	EPT10 CON		✂ 689	VON
1	EA	ELEC PANIC HARDWARE	RX-QEL-35A-NL-OP-4'-388-CON 24 VDC		✂ 626	VON
1	EA	RIM CYLINDER	20-057 ICX		626	SCH
1	EA	PRIMUS CORE	20-740-XP EV29 T		626	SCH
1	EA	45 DEGREE OFFSET PULL	8145EZHD 305MM O		630	IVE
1	EA	OH STOP	100S ADJ		630	GLY
1	EA	SURF. AUTO OPERATOR	9542 MS AS REQ (120/240 VAC)		✂ ANCLR	LCN
1	EA	KEYSWITCH	8310-806K		✂	LCN
2	EA	ACTUATOR, TOUCH	8310-852T		630	LCN
2	EA	ESCUTCHEON	8310-876		✂ 689	LCN
1	EA	PERIMETER SEAL	BY ALUMINUM DOOR SUPPLIER			
1	EA	THRESHOLD	CT__ x FROST INSERT x CT__ X REQ. WIDTH/DEPTH TO MATCH FRAME PROFILE / SITE CONDITIONS		AL	KNC
1	EA	DOOR SWEEP	8192AA X DR WIDTH		AA	ZER
1	EA	WIRE HARNESS	CON-___ TO SUIT		✂	SCH
1	EA	WIRE HARNESS	CON-6W		✂	SCH
1	EA	DOOR CONTACT	BY SECURITY		✂	UNK
1	EA	POWER SUPPLY	PS902 900-4RL-FA KL900 120/240 VAC		✂ LGR	SCE
1	EA	CARD READER	BY SECURITY		✂	UNK
1	EA	REQUEST TO EXIT(REX)	BY DIV 28		✂	UNK

Hardware Group No. 16

For use on Door #(s):

DA1-125

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
2	EA	CONT. HINGE	112XY/ 027XY EPT TO SUIT		628	IVE
2	EA	POWER TRANSFER	EPT10 CON		✂ 689	VON
1	EA	ELEC PANIC HARDWARE	RX-QEL-3549A-EO-4'-CON 24 VDC		✂ 626	VON
1	EA	ELEC PANIC HARDWARE	RX-QEL-3549A-T-4'-360T-CON 24 VDC		✂ 626	VON
1	EA	RIM CYLINDER	20-057 ICX		626	SCH
1	EA	PRIMUS CORE	20-740-XP EV29 T		626	SCH
1	EA	45 DEGREE OFFSET PULL	8145EZHD 305MM O		630	IVE
1	EA	OH STOP	100S		630	GLY
1	EA	OH STOP	100S ADJ		630	GLY
1	EA	SURFACE CLOSER	4040XP TOP JAMB		689	LCN
1	EA	SURF. AUTO OPERATOR	9542 MS AS REQ (120/240 VAC)		✂ ANCLR	LCN
1	EA	FLUSH CEILNG MTG PLT	4040XP-18G		689	LCN
1	EA	KEYSWITCH	8310-806K		✂	LCN
2	EA	ACTUATOR, TOUCH	8310-852T		630	LCN
2	EA	ESCUTCHEON	8310-876		✂ 689	LCN
1	EA	PERIMETER SEAL	BY ALUMINUM DOOR SUPPLIER			
1	EA	ASTRAGAL	BY ALUMINUM DOOR SUPPLIER			
1	EA	THRESHOLD	CT__ x FROST INSERT x CT__ X REQ. WIDTH/DEPTH TO MATCH FRAME PROFILE / SITE CONDITIONS		AL	KNC
2	EA	DOOR SWEEP	8192AA X DR WIDTH		AA	ZER
2	EA	WIRE HARNESS	CON-__ TO SUIT		✂	SCH
2	EA	WIRE HARNESS	CON-6W		✂	SCH
2	EA	DOOR CONTACT	BY SECURITY		✂	UNK
1	EA	POWER SUPPLY	PS902 900-4RL-FA KL900 120/240 VAC		✂ LGR	SCE
1	EA	CARD READER	BY SECURITY		✂	UNK
1	EA	REQUEST TO EXIT(REX)	BY DIV 28		✂	UNK

Hardware Group No. 17

For use on Door #(s):

GA1-113

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HARDWARE	HARDWARE BY GATE SUPPLIER			UNK

END OF SECTION

1 General

1.1 SUMMARY

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

1.2 REFERENCE STANDARDS

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

1.3 SUBMITTALS

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

1.4 QUALITY ASSURANCE

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

1.5 DELIVERY, STORAGE AND HANDLING

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

1.6 SITE CONDITIONS

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

1.7 WARRANTY

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

2 Products

2.1 MATERIALS

- .1 Float Glass: In accordance with CAN/CGSB-12.3, glazing quality and as follows:
 - .1 Clear Glass: No tint
- .2 Tempered Glass (TGL):
 - .1 Conforming to CAN/CGSB-12.1, Type 2, Class 'B'. Tempering shall be performed using horizontal tong free method.
 - .1 Tinted (where indicated): CrystalGray by Guardian or equivalent per Specification 01 25 00.
 - .2 Provide acid etch finish at inboard light where indicated on drawings.
- .3 Laminated Safety Glass: In accordance with CAN/CGSB-12.1 and ASTM C1172 as follows:
 - .1 Glass: Clear, tempered glass.
 - .2 Type: 1 - Laminated.

- .3 Class: B - Float Glass.
- .4 Category: II - Fully Tempered.
- .4 Fire Rated, Ceramic Fire-Rated Glass (FGL-01): Material used in door and screen applications with fire rating requirements of 60 minutes with hose stream test.
 - .1 Fire Rated Glass: Two-ply of glass ceramic, laminated with Teflon or PVB interlayer and as follows:
 - .1 Thickness: 8mm
 - .2 Fire Rating: 60 minutes or as scheduled.
 - .3 Labelled: Permanent logo listing name of product, manufacturer, testing laboratory, fire rating period and safety requirements
 - .4 Basis-of-Design Materials:
 - .1 Technical Glass Products, FireLite Plus
 - .2 VetroTech, Keralite Select L
 - .3 SAFTI: Pyran Platinum L
 - .4 Or approved equivalent.
- .5 Ceramic Frit-Silk Screened Coating (CF): to GANA/GTA 95-1-31, located on number 3 surface.
 - .1 Colour: To be selected by consultant from manufacturer standard colour range.
 - .2 Pattern: circle shaped markings in a grid pattern, spaced at 2" (50mm) horizontally and 2" (50mm) vertically, to comply with Toronto Green Standard (TGS). To be provided at all exterior glazing, unless otherwise noted.
- .6 Gaskets:
 - .1 Neoprene/EPDM thermoplastic rubber type gaskets of sufficient thickness to be compressed 25% when installed, having 2,000 psi tensile strength, with 50 durometer shore A hardness plus/minus 5, maximum 30% resistance to permanent set, resistance to ozone without cracking, minimum elongation at break of 300% and conforming to ASTM C542.
 - .2 Colour - "Black".
- .7 Warm Edge Spacer: Polymer SAN spacer with 35% glass fibre content and high-tech gas barrier foil. Equivalent thermal conductivity (in accordance with to ift guideline WA-17/1): $\lambda = 0.14 \text{ W/mK}$.
 - .1 Acceptable product: Swisspacer Ultimate or equivalent per Specification 01 25 00.
 - .2 Colour: black.
- .8 Sealant:
 - .1 One component, silicone base, solvent curing sealant conforming to ASTM C920. Colour as selected Later by Consultant.
- .9 Glazing Compound:
 - .1 Non-hardening modified oil type glazing compound.
- .10 Setting Blocks:
 - .1 Neoprene/EPDM rubber type, 4" long, with 40 to 50 durometer shore A hardness plus/minus 5; resistant to sunlight, weathering, oxidation and permanent deformation under load and wide enough to extend from fixed stop to opposite

face of glass of thickness suitable to glazing condition to provide adequate glazing "bite".

- .11 Spacer Shims:
 - .1 Neoprene/EPDM rubber type, with 40 to 50 durometer shore A hardness plus/minus 5; resistant to sunlight, weathering, oxidation and permanent deformation under load and of adequate thickness to provide correct glass to face clearance at least 1/8".
- .12 Glazing Tape:
 - .1 Macro-polyisobutylene preformed glazing tape, 'Polyshim' or 'Vision Strip' by Tremco Ltd., division of RPM Company, or approved equal.

2.2 INSULATING GLASS

- .1 Insulating Glass Units: Provide sealed insulating glass units in accordance with CAN/CGSB-12.8 in configurations indicated, IGMA certified, and as specified herein.
- .2 Manufacture sealed insulating glass units without edge channels or tape, that is, with bare glass edges.
- .3 Use two stage seal method of manufacture, as follows:
 - .1 Primary Seal: Polyisobutylene sealing compound between glass and metal spacer/separator. Colour: Black.
 - .2 Secondary Seal: Structural silicone based, filling gap between the lites of glass at the edge up to the spacer/separator and primary seal. Colour: Black.
- .4 Install stainless steel capillary breather tubes to equalize pressure differentials between insulating glass fabricating location and insulating glass installation location; crimp tube immediately prior to installation in accordance with glass fabricators written instructions.
- .5 Insulating Glass Units (IGU):
 - .1 Insulated Glass Unit (IGU-01): At all exterior doors and windows unless noted otherwise, 25mm overall thickness
 - .1 Unit Composition:
 - .1 TGL outboard lite, tinted, minimum 4mm thick or to suit lite size.
 - .1 Low-E Coating (Surface #2) Basis of Design Materials: SunGuard Neutral 78/65 by Guardian Glass, or approved equivalent.
 - .2 Hermetically Sealed Air Space: 90% Argon, 10% air filled.
 - .3 Ceramic Frit (CF) finish to #3 surface where indicated.
 - .4 TGL inboard lite: clear, minimum 4mm thick or to suit lite size.
 - .2 Unit Characteristics:
 - .1 Unit Thickness: 25mm
 - .2 Visible Light Transmittance: 63%
 - .3 Max U-Value: 1.3 w/m²K (centre of glass)
 - .4 Solar Heat Gain Coefficient (SHGC): 0.51
 - .3 Basis of Design Manufacturer: Guardian Glass, or approved equivalent.

2.3 FABRICATION AND MANUFACTURE

- .1 Label each light of glass with the registered name of the product and the weight and quality of the glass.

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

2.4 GLAZING COMPOUND FOR FIRE RATED GLAZING MATERIALS

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

2.5 FABRICATION: FIRE RATED GLASS

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

3 Execution

3.1 EXAMINATION

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

3.2 PREPARATION

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

3.3 INSTALLATION

- .1 Conform to the recommendation of the glazing manual, Flat Glass Marketing Association, latest edition and as specified herein.

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

3.4 INSTALLATION – FIRE RATED GLASS

- .1 Comply with GANA standards and instructions of manufacturers of glass, glazing sealants, and glazing compounds.
- .2 Protect glass from edge damage during handling and installation. Inspect glass during installation and discard pieces with edge damage that could affect glass performance.
- .3 Place hardwood setting blocks located at quarter points of glass with edge block no more than 150mm (6") from corners.
- .4 Glaze vertically into labelled fire rated metal frames or partition walls with same fire rating as glass and push against tape for full contact at perimeter of pane or unit.
- .5 Place glazing tape on free perimeter of glazing in same manner described above.
- .6 Do not remove protective edge tape.
- .7 Install removable stop and secure without displacement of tape.
- .8 Do not pressure glaze. Knife trim protruding tape.
- .9 Provide minimum 1/4" edge clearance.
- .10 Install vision panels in fire rated doors to requirements of NFPA 80.
- .11 Install so that appropriate fire rating labels and markings remain permanently visible.

3.5 CLEANING

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

END OF SECTION

1 General

1.1 SUMMARY

.1 This Section includes requirements for supply and installation of glazing films for the following:

.1 Decorative glazing surface films

1.2 REFERENCE STANDARDS

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

.1 ASTM D1004-09, Standard Test Method for Initial Tear Resistance of Plastic Film and Sheeting

.2 ASTM D3330/D3330M-04 (2010), Standard Test Method for Peel Adhesion of Pressure-Sensitive Tape

1.3 ADMINISTRATIVE REQUIREMENTS

.1 Coordination: Coordinate the Work of this Section with the installation of glazing; sequence work so that installation of glazing films coincides with installation of glass materials without causing delay to the Work.

.2 Pre-Construction Conference: Arrange a site meeting, to coincide with regular bi-weekly site meetings, attended by the Contractor, the Subcontractor's representative and foreman for this project, the Consultant, materials supplier(s), and other relevant personnel before commencement of work for this Section; agenda for meeting will include; but not be limited to, the following:

.1 Review methods and procedures related to installation, including manufacturer's written instructions

.2 Examine substrate conditions for compliance with manufacturers installation requirements

.3 Review temporary protection measures required during and after installation.

1.4 SUBMITTALS

.1 Provide required information in accordance with Division 01.

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

.1 Verification Samples: Submit 300 mm x 300 mm sample of each type of film to the Consultant.

1.5 PROJECT CLOSEOUT SUBMISSIONS

.1 Operation and Maintenance Data: Submit manufacturer's written instructions for cleaning solutions, materials and procedures, include name of original installer and contact information in accordance with Division 01.

1.6 QUALITY ASSURANCE

.1 Qualifications: Provide proof of qualifications when requested by Consultant:

.1 Installer: Use installers having experience with projects of similar extent and complexity and that have experience laminating film to glass on site for a minimum of five (5) years.

1.7 DELIVERY, STORAGE AND HANDLING

.1 Delivery and Acceptance Requirements: Deliver and store packaged materials in their original containers with manufacturer's labels and seals intact; store as recommended by manufacturer in a weatherproof enclosure.

1.8 SITE CONDITIONS

- .1 Ambient Conditions: Proceed with film installation when ambient and substrate temperature conditions are within limits permitted by manufacturer and when glass substrates are free from wetness arising from frost, condensation, or other causes detrimental to adhesion.

2 Products

2.1 MANUFACTURERS

- .1 Basis-of-Design Products: Products named in this Section were used as the basis-of-design for the project; additional manufacturers offering similar products may be incorporated into the work of this Section
- .2 Acceptable Materials Manufacturers: Subject to compliance with requirements specified in this Section and as established by the Basis-of-Design Materials, manufacturers offering products that may be incorporated into the Work include the following:
 - .1 Avery Dennison Graphics
 - .2 Llumar Window Film
 - .3 3M Window Film Solutions
 - .4 Or approved equivalent as per Section 01 25 00.

2.2 GLAZING FILMS

- .1 Translucent Glazing Film (GF): Single layer, translucent decorative film with pressure sensitive ultraviolet resistant adhesive and scratch resistant coating; computer generated and cut.
 - .1 Film Thickness: 1.97 mil
 - .2 Film Type: Polyester
 - .3 Opacity: Translucent
 - .4 Shading Coefficient: 0.44
 - .5 Visible Light Reflectance: 43%
 - .6 Visible Light Transmittance: 21%
 - .7 Surface Finish: Matte
 - .8 Basis-of-Design Materials: 3M FASARA Glass Finishes; Design Pattern: Milky Milky. (or approved equivalent)

3 Execution

3.1 EXAMINATION

- .1 Examine glass and surrounding adjacent surfaces for conditions affecting installation; proceed with installation after verification and correction of surface conditions acceptable to manufacturer.

3.2 PREPARATION

- .1 Prepare glazing films using computer generated CNC cutting methods to eliminate any cutting of films directly on glass at project site.
- .2 Clean glass surfaces of substances that could impair glazing film bond including mould, mildew, oil, grease, dirt and other foreign materials immediately before beginning installation of films.
- .3 Protect window frames and surrounding conditions from damage during installation.

3.3 INSTALLATION

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

END OF SECTION

PART 1 - GENERAL

1.1 SECTION INCLUDES

- .1 Design, labour, Products, tool, equipment and services necessary for aluminum work in accordance with the Contract Documents.
- .2 Aluminum work: Shall mean aluminum curtainwall entrances, windows, operable units, vestibules, doors, and framing mentioned in Part 2 of this Specification Section.

1.2 REFERENCES

- .1 AAMA 611, Voluntary Standards for Anodized Architectural Aluminum.
- .2 AAMA CW-10, Care and Handling of Architectural Aluminum from Shop to Site.
- .3 ANSI H35.1M, Alloy and Temper Designation Systems for Aluminum (Metric).
- .4 ASTM A167, Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet and Strip.
- .5 ASTM B209M, Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
- .6 ASTM B221M, Specification for Aluminum-Alloy Extruded Bars, Rods, Wires, Profiles and Tubes.
- .7 ASTM C920, Specification for Elastomeric Joint Sealants.
- .8 ASTM E283, Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen.
- .9 ASTM E331, Standard Test Method for Water Penetration of Exterior Windows, Curtain Walls and Doors by Uniform Static Air Pressure Difference.
- .10 ASTM F738M, Specification for Stainless Steel Metric Bolts, Screws, and Studs.
- .11 CAN/CGSB 1.108-M, Bituminous Solvent Type Paint.
- .12 CAN/CGSB 79.1-M, Insect Screens.
- .13 CAN/ULC S702, Thermal Insulation, Mineral Fibre, for Buildings.

1.3 DESIGN REQUIREMENTS

- .1 Design aluminum work in accordance with following Climatic Design Data for **Waterloo** contained in the Ontario Building Code.
- .2 Design aluminum work to accommodate following without producing detrimental effect:
 - .1 Cyclic 40°C daily thermal swing of components.
 - .2 Cyclic, dynamic loading and release of loads such as wind loads.
 - .3 13 mm vertical deflection in supporting structure and movement of supporting structure due to live, dead load, and creep or deflections, seismic load, sway displacement and similar items.
- .3 Minimum condensation resistance expressed as Temperature Index (I) shall not be less than 59 as determined in accordance with CAN/SCA-A440.2 and using the following design conditions:
 - .1 Interior temperature: 20°C.
 - .2 Exterior temperature: -18°C.
 - .3 Interior RH: 30%.
- .4 Restrict air infiltration/exfiltration, through aluminum work in accordance with ASTM E283 at pressure differential as indicated:
 - .1 Curtainwall and entrance assemblies: 0.0003 m³/s m² at differential of 300 Pa.

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- .2 Doors (per door): 2.78 m³/h m per linear metre of crack at differential of 75 Pa.
 - .3 Window: to CAN/CSA A440
 - .1 Minimum performance grade: Class AW-PG40-FW (fixed) and Class AW-PG40-AP (awning/hopper).
 - .2 Air tightness: A3 (0.5L/s*m² at 300 Pa) at operable windows; 0.2L/s*m² at 300 Pa for fixed windows.
 - .3 Water tightness: [B7].
 - .4 Wind load resistance: [C5].
 - .5 Forced Entry: [F10]
 - .5 Design and detail controlled drainage path to actively discharge water, which enters into or forms within aluminum work, to exterior; prevent accumulation or storage of water within aluminum work. Prevent water from entering interior when tested in accordance with ASTM E331.
 - .6 Design and detail air barrier, vapour retarder, and rainscreen products and assemblies into continuous and integrated aluminum work envelope. Optimize aluminum work design to align envelope layers and to minimize thermal bridges.
 - .7 Prevent deflection and permanent or progressive glazing displacement. Restrict horizontal and vertical mullion deflection to less than L/175 (under uniformly distributed positive design wind load), and 10 mm maximum regardless of span.
 - .8 Design anchorage inserts for installation as part of other Sections of Work. Design anchorage assemblies to accommodate construction and installation tolerances.
 - .9 Provide all reinforcing within aluminum members as required by design and OBC to provide structurally sound assembly. In any case, mullion size shall not be increased due to provision of reinforcing.
 - .10 Design aluminum work and connections to substrate where the bottom of the aluminum work extends to a point below 1070 mm above finished floor level and separates a floor level from an adjacent interconnected space to withstand the required guard and handrail loads in accordance with the OBC and applicable local regulations. When requested by Consultant, provide a letter signed and sealed by a Professional Engineer certifying that the aluminum work conforms to the OBC requirements.

1.5 SUBMITTALS

- .1 Shop drawings: Submit shop drawings in accordance with the Conditions of the Contract indicating:
 - .1 Plans, sections, details, type of extrusions, profiles, finishes, panels, operating components, doors, related flashings, closures, fillers, and end caps, and sealants.
 - .2 Products and glazing types.
 - .3 Anchorage inserts, system installation tolerances.
 - .4 Section and hardware reinforcement, anchorage, assembly fixings.
 - .5 Detailing, locations, and allowances for movement, expansion, contraction
 - .6 Path of cavity drainage and air pressure equalization.
- .2 Samples: Submit two samples of following in accordance with the Conditions of the Contract.
 - .1 250 mm long samples of each type of extrusion and finish.
 - .2 250 x 200 mm samples of insulating glass unit.
 - .3 One complete corner detail of door frame, glazing, and finish for each door type.
 - .4 Each door and window hardware item for Consultant's approval.
 - .5 200 x 200 mm sample of insect screen for operable windows for Consultant's approval of fibreglass mesh.

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- .3 Reports:
 - .1 Submit substantiating engineering data, and independent test results of pretested, aluminum work to substantiate compliance with the design criteria including air leakage and water penetration conforming to ASTM E283 and ASTM E331.
 - .2 Submit documentation to substantiate ten years of experience in aluminum window and door manufacture and installation.
 - .4 Close-out submittals: Submit window data for incorporation into the Operations and Maintenance Manual as part of the Conditions of the Contract.

1.6 QUALITY ASSURANCE

- .1 Retain a Professional Engineer, licensed in Province of Ontario, with experience in aluminum work of comparable complexity and scope to perform the following services as part of the Work of this Section:
 - .1 Design of aluminum work.
 - .2 Review, stamp, and sign shop drawings.
 - .3 Conduct on-Site inspections and prepare and submit inspection reports.
- .2 Mock-up:
 - .1 Fabricate, deliver, and erect one, full scale mock-up of each type of aluminum work, in location acceptable to Consultant.
 - .2 Demonstrate full range of Products, finishes, textures, quality of fabrication, and workmanship.
 - .3 Mock-up may form part of final Work, if acceptable to Consultant. Remove and dispose of mock-ups which do not form part of Work.

1.7 DELIVERY, STORAGE, AND HANDLING

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

1.8 EXTENDED WARRANTY

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

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURER(S) AND SYSTEM(S)

- .1 **Thermally Broken Aluminum Curtainwall System** (Basis-of-Design Product). To be used in exterior wall locations where scheduled: ThermaWall TW2200 thermally broken stick curtain wall system: 50.8mm x 127mm, as manufactured by Alumicor.
 - .2 Subject to compliance with requirements, provide a comparable product by the following
 - .1 1620 Series Thermally Broken Curtainwall system by Kawneer.
- .2 **Fixed Aluminum Framed Windows** (Basis of Design Product): Rainblade 1970 series, fixed, 133mm depth (or as detailed) architectural window as manufactured by Alumicor.
 - .2 Subject to compliance with requirements, comparable products by the following are accepted:

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- .1 526 IsoPort Window as manufactured by Kawneer
 - .2 Series 1200-F Fixed Window as manufactured by Oldcastle.
 - .3 875 Series by Windspec.
 - .3 **Operable Aluminum Framed Windows** (Basis of Design Product): UniVent 1350 series, awning (project out) architectural window as manufactured by Alumicor.
 - .2 Subject to compliance with requirements, comparable products by the following are accepted:
 - .1 518 IsoPort TPO as manufactured by Kawneer
 - .2 Series 2000-2A Open Out Awning Vent as manufactured by Oldcastle.
 - .3 535 Series Operable vents by Windspec.
 - .4 **Non-Thermal Interior Aluminum Framing** (Basis-of-Design Product). To be used at interior vestibule/partition locations where scheduled: Flushglaze TL1800 non-thermally broken storefront system: 44.5mm x 114mm, as manufactured by Alumicor.
 - .2 Subject to compliance with requirements, comparable products by the following are accepted:
 - .1 Trifab VersaGlaze 450 by Kawneer.
 - .2 FG-2000 Series as manufactured by Oldcastle.
 - .3 630 Series by Windspec.
 - .5 **Thermally Broken Aluminum Exterior doors (medium rail)**
 - .1 'ThermaPorte 7700' T400A by Alumicor Limited.
 - .2 '250/425' Series Thermal Entrance Doors by Kawneer Inc.
 - .3 HTP Series by Windspec.
 - .6 **Non-Thermal Aluminum Interior doors (medium rail)**
 - .1 Canadiana 400A by Alumicor
 - .2 300 Series Standard Entrance by Kawneer.
 - .3 350 Standard Commercial Door by Windspec.

2.2 MATERIALS

- .1 All materials under Work of this Section, including but not limited to, sealants are to have low VOC content limits.
- .2 Aluminum extrusions and channels: ASTM B221 and ANSI H35.1 AA6063 alloy, T6 temper.
 - .1 Profile and dimensions: Refer to Contract Drawings.
 - .2 Thermal breaks in frame members: Vertically aligned with glazing.
 - .3 Aluminum sheet: ASTM B209 and ANSI H35.1 AA1100 aluminum alloy, H14 temper, minimum 1.29 mm for sheets less than 610 mm wide and minimum 2.05 mm for sheets of a greater dimension.
- .4 Reinforcements and anchors: ASTM A167, Type 304 to AISI No. 2B finish. Size as shown.
- .5 Glass and glazing materials: As specified in Section 08800.
- .6 Spandrel panel insulated panel airseal backpan: ASTM A653/A653M; 0.9 mm thick, Z275 galvanized steel sheet.
- .7 Thermal Break: Ensure complete separation of interior and exterior components by means of a structural thermal break. Do not permit screws to penetrate thermal break.
 - .1 24mm dual polyamide thermal barrier together with 6mm EPDM isolator.
- .8 Pressure Plate (at Curtain Wall): fibreglass or glass-reinforced polyamide (aluminum not acceptable).

- .9 Airseal and aluminum work sealant: ASTM C920, Type S, Grade NS, Class 100/50; One-part, low-modulus, moisture-curing, silicone. 'Dow Corning 790' by Dow Corning; 'Spectrem 1' by Tremco. Verify compatibility with insulating glass unit manufacturer's secondary sealant. Colour as selected by Consultant. Primer as recommended by manufacturer.
- .10 Frame sealant: Type as recommended by the aluminum work manufacturer.
- .11 Joint backing: Closed cell foam polyethylene rod, outsized minimum 30-50% larger than joint width and compatible with joint sealant. Product as recommended by sealant manufacturer.
- .12 Airseal transition membrane as per Spec 07 26 50.
- .13 Anchors, clips, and angles: Extruded aluminum or stainless steel.
- .14 Shims and blocking for frame: Rigid plastic, wood is not permitted.
- .15 Flashings, closures and trim: 1.0 mm minimum aluminum sheet, finish to match curtain wall/window framing finish.
- .16 Screws, bolts and other fasteners: ASTM F738M; Stainless Steel Type 304.
- .17 Isolation coating: CAN/CGSB-1.108-M; Bitumastic coating, acid and alkali resistant material.
- .18 Spray Foam Insulation: CFC free, polyurethane foam in place, closed cell low expansion, one component, minimum density 15 kg/m³.
 - .1 'ENERFOAM' by Dow Chemical Canada.
 - .2 'IPF All Weather Pro' by Rivenco Industries.
- .19 Window hardware: Manufacturer's standard heavy duty stainless steel hardware. Provide samples for the Consultant's approval.
 - .1 Provide each Top Hung/Projecting Out window unit with crank operated, scissor type roto-operator, complete with telescopic operator for all hardware located more than 1830mm (6'-0") above finished floor. Provide a total of 6 operators.
 - .2 Include restrictor to limit window opening to 225mm (9").
- .19 Aluminum Insect screen (operable units): Extruded aluminum frames containing heavy duty, fine fibreglass mesh in accordance with CSA A440. Provide samples for the Consultant's approval.
- .20 Weatherstripping: Durable, non-absorbing material resistant to deterioration by aging and weathering.

2.3 FABRICATION

- .1 Fabricate sections true to detail, free from defects impairing appearance, strength and durability. Fabricate extrusions with sharp, well defined corners.
- .2 Fabricate aluminum work systems in accordance with reviewed shop drawings and manufacturer's written instructions.
- .3 Fabricate, fit, and secure framing joints and corners accurately, with flush surfaces, and hairline joints. Apply frame sealant at joints for weatherproof seams.
- .4 Conceal anchors, reinforcement and attachments from view. Fabricate reinforcement in accordance with design requirements.
- .5 Do not expose manufacturer's identification labels on aluminum assemblies.
- .6 Fabricate continuous sill flashings with intermediate anchor clips, and joint reinforcing, form to profile shown. Fabricate filler and closure pieces as necessary for a complete and weather tight installation.
- .7 Position operable windows on main frame to provide direction of opening specified, free and smooth operation, without binding or sticking against main frame members.
- .8 Fabricate doors and frames complete with internal reinforcements, cut-outs, and recesses to accommodate finish hardware. Reinforce cut-outs to assure adequate strength.

- .9 Fabricate aluminum work closures and trim from aluminum sheet. Form to profile shown. Make weathertight.
- .10 Double weatherstrip windows and doors. Install weatherstripping in specially extruded ports and secure to prevent shrinkage or movement.
- .11 Fabricate glazing recess with drainage to exterior.

2.4 FINISH

- .1 Exterior extrusion finish: exposed aluminum surfaces To AA DAF-45-M12C22A44, Architectural Class I, anodized 18 µm (0.0007 inches) minimum thickness, coloured clear.
- .2 Interior exposed aluminum surfaces: To AA DAF-45-M12C22A44, Architectural Class I, anodized 18 µm (0.0007 inches) minimum thickness, coloured clear.

3 EXECUTION

3.1 INSTALLATION

- .1 Install aluminum work in accordance with reviewed shop drawings, manufacturer's written instructions, and CSA A440/A440.1.
- .2 Install Work of this Section securely, in correct location, level, square, plumb, at proper elevations, free of warp or twist.
- .3 Apply isolation coating at 0.8 mm dry film thickness to prevent corrosive or electrolytic action between dissimilar materials such as aluminum to concrete, masonry, galvanized steel and similar conditions.
- .4 Install flashings, closures, and trim pieces.
- .5 Fill voids between aluminum framing and adjacent construction with foam insulation.
- .6 Install sills in maximum lengths possible. For sills over 1200 mm in length, maintain 3 mm to 6 mm space at each end.
- .7 Refer to Contract Drawings for glazing type locations. Install glazing in accordance with Section 08 80 00.
- .8 Automatic door operators to be supplied and installed by Section 08 70 00. Install doors and hardware to manufacturers' written instructions. Clean and adjust hardware for correct performance.
- .9 Install aluminum door manufacturer's standard weatherstripping at door frame perimeter. Install weatherstripping throughout entire length and width of doors at jambs and heads.
- .10 Install doors and hardware to manufacturers' written instructions. Clean and adjust hardware for correct performance.
- .11 Adjust operable parts for correct function.
- .12 Remove damaged or unacceptable Products and assemblies from Site and replace to Consultant's acceptance.
- .13 Install glass presence markers, in two cross stripes extending from diagonal corners. Maintain markers until final clean-up.

3.2 ERECTION TOLERANCES

- .1 Tolerances: Non-cumulative.
 - .1 Maximum variation from plumb: 1.5 mm/3 m non-cumulative or 12 mm/30 m, whichever is less.
 - .2 Maximum misalignment of two adjoining members abutting in plane: 0.8 mm.

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- .3 Vertical and horizontal positions: +/- 3 mm.
 - .4 Racking of face: 6 mm, nil in elevation.
 - .5 Operable components: Consistent with smooth operation and weatherproof performance.
 - .6 Maximum perimeter sealant joint between aluminum work and adjacent construction: 13 mm.

3.3 GLAZING PERIMETER AIRSEAL

- .1 Install glazing perimeter airseal at entire perimeter of each insulating glass unit to achieve an airseal from insulating glass unit to curtain wall frame. Do not obstruct path of cavity drainage and air pressure equalization.
- .2 Perform sealant work in accordance with manufacturer's written requirements.

3.4 AIRSEAL TRANSITION MEMBRANE

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

3.5 JOINT BACKING AND ALUMINUM WORK SEALANT

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

3.6 CLEANING

- .1 Maintain aluminum work, inside and outside, in clean condition throughout construction period.
- .2 Remove labels, protective material, and glass presence markers from prefinished surfaces.
- .3 Remove CSA A440/A440.1 certification labeling when directed by Consultant, in writing.
- .4 Wash aluminum work with solution of mild detergent in warm water, with particular attention to recesses and corners. Wipe surfaces clean and dry.

END OF SECTION

1 General

1.1 SUMMARY

- .1 Section Includes the following:
 - .1 Non-load-bearing steel framing systems for interior partitions.
 - .2 Suspension systems for interior ceilings and soffits.
 - .3 Grid suspension systems for gypsum board ceilings.

1.2 REFERENCE STANDARDS

- .1 Canadian Standards Association (CSA):
 - .1 CSA S136-07, North American Specification for the Design of Cold-Formed Steel Structural Members.
- .2 Canadian General Standards Board (CGSB):
 - .1 CAN/CGSB-7.1-98, Lightweight Steel Wall Framing Components
- .3 American Society for Testing and Materials International (ASTM):
 - .1 ASTM A641/A641M-09a, Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire.
 - .2 ASTM A653/A653M-11 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - .3 ASTM A792/A792M-10, Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process.
 - .4 ASTM A875/A875M-10, Specification for Steel Sheet, Zinc-5% Aluminum Alloy-coated by the Hot Dip Process.
 - .5 ASTM A1003/A1003M-12, Specification for Steel Sheet, Carbon, Metallic and Non-Metallic Coated for Cold Formed Framing Members.
 - .6 ASTM C11-10a, Standard Terminology Relating to Gypsum and Related Building Materials.
 - .7 ASTM C473-12, Standard Test Methods for Physical Testing of Gypsum Panel Products.
 - .8 ASTM C645-11a, Standard Specification for Nonstructural Steel Framing Members.
 - .9 ASTM C665-12, Standard Specification for Mineral-Fibre Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing.
 - .10 ASTM C754-11, Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products.
 - .11 ASTM C834-10, Standard Specification for Latex Sealants.
 - .12 ASTM C841-03(2008)e1, Standard Specification for Installation of Interior Lathing and Furring.
 - .13 ASTM C954-11, Standard Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs From 0.033" to 0.112" in Thickness.
 - .14 ASTM C955-11c, Standard Specification for Load-Bearing (Transverse and Axial) Steel Studs, Runners (Tracks), and Bracing or Bridging for Screw Application of Gypsum Panel Products and Metal Plaster Bases

- .15 ASTM C1002-07, Standard Specification for Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs.
- .4 Canadian Sheet Steel Building Institute (CSSBI):
 - .1 CSSBI S6-2011, Guide Specification for Lightweight Steel Framing

1.3 SUBMITTALS

- .1 Provide submittals in accordance with Division 01.
- .2 Action Submittals: Provide the following submittals before starting any work of this Section:
 - .1 Product Data: Submit manufacturer's product data for each materials specified including recommended application rates and methods of installation.
- .3 Informational Submittals: Provide the following submittals during the course of the work:
 - .1 Product Certificates: For each type of code-compliance certification for studs and tracks.
 - .2 Shop Drawings: Submit shop drawings showing the design, construction and relevant details of furring, enclosures and partitions which require a fire rating.

1.4 QUALITY ASSURANCE

- .1 Code-Compliance Certification of Studs and Tracks: Provide documentation that framing members are certified according to the product-certification program of the Steel Stud Manufacturers Association (SSMA).
- .2 Contractor executing work of this Section shall have a minimum of five (5) years continuous experience in successful installation of work of type and quality shown and specified. Submit proof of experience upon Consultant's request.

1.5 DELIVERY, STORAGE, HANDLING AND PROTECTION

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

2 Products

2.1 PERFORMANCE REQUIREMENTS

- .1 Fire-Test-Response Characteristics: For fire-resistance-rated assemblies that incorporate non-load-bearing steel framing, provide materials and construction identical to those tested in assembly indicated, according to ASTM E119 by an independent testing agency.
- .2 STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated on Drawings, according to ASTM E90 and classified according to ASTM E413 by an independent testing agency.

2.2 FRAMING SYSTEMS

- .1 Framing Members, General: Comply with ASTM C754 for conditions indicated.
 - .1 Steel Sheet Components: Comply with ASTM C645 requirements for steel unless otherwise indicated.

- .2 Steel sheet components shall comply with ASTM C645 requirements for metal, unless otherwise indicated.
 - .3 Steel for non-loadbearing members shall have metallic coats that conform to ASTM A653M or ASTM A792M with minimum metallic coating weighs (mass) of Z120 and AZM150 respectively.
 - .4 Framing members shall comply with the CAN/CSA S136 - North American Specification for the Design of Cold Formed Steel Structural Members, for conditions indicated.
 - .5 Isolate where necessary to prevent electrolysis due to dissimilar metal-to-metal contact or metal-to-masonry and concrete contact. Use bituminous paint, butyl tape or other approved divorcing material.
- .2 Studs and Tracks: ASTM C645.
- .1 Steel Studs and Tracks:
 - .1 Minimum 0.0179" (25 gauge), screwable with crimped web and returned flange. Provide knockout openings in web at 150mm (6") O.C. to accommodate (if required) horizontal mechanical and electrical service lines, and bracing. Widths as indicated on drawings. Provide structural studs where indicated.
 - .2 Framing behind all fire resistant gypsum board shall be minimum 0.0329" (20 gauge).
 - .3 Where metal stud framing forms walls are to be thermally insulated as indicated on drawings, provide metal studs with integrated fastening system for glass fibre/mineral fibre insulation.
 - .4 Provide special shapes indicated on drawings as part of steel stud/drywall assemblies.
 - .3 Slip-Type Head Joints: Where indicated, provide one of the following:
 - .1 Clip System: Clips designed for use in head-of-wall deflection conditions that provide a positive attachment of studs to tracks while allowing 2" (51-mm) minimum vertical movement.
 - .2 Double-Track System: ASTM C645 top outer tracks, inside track with 2" (51 mm) deep flanges in thickness not less than indicated for studs and fastened to studs, and outer track sized to friction-fit over inner track.
 - .3 Deflection Track: Steel sheet top track manufactured to prevent cracking of finishes applied to interior partition framing resulting from deflection of structure above; in thickness not less than indicated for studs and in width to accommodate depth of studs.
 - .4 Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.
 - .1 Minimum Base-Steel Thickness: As indicated on Drawings.
 - .5 Cold-Rolled Channel Bridging: Steel, 0.0538" (1.367 mm) minimum base-steel thickness, with minimum 1/2" (13 mm) wide flanges.
 - .1 Depth: As indicated on Drawings.
 - .2 Clip Angle: Not less than 1-1/2" x 1-1/2" (38 mm x 38 mm), 0.068" (1.72 mm) thick, galvanized steel.

- .6 Hat-Shaped, Rigid Furring Channels: ASTM C645.
 - .1 Depth: As indicated on Drawings.
- .7 Resilient Furring Channels: ½" (13 mm) deep, steel sheet members designed to reduce sound transmission.
 - .1 Configuration: hat shaped.
- .8 Cold-Rolled Furring Channels: 0.053" (1.34 mm) uncoated-steel thickness, with minimum ½" (13 mm) wide flanges.
 - .1 Depth: As indicated on Drawings
 - .2 Furring Brackets: Adjustable, corrugated-edge-type steel sheet with minimum uncoated-steel thickness of 0.0329" (0.8 mm).
 - .3 Tie Wire: ASTM A641/A641M, Class 1 zinc coating, soft temper, 0.062" (1.59 mm) diameter wire, or double strand of 0.048" (1.21 mm) diameter wire.
- .9 Z-Shaped Furring: With slotted or nonslotted web, face flange of 1-1/4" (32 mm), wall attachment flange of 7/8" (22 mm), minimum uncoated-steel thickness of 0.0179" (0.455 mm), and depth required to fit insulation thickness indicated.

2.3 SUSPENSION SYSTEMS

- .1 Tie Wire: ASTM A641/A641M, Class 1 zinc coating, soft temper, 0.062" (1.59 mm) diameter wire, or double strand of 0.048" (1.21 mm) diameter wire.
- .2 Wire Hangers: ASTM A641/A641M, Class 1 zinc coating, soft temper, 0.16" (4.12 mm) in diameter.
- .3 Flat Hangers: Steel sheet, in size indicated on Drawings.
- .4 Carrying Channels (Main Runners): Cold-rolled, commercial-steel sheet with a base-steel thickness of 0.0538" (1.367 mm) and minimum ½" (13 mm) wide flanges.
 - .1 Depth: As indicated on Drawings.
- .5 Furring Channels (Furring Members):
 - .1 Cold-Rolled Channels: 0.0538" (1.367 mm) uncoated-steel thickness, with minimum ½" (13 mm) wide flanges, ¾" (19 mm) deep.
 - .2 Steel Studs and Tracks: ASTM C645.
 - .1 Depth: As indicated on Drawings.
 - .3 Hat-Shaped, Rigid Furring Channels: ASTM C645, 7/8 inch (22 mm) deep.
 - .4 Resilient Furring Channels: 1/2" (13 mm) deep members designed to reduce sound transmission.
 - .1 Configuration: Hat shaped.
- .6 Grid Suspension System for Gypsum Board Ceilings: ASTM C645, direct-hung system composed of main beams and cross-furring members that interlock.

2.4 AUXILIARY MATERIALS

- .1 General: Provide auxiliary materials that comply with referenced installation standards.
 - .1 Fasteners for Steel Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.

- .2 Isolation Strip at Exterior Walls: Provide one of the following:
 - .1 Asphalt-Saturated Organic Felt: ASTM D226/D226M, Type I (No. 15 asphalt felt), nonperforated.
 - .2 Foam Gasket: Adhesive-backed, closed-cell vinyl foam strips that allow fastener penetration without foam displacement, 1/8" (3.2 mm) thick, in width to suit steel stud size.

3 Execution

3.1 EXAMINATION

- .1 Examine areas and substrates, with Installer present, and including welded hollow-metal frames, cast-in anchors, and structural framing, for compliance with requirements and other conditions affecting performance of the Work.
- .2 Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- .1 Suspended Assemblies: Coordinate installation of suspension systems with installation of overhead structure to ensure that inserts and other provisions for anchorages to building structure have been installed to receive hangers at spacing required to support the Work and that hangers will develop their full strength.
 - .1 Furnish concrete inserts and other devices indicated to other trades for installation in advance of time needed for coordination and construction.
- .2 Coordination with Sprayed Fire-Resistive Materials:
 - .1 Before sprayed fire-resistive materials are applied, attach offset anchor plates or ceiling tracks to surfaces indicated to receive sprayed fire-resistive materials. Where offset anchor plates are required, provide continuous plates fastened to building structure not more than 24" (610 mm) o.c.
 - .2 After sprayed fire-resistive materials are applied, remove them only to extent necessary for installation of non-load-bearing steel framing. Do not reduce thickness of fire-resistive materials below that are required for fire-resistance ratings indicated. Protect adjacent fire-resistive materials from damage.

3.3 INSTALLATION, GENERAL

- .1 Installation Standard: ASTM C754.
 - .1 Gypsum Plaster Assemblies: Also comply with requirements in ASTM C841 that apply to framing installation.
 - .2 Gypsum Board Assemblies: Also comply with requirements in ASTM C840 that apply to framing installation.
- .2 Install framing and accessories plumb, square, and true to line, with connections securely fastened.
- .3 Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.
- .4 Install bracing at terminations in assemblies.
- .5 Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.

3.4 INSTALLING FRAMED ASSEMBLIES

- .1 Install framing system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.
- .2 Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.
- .3 Install studs so flanges within framing system point in same direction.
- .4 Install tracks at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts that penetrate partitions above ceiling.
 - .1 Slip-Type Head Joints: Where framing extends to overhead structural supports, install to produce joints at tops of framing systems that prevent axial loading of finished assemblies.
 - .2 Door Openings: Screw vertical studs at jambs to jamb anchor clips on door frames; install track section (for cripple studs) at head and secure to jamb studs.
 - .1 Extend jamb studs through suspended ceilings and attach to underside of overhead structure.
 - .3 Other Framed Openings: Frame openings other than door openings the same as required for door openings unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.
 - .4 Fire-Resistance-Rated Partitions: Install framing to comply with fire-resistance-rated assembly indicated and support closures and to make partitions continuous from floor to underside of solid structure.
 - .5 Sound-Rated Partitions: Install framing to comply with sound-rated assembly indicated.
 - .6 Curved Partitions:
 - .1 Bend track to uniform curve and locate straight lengths so they are tangent to arcs.
 - .2 Begin and end each arc with a stud, and space intermediate studs equally along arcs. On straight lengths of no fewer than two studs at ends of arcs, place studs 6" (150 mm) o.c.
- .5 Direct Furring:
 - .1 Screw to wood framing.
 - .2 Attach to concrete or masonry with stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches (610 mm) o.c.
- .6 Z-Shaped Furring Members:
 - .1 Erect insulation, vertically and hold in place with Z-shaped furring members spaced 24" (610 mm).
 - .2 Except at exterior corners, securely attach narrow flanges of furring members to wall with concrete stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24" (610 mm) o.c.
 - .3 At exterior corners, attach wide flange of furring members to wall with short flange extending beyond corner; on adjacent wall surface, screw-attach short flange of furring channel to web of attached channel. At interior corners, space second member no more than 12" (305 mm) from corner and cut insulation to fit.
- .7 Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8" (3 mm) from the plane formed by faces of adjacent framing.

3.5 INSTALLING CEILING SUSPENSION SYSTEMS

- .1 Install suspension system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.
 - .1 Hangers: 48" (1219 mm).
 - .2 Carrying Channels (Main Runners): 48" (1219 mm)
 - .3 Furring Channels (Furring Members): 24" (610 mm), unless otherwise indicated on the Drawings.
- .2 Isolate suspension systems from building structure where they abut or are penetrated by building structure to prevent transfer of loading imposed by structural movement.
- .3 Suspend hangers from building structure as follows:
 - .1 Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or suspension system.
 - .1 Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
 - .2 Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with locations of hangers required to support standard suspension system members, install supplemental suspension members and hangers in the form of trapezes or equivalent devices.
 - .1 Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced installation standards.
 - .3 Wire Hangers: Secure by looping and wire tying, either directly to structures or to inserts, eye screws, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause hangers to deteriorate or otherwise fail.
 - .4 Flat Hangers: Secure to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices and fasteners that are secure and appropriate for structure and hanger, and in a manner that will not cause hangers to deteriorate or otherwise fail.
 - .5 Do not attach hangers to steel roof deck.
 - .6 Do not attach hangers to permanent metal forms. Furnish cast-in-place hanger inserts that extend through forms.
 - .7 Do not attach hangers to rolled-in hanger tabs of composite steel floor deck.
 - .8 Do not connect or suspend steel framing from ducts, pipes, or conduit.
- .4 Fire-Resistance-Rated Assemblies: Wire tie furring channels to supports.
- .5 Grid Suspension Systems: Attach perimeter wall track or angle where grid suspension systems meet vertical surfaces. Mechanically join main beam and cross-furring members to each other and butt-cut to fit into wall track.
- .6 Installation Tolerances: Install suspension systems that are level to within 1/8" in 12' (3 mm in 3.6 m) measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

END OF SECTION

1 General

1.1 SUMMARY

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

1.2 REFERENCE STANDARDS

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

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- .14 ASTM C840-11, Standard Specification for Application and Finishing of Gypsum Board.
 - .15 ASTM C841-03(2008)e1, Standard Specification for Installation of Interior Lathing and Furring.
 - .16 ASTM C954-11, Standard Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs From 0.033" to 0.112" in Thickness.
 - .17 ASTM C955-11c, Standard Specification for Load-Bearing (Transverse and Axial) Steel Studs, Runners (Tracks), and Bracing or Bridging for Screw Application of Gypsum Panel Products and Metal Plaster Bases
 - .18 ASTM C1002-07, Standard Specification for Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs.
 - .19 ASTM C1047-10a, Standard Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base.
 - .20 ASTM C1177/C1177M-08, Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing.
 - .21 ASTM C1178/C1178M-11, Standard Specification for Coated Glass Mat Water-Resistant Gypsum Backing Panel.
 - .22 ASTM C1186-08, Standard Specification for Flat Fiber-Cement Sheets.
 - .23 ASTM C1278/C1278M-07a(2011), Standard Specification for Fiber-Reinforced Gypsum Panel.
 - .24 ASTM C1396/C1396M-11, Standard Specification for Gypsum Board.
 - .25 ASTM C1629/C1629M-06(2011), Standard Classification for Abuse-Resistant Nondecorated Interior Gypsum Panel Products and Fiber-Reinforced Cement Panels.
 - .26 ASTM C1658/C1658M-12, Standard Specification for Glass Mat Gypsum Panels.
 - .27 ASTM D3273-12, Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber.
 - .28 ASTM D3274-09, Standard Test Method for Evaluating Degree of Surface Disfigurement of Paint Films by Fungal or Algal Growth, or Soil and Dirt Accumulation.
 - .29 ASTM D3678-97(2008)e1, Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Interior-Profile Extrusions.
 - .2 Gypsum Association (GA):
 - .1 GA-214-10, Recommended Levels of Gypsum Board Finish.
 - .2 GA-216-10, Application and Finishing of Gypsum Board.
 - .3 GA-231-06, Assessing Water Damage to Gypsum Board.
 - .4 GA-238-03, Guidelines for the Prevention of Mold Growth on Gypsum Board.
 - .3 Underwriters Laboratories of Canada (ULC):
 - .1 CAN/ULC S101-07, Standard Methods of Fire Endurance Tests of Building Construction and Materials
 - .2 CAN/ULC S102-10, Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies
 - .3 ULC List of Equipment and Materials

- .4 Underwriters' Laboratories (UL), Standards for Safety acceptable to the Standards Council of Canada (SCC)

1.3 QUALITY ASSURANCE

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

1.4 SUBMITTALS

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

1.5 DELIVERY, STORAGE, HANDLING AND PROTECTION

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

1.6 PROJECT CONDITIONS

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

2 Products

2.1 MATERIALS – WALLBOARD (GWB)

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

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

2.2 ACCESSORIES

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

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

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

3 Execution

3.1 EXAMINATION

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

3.2 PREPARATION

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

3.3 INSTALLATION - GENERAL

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

3.4 GYPSUM WALLBOARD - SINGLE LAYER APPLICATION

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

- .2 Screws shall be driven with a power screw gun and set with countersunk head slightly below the surface of the board.
- .3 Joints:
 - .1 Finish all joints.

3.5 GYPSUM WALLBOARD - DOUBLE LAYER APPLICATION

- .1 General:
 - .1 Lay out work to minimize end joints on the face layer and to offset parallel joints between face and base layers by at least 254mm (10"). Apply the face layer at right angles to the base layer.
- .2 Base Layer:
 - .1 The base layer shall be same as face layer or wallboard backing board applied at right angles to framing members. Secure base layers with screws spaced 305mm (12") O.C. to each member. Perimeter screws shall be opposite the screws on adjacent boards.
 - .2 The surface of the erected base layer shall be straight, plumb or level, and without protrusions before the face layer is applied.
- .3 Face Layer:
 - .1 Apply face layer at right angles to base layer with adhesive. Apply adhesive with a notched spreader to leave 10mm x 13mm (3/8" x 1/2") ribbons, 38mm (1-1/2") apart over entire back side of face layer. Erect wallboard immediately after spreading adhesive.
 - .2 Supplement adhesive with screw fasteners. Provide temporary support for wallboard until adhesive bond has fully developed.
 - .3 As an alternative to adhesive specified, joint compound mixed with water in accordance with manufacturer's directions may be used. Allow joint compound and water mixture to stand thirty (30) minutes before using.
- .4 Joints:
 - .1 Finish joints in face layers only, unless otherwise required to achieve fire resistant ratings indicated, as hereinafter specified.

3.6 TILE BACKING PANELS

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

3.7 EXTERIOR SHEATHING BOARD

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

3.8 FIRE RESISTANT ASSEMBLIES

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

3.9 CONTROL JOINTS

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

3.10 BULKHEADS

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

3.11 PRESSED STEEL (HOLLOW METAL) FRAMES

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

3.12 THERMAL BREAK

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

3.13 FINISHING

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

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

3.14 REPAIRS

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

3.15 PROTECTION

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

END OF SECTION

1 General

1.1 SUMMARY

- .1 The work in this section includes supply and installation for the following:
 - .1 Porcelain Floor Tile
 - .2 Ant-Fracturing Waterproof Membrane
 - .3 Edge trims, Transition Strips and Accessories
 - .4 Raised steel tactile warning indicators

1.2 REFERENCE STANDARDS

- .1 American National Standards Institute/Ceramic Tile Institute (ANSI/CTI):
 - .1 ANSI/CTI A108.1-2011, Specification for the Installation of Ceramic Tile: Collection of 20 ANSI/CTI A108, A118 and A136 Series of Standards on Tile Installation
- .2 American Society for Testing and Materials (ASTM):
 - .1 ASTM C241/C241M-09, Standard Test Method for Abrasion Resistance of Stone Subjected to Foot Traffic
 - .2 ASTM C627-10, Standard Test Method for Evaluating Ceramic Floor Tile Installation Systems Using the Robinson-Type Floor Tester
 - .3 ASTM C920-11, Standard Specification for Elastomeric Joint Sealants
 - .4 ASTM C1028-07e1, Standard Test Method for Determining the Static Coefficient of Friction of Ceramic Tile and Other Like Surfaces by the Horizontal Dynamometer Pull-Meter Method
- .3 Canadian General Standards Board (CGSB):
 - .1 CAN/CGSB-75.1-M88, Tile, Ceramic
- .4 Terrazzo, Tile and Marble Association of Canada (TTMAC):
 - .1 2019-2021 Specification Guide 09 30 00, Tile Installation Manual
 - .2 Hard Surface Maintenance Guide

1.3 EXAMINATION

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

1.4 SUBMITTALS

- .1 Submit submittals in accordance with Division 01.
- .2 Samples:
 - .1 Submit sample panel of each type and colour tile, 610mm x 610mm (24" x 24").
 - .2 Adhere to a rigid board with setting compound, grout and a dummy control joint showing sealant as specified. Identify samples by project number, date, name of sub-contractor and tile type.
 - .3 Tile and grout used in the building shall correspond to appearance of approved samples in all respects. Do not install tile until samples are approved.
 - .4 Upon Consultant's request submit samples of base, trim and fittings.

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

1.5 QUALITY ASSURANCE

- .1 Subcontractor executing work of this Section shall employ installers having a minimum of five (5) years continuous experience in successful installation of work of type and quality shown and specified. Submit proof of experience upon Consultant's request.
- .2 Work of this Section shall be executed by workers especially trained and experienced in this type of work. Have a full time, qualified representative at the Site to direct the work of this Section at all times.
- .3 Ensure proper use of proprietary materials in strict accordance with the material manufacturer's directions. It shall be the responsibility of the material manufacturer or supplier to furnish these directions to the Contractor and to check periodically at the site to ensure that they are being carried out.

1.6 PRE-INSTALLATION CONFERENCE

- .1 Pre-Construction Conference: Arrange a site meeting, to coincide with regular bi-weekly site meetings, attended by the Contractor, the Subcontractor's representative and foreman for this project, the Consultant, materials supplier(s), and other relevant personal before commencement of work for this Section; agenda for meeting will include; but not be limited to, the following:
 - .1 Substrate conditions, non-structural cracks, structural cracks and preparation requirements;
 - .2 Floor and wall surface irregularities and levelness tolerances, including all remedial requirements;
 - .3 Installation of anti-fracturing membranes and setting bed materials;
 - .4 Installation of tiles and grouting;
 - .5 Edge details and treatments;

- .6 Installation of tile and grout sealers.

1.7 DELIVERY, STORAGE, HANDLING AND PROTECTION

- .1 Co-ordinate deliveries to comply with construction schedule and arrange ahead for off the ground, under cover storage location. Do not load any area beyond the design limits.
- .2 Materials shall be carefully checked, unloaded, stored and handled to prevent damage. Protect materials with suitable non-staining waterproof coverings.
- .3 Store material in original, undamaged containers or wrappings with manufacturer's seals and labels intact.
- .4 Restrict traffic by other trades during installation.
- .5 Provide adequate protection of completed tiled surfaces to prevent damage by other trades until final completion of this project. Minimum protection shall consist of 4 mil polyethylene sheets lapped 100mm (4") and taped.
- .6 Heavily travelled areas shall have additional 13mm (1/2") thick fibreboard sheet protection with taped joints over polyethylene sheet protection as specified above.
- .7 Protect exposed edges of floor tile with same thickness as tile x 100mm (4") wide tapered strip of plywood adhered to floor until adjoining floor finish is to be installed.

1.8 SITE CONDITIONS

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

1.9 WARRANTY

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

2 Products

2.1 PERFORMANCE REQUIREMENTS

- .1 Dynamic Coefficient of Friction (DCOF): Tile installed on walkway surfaces having following values as determined by testing identical products per ANSI A137.1:
 - .1 Level Interior Wet Spaces: A minimum wet DCOF AcuTest Value of 0.42 or higher.

- .2 Level Interior Dry Spaces: A minimum wet DCOF AcuTest Value below 0.42
- .2 Floor Level Tolerances: Provide materials to attain floor levelness tolerances required by this Section.
 - .1 Calculate quantity of materials based on the difference between the specified tolerance and the initial tolerance specified in Section 03 35 00.
 - .2 Measurements: As indicated in Section 03 35 00.

2.2 MATERIALS

- .1 Porcelain Floor Tiles (POR):
 - .1 Size: 30cm x 60cm
 - .2 Finish: matte/unglazed
 - .3 Basis of Design Model and Manufacturer: Olympia Tile Unicolour Series; unglazed/thru body porcelain or equivalent per Specification 01 25 00.
 - .1 Colour to be selected from standard colour range, allow for 2 colours.
- .2 Tactile Attention Indicators (TAI) for installation at top of all curb ramps/stairs as indicated in drawings:
 - .1 Cast iron plates cast in place in concrete floor finish with bolted connections between adjacent plates.
 - .2 Domes to be 22mm diameter and shall extend above adjacent floor finish 5mm with a domed head, complete with crosshatch pattern on face.
 - .1 Plate and dome material: Cast Iron.
 - .2 Adhesive: As recommended by manufacturer.
 - .3 Acceptable Manufacturer: ADV-CI-__24 as manufactured by Advantage Tactile Systems or equivalent as per Specification 01 25 00. Size as per drawings.
 - .4 Colour: Federal Yellow
- .3 Control Joint Caulking:
 - .1 As supplied by the Grout Manufacturer.
 - .2 Colour: To match adjacent grout, as approved by the Consultant.
- .4 Tile Straight Edge Trim:
 - .1 Extruded clear satin anodized aluminum edge trim, 3mm (1/8") wide at top edge; Height as required to suit tile installation; with integral perforated anchoring leg for setting the strip into the setting material.
 - .2 Basis of Design Materials: Schlüter Schiene AE by Schlüter.

2.3 MORTAR SETTING MATERIALS

- .1 Manufacturers: Mortar and grout materials listed in this Section shall be of a uniform quality for each mortar, and grout component from a single manufacturer and each aggregate from one source or producer as follows:
 - .1 Flextile Ltd.
 - .2 MAPEI Inc.
 - .3 Custom Building Products Ltd.
 - .4 Laticrete International Inc.
 - .5 Or approved equivalent.
- .2 Surface Preparation Materials: As indicated in Section 03 35 00.

- .3 Interior Thin Set Epoxy Method Floor System: 100% solids epoxy mortar meeting requirements of ANSI A118.3.
- .4 Refer also to TTMAC detail 311F.

2.4 GROUT MATERIALS

- .1 Grout Colours: As selected by the Consultant from manufacturer's full product range.
- .2 Epoxy Grout for Wall and Floor Joints $\leq 3\text{mm}$ (1/8") Interior Only: 100% solids epoxy grout meeting requirements of ANSI A118.3:
- .3 Latex-Portland Cement Grout for Floors with Joints $\geq 3\text{mm}$ (1/8") Interior or Exterior: 100% solids epoxy grout meeting requirements of ANSI A118.3:

2.5 WATERPROOFING ANTI-FRACTURING MEMBRANES

- .1 Waterproofing Anti-Fracturing Membranes: Load bearing, reinforced, liquid applied membrane; manufactured to accommodate flood testing and reduce the incidence of thermal shock cracking to tiling installations; meeting requirements of ANSI A108.1 and compatible with 100% solids epoxy mortar and grout materials. Waterproof Anti Fracture Membrane to be provided at all horizontal and vertical surfaces scheduled to receive tile finish:
 - .1 Acceptable Membrane Materials:
 - .1 Flex WP-980 Waterproof and Crack Isolation Membrane by Flextile Ltd.
 - .2 Mapelastic 315 Waterproofing and Reinforcing Fabric by MAPEI Inc.
 - .3 Level Quik Waterproof and Anti-Fracture Membrane by Custom Building Products.
 - .4 Hydroban Waterproofing by Laticrete International Inc.
 - .5 Or approved equivalent per Specification 01 25 00
 - .2 Reinforcing Fabric: strong, absorbent, flexible, alkali-resistant, polyester reinforcing fabric for use at coves, corners, cracks and around drains.
 - .1 Acceptable product: Reinforcing Fabric by Mapei
 - .2 Or approved equivalent per Specification 01 25 00

2.6 ACCESSORY MATERIALS

- .1 Tile Cleaner: A neutral cleaner capable of removing soil and residue without harming tile and grout surfaces, specifically approved for materials and installations indicated by tile and grout manufacturers and as follows:
 - .1 Job Site Cleaner: Phosphoric acid/nitric acid based cleaning solution mixed in accordance with cleaner manufacturer's recommendations and as recommended by tile manufacturer.
 - .2 Maintenance Cleaner: Non-toxic, electrolytic, biodegradable, non-ammonia containing, pH controlled cleaning solution mixed in accordance with manufacturer's recommendations.

3 Execution

3.1 EXAMINATION

- .1 Maintain minimum temperature of 13 deg C at tile installation area for twenty-four (24) hours prior to curing and for twenty-four (24) hours after installation. Do not apply work to frozen surfaces.
- .2 Examine carefully surfaces to which tile is to be installed and report any defects to the Consultant.

- .3 Waterproof Anti-Fracturing Membranes:
 - .1 Prepare all surfaces of non-structural and structural cracks in strict accordance with the anti-fracturing membrane manufacturer's written instructions.
 - .2 Prime and fill all surfaces of non-structural and structural cracks in strict accordance with the anti-fracturing membrane manufacturer's written instructions.
- .4 Commencement of installation shall signify complete acceptance of surfaces and conditions.

3.2 PREPARATION

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

3.3 INSTALLATION – WATERPROOF ANTI-FRACTURING MEMBRANES

- .1 Install waterproofing anti-fracturing membrane in accordance with waterproofing manufacturer's written instructions to produce a waterproof membrane of uniform thickness bonded securely to substrate.
- .2 Do not install tile over waterproofing membrane until waterproofing has cured and been tested to determine that it is watertight.
- .3 Prepare floor and wall substrates in accordance with manufacturers written instructions.
 - .1 All substrates should be structurally sound, stable, dry, clean and free of any substance or condition that may reduce or prevent proper adhesion.
 - .2 Do not use chemicals (acid etching or stripping) to prepare approved substrates.
 - .3 Concrete substrates should have a concrete surface profile of #2 per the International Concrete Repair Institute (ICRI). Mechanically clean and profile by diamond-cup grinding or other engineer-approved method when necessary.
- .4 Application
 - .1 Fill all cracks, control joints and gaps in corners and coves that are greater than 1/32" (1 mm) with an appropriate filler material. Force material into crack and finish smooth with trowel. Let dry.
 - .2 Pre-treat cracks, corners, coves and floor wall intersections with 2 coats of waterproof membrane.
 - .3 Pre-treat drains by filling space between drain pipe and substrate with appropriate expansion joint materials and apply 2-coats of waterproof membrane

- .5 Fabric Reinforcing Application
 - .1 Lay reinforcing fabric into wet waterproof membrane at all "pre-treat" sections as outlined in application section below (cracks, coves, corners and penetrations). Allow for 50mm fabric on horizontal surface and 100mm fabric on vertical surface. Use brush to press fabric into corners until liquid comes through fabric. Work out any wrinkles or bubbles.
 - .2 While fabric is wet, apply additional waterproof membrane over fabric until completely covered to create void-free surface. Let dry. Apply a second coat and let dry.
 - .3 Install reinforcing fabric through main/field areas by placing into wet first coat of waterproof membrane. Using a roller, apply pressure to the fabric, working out wrinkles or bubbles while forcing liquid waterproof membrane to come through the fabric. Overlap seams and ends of the fabric by 2" (50mm). While fabric is still wet, apply additional liquid waterproof membrane over the fabric until completely covered, creating a void-free surface. Let dry completely.
 - .4 Apply a second coat of liquid waterproof membrane to entire area. Let dry.
 - .5 Apply a bead of commercial-grade silicone or urethane sealant between the membrane and the drain flange, about 1/2" (12 mm) in from the drain opening.
 - .6 Bolt the drain collar into place while the sealant is still fresh.
 - .7 Install tile as per following section below.

3.4 INSTALLATION - GENERAL

- .1 Unless otherwise specified, execute tile work according to the latest issue of Specification Guide 09 30 00, Tile Installation Manual - published by Terrazzo, Tile and Marble Association of Canada, as the minimum standard except as varied by this Specification.
- .2 Thoroughly clean surfaces to which tile is to be applied.
- .3 Back butter all floor tile.
- .4 Neatly cut tile around fitments, fixtures, access panels, and the like. Splitting of tile is expressly prohibited except where no alternative is possible. Form intersections, corners and returns accurately.
- .5 Finish surfaces flat and level or, sloped and graded as required.
- .6 Joint Widths: Install tile with the following joint widths, unless indicated on drawings:
 - .1 Wall Tile: 1.6mm (1/16")
 - .2 Floor Tile: 6mm (1/4"), unless otherwise indicated on the Drawings.
 - .3 Quarry Tile: As per manufacturers recommendations.
 - .4 Make joints consistent width and alignment within tile area.
 - .5 Maintain 2/3 of grout joint depth free of setting material.
- .7 Joints in base shall match floor patterns. Joints shall be watertight without voids, cracks or excess grout.
- .8 Lay out tile so that fields or patterns are centred on wall areas or architectural features and so that no tile less than 1/2 size occurs.
- .9 Arrange and set recessed accessories in tile work so that they are evenly spaced, centred with joints and set true with correct projection. Rigidly install accessories.
- .10 Provide manufacturer's standard trim pieces at changes of direction and at terminations. Unless otherwise indicated provide the following corner and edge conditions:
 - .1 Internal horizontal corners: Coved.

- .2 External vertical and horizontal corners: Bullnosed.
- .3 Internal vertical corners and unexposed edges: Square.
- .11 Install tiles in patterns and locations as indicated on drawings.
- .12 Install wall tile full wall height unless shown otherwise.
- .13 Coordinate work of this Section with work of other Sections for items requiring to be recessed into work of this Section.
- .14 Sound tiles after setting and remove and replace tiles not fully bedded.
- .15 Re-point joints after cleaning to eliminate imperfections. Avoid scratching tile surfaces.
- .16 Finished tile work shall be clean and free of tiles which are pitted, chipped, cracked or scratched. All damaged tile shall be removed and replaced.
- .17 Where indicated on Drawings or as required, install continuous single piece metal edge trims centred under doors in closed position and other locations where tile meets other floor finishes.

3.5 MORTAR APPLICATION METHOD

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

3.6 GROUTING

- .1 Grout tiles in accordance with ANSI A108.6 and as specified herein.
- .2 When grouting a fresh laid floor, make certain that traffic and grouting will not cause movement of floor in setting bed. Protect floor by using kneeling boards or gypsum board to defend floor against traffic while grouting.
- .3 Mix grouts and install in strict accordance with the manufacturer's instructions.
- .4 Excess grout shall be removed from the surface of tiles using the edge of a rubber float held at a 45 deg angle, moving it diagonally to the joints. Fill all gaps and air holes.
- .5 Do not allow grout to harden on face of tile. Refer to manufacturer's instructions for thorough removal.
- .6 Floors which required damp curing shall be cured for the required length of time using heavy kraft paper, not polyethylene sheets. Consult manufacturer for instructions.

3.7 CONTROL JOINTS AND SEALING

- .1 Control joints of a flexible caulking material shall be placed every 4877mm to 6096mm (16' to 20') apart, directly over existing control joints and/or where indicated on drawings or as required in accordance with TTMAC Detail No. 301MJ-2019-2021, Details E, F and G, whichever is applicable.
- .2 Control joints shall be placed around the floor perimeter at walls, around columns, and where tile abuts other hard materials or vertical surfaces. Saw cutting of tile after installation is prohibited. Tile shall be cut if required and installed along each side of control joints.
- .3 Expansion joints must always be placed directly over all slab expansion joints in accordance with TTMAC Detail No. 301MJ-2019-2021, Details A and B, whichever is applicable.

- .4 Locate expansion, control, contraction, and isolation joints, as indicated below, unless specifically indicated otherwise on the Drawings:
 - .1 Interior: 4877mm (16') maximum: 6mm (1/4") joint width.
- .5 Joints around fixtures, pipes or other fittings shall be sealed with a sealant. Refer to Section 07 92 00 for type of sealants to be used.
 - .1 Colour of sealant shall match grout as selected later by Consultant.

3.8 CLEANING AND PROTECTION

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

END OF SECTION

PART 1 - GENERAL

1.1 References

- .1 American Society for Testing and Materials (ASTM):
 - .1 ASTM A 1008 Standard Specification for Steel, Sheet, Cold Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.
 - .2 ASTM A 641 Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire.
 - .3 ASTM A 653 Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process.
 - .4 ASTM C 423 Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.
 - .5 ASTM C 635 Standard Specification for Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings.
 - .6 ASTM C 636 Recommended Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels.
 - .7 STM E 84 Standard Test Method for Surface Burning Characteristics of Building Materials.
 - .8 ASTM E 1414 Standard Test Method for Airborne Sound Attenuation Between Rooms Sharing a Common Ceiling Plenum.
 - .9 ASTM E 1111 Standard Test Method for Measuring the Interzone Attenuation of Ceilings Systems.
 - .10 ASTM E 1264 Classification for Acoustical Ceiling Products.
 - .11 ASTM E 1477 Standard Test Method for Luminous Reflectance Factor of Acoustical Materials by Use of Integrating-Sphere Reflectometers.
 - .12 ASTM D 3273 Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber.
 - .13 ASTM E 119 Standard Test Methods for Fire Tests of Building Construction and Material.
- .2 ASHRAE Standard 62.1-2004, "Ventilation for Acceptable Indoor Air Quality"

1.2 Equivalent Products

- .1 As per Section 01 25 00 – Product Substitution Procedures.
- .2 Submittals which do not provide adequate data for the product evaluation will not be considered. The proposed substitution must meet all requirements of this section, including but not necessarily limited to, the following: Single source materials suppliers (if specified); Underwriters' Laboratories Classified Acoustical performance; Panel design, size, composition, color, and finish; Suspension system component profiles and sizes; Compliance with the referenced standards.

1.3 SUBMITTALS

- .1 Product Data: Submit manufacturer's technical data for each type of acoustical ceiling unit and suspension system required.
- .2 Samples: Minimum 6 inch x 6 inch samples of specified acoustical panel; 8 inch long samples of exposed wall molding and suspension system, including main runner and 4 foot cross tees.
- .3 Shop Drawings: Layout and details of acoustical ceilings. Show locations of items which are to be coordinated with, or supported by the ceilings.
- .4 Certifications: Manufacturer's certifications that products comply with specified requirements, including laboratory reports showing compliance with specified tests and standards. For acoustical

performance, each carton of material must carry an approved independent laboratory classification of NRC, CAC, and AC.

- .5 If the material supplied by the acoustical subcontractor does not have an Underwriter's Laboratory classification of acoustical performance on every carton, subcontractor shall be required to send material from every production run appearing on the job to an independent or NVLAP approved laboratory for testing, at the architect's or owner's discretion. All products not conforming to manufacturer's current published values must be removed, disposed of and replaced with complying product at the expense of the Contractor performing the work.

1.4 QUALITY ASSURANCE

- .1 Single-Source Responsibility: Provide acoustical panel units and grid components by a single manufacturer.
- .2 Fire Performance Characteristics: Identify acoustical ceiling components with appropriate markings of applicable testing and inspecting organization.
 - .1 Surface Burning Characteristics: As follows, tested per ASTM E 84 and complying with ASTM E 1264 for Class A products.
 - a. Flame Spread: 25 or less
 - b. Smoke Developed: 50 or less
 - .2 Fire Resistance Ratings: As indicated by reference to design designations in UL Fire Resistance Directory, for types of assemblies in which acoustical ceilings function as a fire protective membrane and tested per ASTM E 119.
 - a. Protect lighting fixtures and air ducts to comply with requirements indicated for rated assembly.
- .3 Handle acoustical ceiling units carefully to avoid chipping edges or damaged units in any way.

1.5 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver acoustical ceiling units to project site in original, unopened packages and store them in a fully enclosed space where they will be protected against damage from moisture, direct sunlight, surface contamination, and other causes.
- .2 Before installing acoustical ceiling units, permit them to reach room temperature and a stabilized moisture content.
- .3 Handle acoustical ceiling units carefully to avoid chipping edges or damaged units in any way.

1.6 PROJECT CONDITIONS

- .1 All ceiling products and suspension systems must be installed and maintained in accordance with manufacturer written installation instructions for that product in effect at the time of installation and best industry practice. Prior to installation, the ceiling product must be kept clean and dry, in an environment that is between 32°F (0°C) and 120°F (49°C) and not subject to Abnormal Conditions. Abnormal conditions include exposure to chemical fumes, vibrations, moisture from conditions such as building leaks or condensation, excessive humidity, or excessive dirt or dust buildup.

1.7 WARRANTY

- .1 Acoustical Panel: Submit a written warranty executed by the manufacturer, agreeing to repair or replace acoustical panels that fail within the warranty period. Failures include, but are not limited to:
 - .1 Acoustical Panels: Sagging and warping as a result of defects in materials or factory workmanship.
 - .2 Grid System: Rusting and manufacturer's defects

- .3 Acoustical Panels designated as inherently resistive to the growth of micro-organisms installed with corresponding suspension systems: Visible sag and will resist the growth of mold/mildew and gram positive and gram negative odor and stain causing bacteria.
- .2 Warranty Period Humiguard:
 - .1 Acoustical panels: Ten (10) years from date of substantial completion.
 - .2 Grid: Ten (10) years from date of substantial completion.
 - .3 Acoustical panels and grid systems with HumiGuard Plus or HumiGuard Max performance supplied by one source manufacturer is thirty (30) years from date of substantial completion.
- .3 The Warranty shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and will be in addition to and run concurrent with other warranties made by the Contractor under the requirements of the Contract Documents.

1.8 MAINTENANCE

- .1 Extra Materials: Deliver extra materials to Owner. Furnish extra materials described below that match products installed. Packaged with protective covering for storage and identified with appropriate labels.
 - .1 Acoustical Ceiling Units: Furnish quantity of full-size units equal to 5.0 percent of amount installed, for each ceiling type/pattern.
 - .2 Exposed Suspension System Components: Furnish quantity of each exposed suspension component equal to 2.0 percent of amount installed, for each ceiling type/pattern.
 - .3 Linear Acoustic Baffles: Furnish quantity of full-size units equal to 5.0 percent of amount installed, for each ceiling type/pattern.

PART 2-PRODUCTS

2.1 MANUFACTURERS

- .1 Ceiling Panels: Model numbers for acoustic ceiling tiles and grid as manufactured by Armstrong World Industries, are listed to establish a standard of quality for design, function, materials, performance, workmanship, and appearance. The following manufacturers may be submitted for evaluation by the architect by following the conditions of the Product Substitutions Section 01 25 00. The architect shall be the sole judge as to the acceptability of all products submitted for substitution.
 - .1 CertainTeed.
 - .2 Canadian Gypsum Company (CGC).

2.2 ACOUSTICAL CEILING UNITS

- .1 Acoustic Ceiling Tile ACT-1
 - .1 Surface Texture: Fine
 - .2 Composition: Mineral Fibre
 - .3 Color: White
 - .4 Size: 24in X 48in X 7/8in
 - .5 Edge Profile: Square
 - .6 Noise Reduction Coefficient (NRC): 0.75.
 - .7 CAC: 35
 - .8 Fire Performance: ASTM E84 and CAN/ULC S102 surface burning characteristics. Flame Spread Index 25 or less. Smoke Developed Index 50 or less (UL labeled.)
 - .9 Flame Spread: ASTM E 1264; Type XII, Form 2, Pattern E Fire Class A

- .10 Light Reflectance (LR): ASTM E 1477; White Panel: Light Reflectance: 0.88.
- .11 Antimicrobial Protection: Inherent - Resists the growth of mold/mildew and bacterial growth.
- .12 Acceptable Product: Ultima High NRC 1943 as manufactured by Armstrong World Industries, or equivalent.
- .2 Acoustic Ceiling Tile ACT-2
 - .1 Surface Texture: Smooth
 - .2 Composition: Mineral fibre
 - .3 Color: White
 - .4 Size: 24in X 24in X 3/4in lay in
 - .5 Edge Profile: Square
 - .6 Noise Reduction Coefficient (NRC): 0.70.
 - .7 CAC: 38
 - .8 Fire Performance: ASTM E84 and CAN/ULC S102 surface burning characteristics. Flame Spread Index 25 or less. Smoke Developed Index 50 or less (UL labeled.)
 - .9 Flame Spread: ASTM E 1264; Class A
 - .10 Light Reflectance (LR): ASTM E 1477; White Panel: Light Reflectance: 0.86.
 - .11 Antimicrobial Protection: Inherent - Resists the growth of mold/mildew and bacterial growth.
 - .12 Acceptable Product: Ultima Health Zone 1938 as manufactured by Armstrong World Industries, or equivalent.

2.3 SUSPENSION SYSTEMS FOR ACOUSTICAL CEILING UNITS

- .1 Components: All main beams and cross tees shall be commercial quality aluminum as per ASTM A 653. Main beams and cross tees are double-web steel construction with 15/16 IN type exposed flange design. Exposed surfaces chemically cleansed, capping pre-finished aluminum in baked polyester paint.
 - .1 Structural Classification: ASTM C 635 LD.
 - .2 Color: White Aluminum and match the actual color of the selected ceiling tile, unless noted otherwise.
 - .3 Acceptable Product: Prelude XL 15/16" Exposed Tee as manufactured by Armstrong World Industries, Inc.
- .2 Attachment Devices: Size for five times design load indicated in ASTM C 635, Table 1, Direct Hung unless otherwise indicated.
- .3 Wire for Hangers and Ties: ASTM A 641, Class 1 zinc coating, soft temper, pre-stretched, with a yield stress load of at least three times design load, but not less than 12 gauge.
- .4 Edge Moldings and Trim: Metal or extruded aluminum of types and profiles indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations, including light fixtures, that fit type of edge detail and suspension system indicated. Provide moldings with exposed flange of the same width as exposed runner.
- .5 Accessories
 - .1 Shadow molding with 1/2" (13mm) reveal, exposed flange same width as exposed runners, to be used at interface with walls/bulkheads.
- .6 Floating Edge Trim: extruded aluminum floating edge channel to be provided at all locations where ACT ceiling does not terminate at wall/bulkhead.
 - .1 Acceptable product: Axiom Classic as manufactured by Armstrong.
 - .2 Colour: to be selected by Consultant from standard colour range (1 colour throughout).

.3 Height: 3-7/8 and/or as detailed

PART 3 - EXECUTION

3.1 EXAMINATION

- .1 Do not proceed with installation until all wet work such as concrete, terrazzo, plastering and painting has been completed and thoroughly dried out, unless expressly permitted by manufacturer's printed recommendations. (Exception: HumiGuard Max Ceilings)

3.2 PREPARATION

- .1 Measure each ceiling area and establish layout of acoustical units to balance border widths at opposite edges of each ceiling. Avoid use of less than half width units at borders, and comply with reflected ceiling plans. Coordinate panel layout with mechanical and electrical fixtures.
- .2 Coordination: Furnish layouts for preset inserts, clips, and other ceiling anchors whose installation is specified in other sections.
 - .1 Furnish concrete inserts and similar devices to other trades for installation well in advance of time needed for coordination of other work.

3.3 INSTALLATION

- .1 Install suspension system and panels in accordance with the manufacturer's instructions, and in compliance with ASTM C 636 and with the authorities having jurisdiction.
- .2 Suspend main beam from overhead construction with hanger wires spaced 4-0 on center along the length of the main runner. Install hanger wires plumb and straight.
- .3 Install wall moldings at intersection of suspended ceiling and vertical surfaces. Miter corners where wall moldings intersect or install corner caps.
- .4 For reveal edge panels: Cut and reveal or rabbet edges of ceiling panels at border areas and vertical surfaces.
- .5 Install acoustical panels in coordination with suspended system, with edges resting on flanges of main runner and cross tees. Cut and fit panels neatly against abutting surfaces. Support edges by wall moldings.

3.4 INTERFACE WITH OTHER WORK

- .1 Co-ordinate ceiling work to accommodate components of other sections, such as light fixtures, diffusers, speakers, sprinkler heads, to be built into acoustical ceiling components.

3.5 ADJUSTING AND CLEANING

- .1 Replace damaged and broken panels.
- .2 Clean exposed surfaces of acoustical ceilings, including trim, edge moldings, and suspension members. Comply with manufacturer's instructions for cleaning and touch up of minor finish damage.
 - .1 Ceiling Touch-Up Paint, (Item #5760, 8oz. bottles) (Item #5761, quart size cans), "global white" latex paint should be used to hide minor scratches and nicks in the surface and to cover field tegularized edges that are exposed to view.
- .3 Remove and replace work that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION

1 General

1.1 SUMMARY

.1 This Section includes, but is not limited to, the following:

.1 Resilient tile materials:

.1 Rubber sheet flooring.

1.2 REFERENCE STANDARDS

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

.1 ASTM F1344-12, Standard Specification for Rubber Floor Tile

.2 ASTM F1516-13, Standard Practice for Sealing Seams of Resilient Flooring Products by the Heat Weld Method (when Recommended)

.3 ASTM F1869-11, Standard Test Method for Measuring Moisture Vapour Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride

.2 Canadian General Standards Board (CGSB):

.1 CAN/CGSB-51.34-M86, Vapour Barrier, Polyethylene Sheet for Use in Building Construction

1.3 ADMINISTRATIVE REQUIREMENTS

.1 Coordination: Close spaces to traffic during flooring installation and until time period after installation recommended in writing by manufacturer; install flooring and accessories after other finishing operations, including painting and ceiling construction have been completed.

.2 Pre-Construction Conference: Arrange a site meeting, to coincide with regular bi-weekly site meetings, attended by the Contractor, the Subcontractor's representative and foreman for this project, the Consultant, materials supplier(s), and other relevant personal before commencement of work for this Section.

1.4 SUBMITTALS

.1 Provide submittals in accordance with Division 01.

.2 Action Submittals:

.1 Product Data: Submit one copy of product data for each type of product specified.

.2 Shop Drawings: Submit shop drawings indicating:

.1 Location of seams and edges

.2 Location of columns, doorways, enclosing partitions, built-in furniture, cabinets, and cut-out locations

.3 Samples for Selection: Submit manufacturer's colour charts and samples for initial selection consisting of full range of colours and patterns available for each type of product indicated.

.4 Samples for Verification:

.1 Resilient Flooring: Submit samples of each different specified product for verification of colour and pattern in manufacturer's standard size, but not less than 150mm x 150mm (6" x 6") in size for tile.

- .3 Informational Submittals: Provide the following submittals during the course of the work:
 - .1 Site Quality Control Test Results: Submit results or moisture emission testing of concrete subfloors prior to installation of flooring. Results shall include comparison of manufacturer's recommended moisture content to actual moisture vapour emission rate.
- .4 Maintenance Data and Operating Instructions:
 - .1 Operation and Maintenance Data: Submit manufacturer's written instructions for maintenance and cleaning procedures, include list of manufacturers recommended cleaning and maintenance products, and name of original installer and contact information in accordance with Division 01.
- .5 Safety Data Sheets:
 - .1 Submit WHMIS safety data sheets for incorporation into the Operation and Maintenance Manual. Keep one copy of WHMIS safety data sheets on site for reference by workers.
- .6 Maintenance Materials:
 - .1 Provide five percent (5%) of each colour and type of resilient flooring specified, boxed and labelled.
 - .2 Store maintenance materials on the premises as directed by the Owner.

1.5 QUALITY ASSURANCE

- .1 Contractor executing work of this Section shall have a minimum of five (5) years continuous experience in successful and installation of work of type and quality shown and specified. Submit proof of experience upon Consultant's request.
- .2 Resilient Flooring Installer: Use an installer who is competent in heat welding and have a minimum of five (5) years documented experience in the installation of resilient flooring and seams in accordance with manufacturer's training or certification program.

1.6 DELIVERY, STORAGE, HANDLING AND PROTECTION

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

1.7 ENVIRONMENTAL CONDITIONS

- .1 Temperature of room, floor surface and materials shall not be less than 21 deg C for forty-eight (48) hours before, during and for forty-eight (48) hours after installation. Concrete floors shall be aged for a minimum of twenty-eight (28) days and shall be dry before application of the resilient flooring.
- .2 Moisture content of floor shall not exceed a maximum of 3 lbs. of water per 1,000 sq. ft. of concrete slab area over a twenty-four (24) hour period as measured by one (1) of the following methods, as approved by Consultant:
 - .1 Rubber Manufacturer's Association (RMA) moisture test using anhydrous calcium chloride.
 - .2 Does not exceed 3% as measured by Calcium Carbide Hygrometer procedure.
 - .3 Does not exceed 5% as measured by normal Protimeter.
- .3 Avoid exposure to high humidity, cold drafts and abrupt temperature changes.

1.8 WARRANTY

- .1 Warrant the work of this Section against defects in materials and workmanship in accordance with the General Conditions but for an extended period of five (5) years and agree to repair or replace faulty materials or work which become evident during warranty period without cost to the Owner.
- .2 Defects shall include, but not limited to, bond failure, and extensive colour fading.

2 Products

2.1 MANUFACTURERS

- .1 Basis-of-Design Manufacturers: Manufacturers named in this Section were approved to provide work specified in this Section. Additional manufacturers offering similar products may be incorporated into the work of this Section provided they meet the performance requirements indicated and provided requests for substitution are provided a minimum of five (5) days in advance of Bid Closing.
- .2 Health-Conscious Production: Rubber flooring to be free from red listed ingredients (LBC Red List v4.0) and is manufactured without bisphenol A (BPA), formaldehyde, halogens, heavy metals, isocyanates, phthalates and polyvinyl chloride (PVC). HPD (Health Product Declaration) and EPD (Environmental Product Declaration) available.
- .3 Approved manufacturers:
 - .1 Mondo Flooring
 - .2 Nora Rubber Flooring
 - .3 Tarkett / Johnsonite
 - .4 Or approved equivalent.

2.2 RESILIENT SHEET FLOORING MATERIALS

- .1 Resilient Rubber Sheet Flooring (RES-1): Conforming to ASTM F1859 and the following:
 - .1 Material: prefabricated resilient rubber flooring, calendered and vulcanized with a base of synthetic rubber, stabilizing agents and pigmentation
 - .2 Classification: Homogeneous rubber compound with a random scattered design.
 - .3 Colour: As selected by the Consultant from manufacturers standard product line; allow for 2 colours.
 - .4 Surface: smooth.
 - .5 Dimensions: 10m by 1.9m
 - .6 Thickness: Overall Thickness: Nominal 3mm
 - .7 Surface Burning (CAN/ULC-S102.2): FSC1 of 125 and SD of 370
 - .8 Slip Resistance (ASTM D2047): Static coefficient of friction, Neolite dry 0.8
 - .9 Hardness (ASTM D2240): Shore type "A", 97
 - .10 Basis of Design Material: Mondo Harmonie Rubber Sheet Flooring, or approved equivalent.
- .2 Resilient Rubber Sheet Flooring (RES-2): Conforming to ASTM F1344 and the following:
 - .1 Material: prefabricated resilient rubber flooring, calendered and vulcanized with a base of synthetic rubber, stabilizing agents and pigmentation
 - .2 Classification: Homogeneous rubber compound with a random scattered design.
 - .3 Colour: As selected by the Consultant from manufacturers standard product line; allow for 2 colours.

- .4 Surface: smooth.
- .5 Dimensions: 10m by 1.9m
- .6 Thickness: Overall Thickness: Nominal 3mm
- .7 Surface Burning (CAN/ULC-S102.2): FSC1 of 125 and SD of 370
- .8 Slip Resistance (ASTM D2047): Static coefficient of friction, Neolite dry 0.8
- .9 Hardness (ASTM D2240): Shore type "A", 97
- .10 Basis of Design Material: Mondo Lava Rubber Sheet Flooring, or approved equivalent.

2.3 RUBBER BASE

- .1 Rubber thermoplastic wall base to ASTM F1861 consisting of a blend of a thermoplastic and rubber backing covered with a durable colored top layer
- .2 Dimensions: 107.95mm high x 9.53mm thick x 2440mm lengths
- .3 Colour: To be selected by Consultant from manufacturer's full colour range; allow for 3 colours.
- .4 Surface burning: Class A per ASTM E84/NFPA 253, FSR 50/SDS 175 per CAN/ULC-S102.2
- .5 Acceptable product:
 - .1 Contours, PV4060 #60 Candid by Roppe
 - .2 Equivalent per 01 25 00

2.4 RESILIENT ACCESSORIES

- .1 Trowellable Levelling and Patching Compounds: As indicated in Section 03 35 00.
- .2 Heat Welding Bead: Solid strand product recommended by flooring manufacturer for heat welding seams, and as follows:
 - .1 Colour and Pattern: Colour: As selected by Consultant from manufacturer's full range of colours to contrast with field colour of resilient flooring.
- .3 Fillers and Primers:
 - .1 Types and brands approved, acceptable to flooring material and resilient base manufacturers for the applicable conditions. Use non-shrinking latex compound.
- .4 Resilient Floor Tile Adhesive:
 - .1 Standard Tile: Waterproof, clear setting type and brands as recommended by the tile manufacturer.
- .5 Sealer and Wax:
 - .1 Coordinated with Owners preferred long term maintenance program, sealer or wax as appropriate to flooring materials specified.

3 Execution

3.1 EXAMINATION

- .1 Testing and Inspections: Test moisture emission rate of concrete subfloor prior to installing flooring, using the calcium chloride test method in accordance with ASTM F1869.
- .2 Examine substrates, areas, and conditions affecting work are in accordance with manufacturer's requirements, and as follows:

- .1 Verify that floor surfaces are smooth and flat to plus or minus 3mm over 3m (1/8" over 10'); notify Consultant in writing where floor tolerances are not within acceptable values.
- .2 Verify that concrete slabs exhibit normal alkalinity of between 5 and 9 and that they are free of carbonization or dusting deleterious to flooring installation or adhesive bond.
- .3 Verify that subfloors are free of cracks, ridges, depressions, scale, and foreign deposits that could interfere with flooring installation.

3.2 PREPARATION

- .1 Comply with resilient flooring manufacturer's written installation instructions for preparing substrates indicated to receive flooring.
- .2 Fill cracks, holes, and depressions in substrates using trowellable levelling and patching compounds in accordance with manufacturers written instructions, and as indicated in Section 03 35 00.
- .3 Remove coatings from concrete substrates, including curing compounds and other substances that are incompatible with flooring adhesives, and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer; do not use solvents.
- .4 Broom and vacuum clean substrates immediately before installing resilient flooring.

3.3 INSTALLATION: SHEET FLOORING

- .1 Comply with resilient flooring manufacturer's written installation instructions.
- .2 Unroll flooring and allow stabilizing before cutting and fitting in accordance with manufacturer's installation instructions.
- .3 Apply primer in strict accordance with manufacturer's printed instructions. Permit primer to dry.
- .4 Apply adhesive uniformly with an approved notchooth spreader at the recommended rate. (Mechanical spreader not approved). Do not spread more adhesive than can be covered before initial set takes place. Use waterproof adhesive throughout. Follow manufacturer's instructions.
- .5 Lay flooring with seams parallel to building lines to produce a minimum number of seams. Border widths minimum 1/3 width of full material.
- .6 Run sheets in direction of traffic. Double cut sheet joints and continuously seal heat weld according to manufacturer's printed instructions.
- .7 Accurately scribe flooring around walls, and other floor conditions.
- .8 Each type of material used shall be from one manufacturer throughout the work and material in each area shall be of same production run.
- .9 Install metal edge strips at unprotected or exposed edges where flooring terminates.

3.4 INSTALLATION: BASE

- .1 Ensure substrate/background meets the requirements of ASTM F1861 and Manufacturer Installation Instructions and Technical Data.
- .2 Fill cracks, holes, depressions and irregularities in the substrate/background to prevent transferring through to the surface of the resilient wall base.
- .3 Lay out base to keep number of joints at minimum.
 - .1 Select the appropriate adhesive for the application and job site conditions.
 - .2 Install material according to roll sequence or with like run numbers.

- .3 Ensure material is rolled appropriately into the adhesive using a hand roller.
- .4 Install straight and level to variation of 1:1000.
- .5 Scribe and fit to door frames and other obstructions.
- .6 Conduct initial maintenance prior to final usage per the Manufacturer Care & Maintenance Documents. Do not conduct initial maintenance until adhesive has cured per the adhesive technical data.

3.5 CLEANING AND PROTECTION

- .1 Cleaning, sealing and finishing of resilient flooring in accordance with the manufacturer's instructions and recommendations.
- .2 Work shall be handed over to the Owner free of blemishes and in perfect condition.

END OF SECTION

1 General

1.1 SUMMARY

- .1 Section includes surface preparation and the application of paint systems on the following interior and exterior substrates:
 - .1 Concrete;
 - .2 Concrete masonry units (CMU)
 - .3 Steel and iron;
 - .4 Galvanized metal;
 - .5 Hollow metal doors and frames;
 - .6 Gypsum board;
 - .7 Exterior wood cladding
 - .8 Cotton or canvas insulation covering.

1.2 REFERENCE STANDARDS

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

1.3 DEFINITIONS

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

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

1.4 SUBMITTALS

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

1.5 PROJECT CLOSEOUT SUBMISSIONS

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

1.6 QUALITY ASSURANCE

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

1.7 MOCKUPS

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

1.8 DELIVERY, STORAGE, AND HANDLING

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

1.9 FIELD CONDITIONS

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

1.10 WARRANTY

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

2 Products

2.1 MANUFACTURERS

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

2.2 PAINT, GENERAL

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

2.3 PREPARATORY COATS

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

3 Execution

3.1 EXAMINATION

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

3.2 PREPARATION

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

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

3.3 APPLICATION

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

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

- .1 Colour: Flat (gloss level 1), nonspecular, black.

3.4 FIELD QUALITY CONTROL

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

3.5 CLEANING AND PROTECTION

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

3.6 EXTERIOR PAINTING SCHEDULE

- .1 Galvanized Metal (doors, frames, railings, misc. steel, pipes, overhead decking, ducts, gutters, flashing, etcetera):
 - .1 Latex System - MPI EXT 5.3A:
 - .1 Semi-gloss (MPI Gloss Level 5).
 - .2 Wash Primer/2-Component Aliphatic Polyurethane Finish (High Contact Areas) - MPI EXT 5.3D:
 - .1 Semi-gloss (MPI Gloss Level 5).
- .2 Wood Cladding/Soffits
 - .1 Stain System – MPI EXT 6.4D
 - .1 Semi-transparent stain (MPI Gloss Level 4).

3.7 INTERIOR PAINTING SCHEDULE

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

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

END OF SECTION

1.0 GENERAL

1.1 SECTION INCLUDES

- .1 Natural linoleum pinboard/bulletin board in aluminum frame.

1.2 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with Section 01 33 00 – Submittals.
- .2 Indicate type dimensions, frame materials, bulletin board materials, colour and mounting system.

1.3 SAMPLES

- .1 Submit samples in accordance with Section 01 33 00 – Submittals.
- .2 Submit duplicate 50 x 50 mm samples of colour and finish.

1.4 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver and store products in manufacturer's unopened packaging bearing the brand name and manufacturer's identification until ready for installation.
- .2 Handle materials to avoid damage.

2.0 PRODUCTS

2.1 MATERIALS

- .1 Natural Cork Bulletin boards (BB) to be ¼" (6mm) thick finest quality Krommenie Linoleum cork with burlap backing. Colour to be selected by consultant from full manufacturer range, allow for 2 colours.
 - .1 Basis of design product: Bulletin Board by Forbo or equivalent.
- .2 Accessories
 - .1 Aluminum reveal edge trim
 - .2 Mounting adhesive to manufacturers recommendation
- .3 Glass markerboard (WB) to be low iron, ultra-clear, safety writing glass with polished edges. Non-ghosting, smooth, bright white back finish intended for use with dry-erase markers; wet erase markets can be used but are not recommended.
 - .1 Thickness: ¼ inch (6mm)
 - .2 Edge Profile: Polished.

- .3 Treatment: Fully tempered to comply with ANSI Z97.1 or 16 CFR 1201 criteria for safety glazing.
- .4 Steel back for Magnetic Board: Required.
- .5 Basis of design product: Glass Markerboard by ASI Visual Display Products or approved equivalent.

2.2 SCHEDULE

- .1 Bulletin Board sizes:
 - .1 BB-01 – 2438mm W x 1219mm H
 - .2 BB-02 - 1829mm W x 1219mm H
 - .3 BB-03 – 1219mm W x 915mm H

.2 Bulletin Board Locations/Quantities

Location	Quantity
Corridor 102	1no BB-01 1no BB-02 refer to Corridor elevations for Bulletin board above cubbies
Servery 106	1no BB-02
Staff 105	1no BB-03

- .3 Whiteboard sizes:
 - .1 WB-01 – 36”W x 48”H
 - .2 WB-02 – 96”W x 48”H

.4 Whiteboard Locations/Quantities:

Location	Quantity
Infant Cubbies A1-114	1no WB-01
Toddler A1-111	1no WB-02 1no WB-01
Preschool A1-108	2no WB-02

3.0 EXECUTION

3.1 EXAMINATION

- .1 Verify that substrates are properly prepared to receive visual display boards.
- .2 Do not begin installation until substrates have been properly prepared.
- .3 If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 PREPARATION

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

3.3 INSTALLATION

- .1 Install in accordance with manufacturer's instructions.
- .2 Install bulletin boards level and plumb, keeping perimeter trim aligned in accordance with manufacturer's recommendations.

3.4 ADJUSTING AND CLEANING

- .1 Verify that all accessories are installed as required for each unit.
- .2 Upon completion of installation, clean surfaces and trim in accordance with manufacturer's recommendations, leaving all materials ready for use.

END OF SECTION

PART 1 - GENERAL

1.01 SUMMARY

.1 Section Includes

Furnish, deliver and install all Toilet Partitions as indicated on the drawings and as required by actual conditions at the building. The Toilet Partitions shall include the furnishing of all necessary screws, special screws, bolts, special bolts, expansion shields and all other devices necessary for the proper installation and application of the Toilet Partitions.

1.02 REFERENCES

.1 ASTM International (ASTM):

.1 ASTM A167 - Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.

.2 American National Standards Institute (ANSI):

.2 ANSI A117.1 - Accessible and Usable Buildings and Facilities Standards.

.3 National Electrical Manufacturers Association (NEMA):

.3 NEMA LD3 - High Pressure Decorative Laminates.

1.03 SUBMITTALS

.1 Make all submittals in accordance with Section: 01 33 00

.2 Submit detailed shop drawings. Drawings must clearly indicate all methods of attachment at floor/ceiling/walls.

.3 Submit product sheets and/or catalogue cuts, of all products listed in the shop drawings.

.4 Samples

1. Upon request, a returnable sample of the Toilet Partitions shall be submitted to the Consultant/Owner for approval not later than (10) days after requested. All samples must be properly identified including: name of supplier, and name of manufacturer.

.5 Operations and Maintenance Data

1. Provide closeout documents in accordance with Specification 01 78 00.

2. Include at a minimum documentation relating to proper care of toilet partitions, such as required lubrications, adjustments, cleaning, etc

1.04 QUALITY ASSURANCE

.1 Supplier Qualifications

1. Toilet Partition shop drawings and Toilet Partitions shall be procured from a source of supply approved by the Consultant/Owner/Architect. Supplier is responsible for the complete Toilet Partition subcontract.

1.05 DELIVERY, STORAGE AND HANDLING

.1 Marking and Packaging

1. Toilet Partitions must be delivered to the job site in the manufacturers' original packages and marked to correspond with the approved shop drawings.

.2 Delivery

1. Toilet Partitions must be delivered in an amount of time deemed appropriate by the Consultant/Owner.

1.06 WARRANTY

.1 Written Guarantee

1. The Toilet Partition manufacturer shall guarantee all Toilet Partitions by written certification, for a period of (5) years from date of certified substantial performance of the project, against any defects in design, materials and workmanship. Any defects as described will be made good by the manufacturer at no additional cost to the owner.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

.1 Approved Manufacturers/Products

1. Bobrick Washroom Equipment of Canada Ltd, Sierra Series
2. ASI Watrous/Global Toilet Partitions, Thru Colour Phenolic Partitions
3. Equivalent as per Spec 01 25 00.

2.02 MATERIALS

.1 Solid Color Reinforced Composite (SCRC) Toilet Partition Screens.

.1 Design Type: Wall Hung

- .1 Screen height: 1200mm H x 800mm W complete with custom radius
- .2 Floor Clearance: 200mm

.2 Mounting Brackets:

- .1 18 gauge (1.2mm) stainless steel brackets to extend full height of panel and securely fasten privacy screen to backup wall.
- .2 Stainless steel pilaster support bracket consisting of floor mounted circular flange, circular post and u-bracket to support leading edge of privacy screen. Acceptable product: Jacknob #1057838503

.3 Materials: Solid color reinforced composite (SCRC) material for stiles, panels, doors, and screens with anti-graffiti coating, thermoset and integrally fused into homogenous piece; high density polyethylene (HDPE), not acceptable.

- .1 Composition: Dyes, organic fibrous material, and polycarbonate/phenolic resins.
- .2 Surface Treatment: Non-ghosting, graffiti resistant surface integrally bonded to core through a manufacturing steps requiring thermal and mechanical pressure.
- .3 Edges: Same color as the surface.
- .4 Color: As selected by Architect from manufacturer's standard colour range.
- .5 Acceptable SCRC Products: Or manufacturer approved equal.
 - .1 Ultimate Corian System by Shower Shapes.
 - .2 WilsonArt Gibraltar Material.
 - .3 WilsonArt EarthStone Material.

.4 Performance Requirements:

- .1 Graffiti Resistance (ASTM D 6578): Passed cleanability test; 5 staining agents.
- .2 Scratch Resistance (ASTM D 2197): Maximum load value exceeds 10 kilograms.
- .3 Impact Resistance (ASTM D 2794): Maximum impact force exceeds 30 inch-pounds.
- .4 Smoke Developed Index (ASTM E 84): Less than 450.
- .5 Flame Spread Index (ASTM E 84): Less than 75.

- .6 National Fire Protection Association/International Building Code Interior Wall and Ceiling Finish: Class B.
- .7 Uniform Building Code: Class II.

PART 3 - EXECUTION

3.01 EXAMINATION

- .1 Site Preparation
 - 1. The contractor must examine all site conditions that would prevent the proper application and installation of Toilet Partitions. Any defect must be immediately identified and corrected, prior to the installation of the Toilet Partitions.

3.02 INSTALLATION

- .1 Mounting Locations
 - 1. All Toilet Partitions must be mounted according Manufacturers standard locations and those specified on the drawings.

3.03 FIELD QUALITY CONTROL

- .1 Inspection
 - 1. After installation has been completed, provide for a site inspection of all Toilet Partitions to determine that all items have been supplied and installed as per the enclosed details. Also, check the operation and adjustment of all Toilet Partitions. Any discrepancies, or malfunctioning product, must be reported to the Architect immediately.

3.04 ADJUSTMENT AND CLEANING

- .1 Final Preparation
 - 1. At final completion, Toilet Partitions shall be left clean and free from disfigurement. Make all final adjustments. Where Toilet Partitions are found defective, repair or replace or otherwise correct as directed.

3.05 PROTECTION

- .1 Site Protection
 - 1. The Contractor must provide for the proper protection of all Toilet Partitions until the owner accepts the project as complete.

3.06 TOILET PARTITION SCHEDULE

- .1 Schedule
 - 1. Provide Toilet Partitions as specified in all above sections and as per the detailed Architectural Drawings.

END OF SECTION

1.0 GENERAL

1.1 REFERENCES

- .1 CAN/CGSB-44.40-[92], Steel Clothing Locker.

1.2 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with Section 01 33 00 – Submittals.
- .2 Indicate type and class of locker, thicknesses of metal, fabricating and assembly methods, assembled banks of lockers, tops, rods, hooks, shelves, bases, trim, numbering, filler panels, end/back panels, doors, handles, locking method, ventilation method, finishes.

1.3 SAMPLES

- .1 Submit samples in accordance with Section 01 33 00 – Submittals.
- .2 Submit duplicate 50 x 50 mm samples of colour and finish on actual base metal.

2.0 PRODUCTS

2.1 MANUFACTURED UNITS

- .1 Approved Manufacturers:
 - .1 Emperor Lockers by Hadrian Manufacturing
 - .2 ASI Storage Solutions
 - .3 Deluxe Series Lockers by Shannahan's
 - .4 Or approved equivalent as per Section 01 25 00.
- .2 Size:
 - .1 Locker type 1 (double tier): 15" wide x 18" deep x 72" high.
- .3 Assembly: knock down construction
 - .1 Sides and backs shall be no less than 22-gauge and should not contain extra unnecessary holes unless otherwise specifically used for the assembly of the lockers and accessories on the project.
 - .2 Edges shall be formed to provide a strong and rigid assembly when bolted or riveted together Locker backs are flanged at right angles providing a triple thickness of metal at the back corner connections.

- .4 Doors: double pan design consisting of 20ga outer panel welded to 24ga inner panel with 1" cell honeycomb core, continuous 14ga piano hinge, door swing Right Hand Reverse. Provide magnet at latch to keep door in closed position.
- .5 Accessories: 20ga hat shelf, 3 single prong coat hooks, 4" tall pedestal base, flat top, 11ga hasp for trouble free use with standard padlock
- .6 Finish: high grade epoxy polyester powder finish, colour to be determined by consultant from manufacturer's standard colour range.

2.2 SCHEDULE

- .1 Provide lockers as scheduled in the following quantities:
 - .1 Staff Room 150: 3no locker type 1 (double tier/6 total lockers).

3.0 EXECUTION

3.1 INSTALLATION

- .1 Assemble and install lockers in accordance with manufacturer's written instructions.
- .2 Safely and securely anchor all lockers properly to walls and/or floors as required. Use fasteners appropriate to load and the substrate.
- .3 Provide continuous sealant between wall and locker – see specification 07 90 00 for sealant.
- .4 Install finished end panels to exposed ends of locker banks.

END OF SECTION

PART 1. GENERAL

1.1 SUMMARY

- .1 This section includes toilet and bath accessories in accordance with the Contract Documents. The Work of this Section shall include but not be limited to the following:
 1. Surface, partition and recessed mounted toilet and bath accessories indicated on the Drawings and Schedules.
- .2 Related work:
 - .1 Wall backing required to secure accessories
 - .2 Glazing
 - .3 Tile
 - .4 Toilet compartments
 - .5 Unit masonry
 - .6 Gypsum wallboard systems
 - .7 Plumbing fixtures
 - .8 Countertops

1.2 SUBMITTALS

- .1 Comply with requirements of Section regarding submittals.
- .2 Provide required number copies of:
 - .1 Product data sheets.
 - .2 Installation instructions.
 - .3 Service and parts manual

1.3 WORK INCLUDED

- .1 Toilet Room Accessories

1.4 REFERENCES (INCLUDING BUT NOT LIMITED TO)

- .1 Ontario Building Code (latest edition)

1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

- .1 Deliver items in manufacturer's original unopened protective packaging.
- .2 Store materials in original protective packaging to prevent physical damage or wetting.
- .3 Handle so as to prevent damage to accessories.

1.6 WARRANTY

- .1 Furnish one year guarantee against defects in material and workmanship on all accessories.
- .2 In addition to the above the following shall apply:
 - .1 Welded stainless steel framed mirrors shall have a fifteen year guarantee against silver spoilage.

PART 2. PRODUCTS

2.1 TOILET ROOM ACCESSORIES SCHEDULE

- .1 Provide the following toilet and bath accessories in the locations indicated on the drawings/schedules:

Type	Model/Series	Description
W1	Bobrick B-290 1830 Or approved equivalent	18"x24" Mirror, 1 lavatory and/or as shown on drawings
W2	Bobrick B-293 1830 Or approved equivalent	18" x 30" Fixed Position Tilt Mirror, 1 per accessible lavatory
W3	Frost 109-60S Paper Towel Dispenser	Front loading, stainless steel finish, complete with tumbler lock. Quantities/locations as scheduled.
W4	Bobrick B-4112 Soap Dispenser, Frost 708A Soap Dispenser, Or approved equivalent	Liquid push-in valve, 1.2L/40 fl oz. capacity, keyed lock filler cap at top, plastic soap level indicator window, 20-gauge stainless steel with all mounting screws concealed. 1 per lavatory and/or as shown on drawings
W5	Bobrick B-4288 Toilet tissue dispenser Or approved equivalent	Vertical double-roll type, surface mounted, capacity of 2 standard core toilet tissue roles up to 133mm dia., keyed access with stainless steel finish
W6	Bobrick B-6806.99 Horizontal grab bar Or approved equivalent	1.214mm (0.048") thickness; 765mm (30") long x 32mm (1-1/4") Ø, straight, stainless steel, slip resistant grip, concealed mounting, cap secured with vandal resistant set screws.
W7	Bobrick B-6898.99 L-shaped grab bar Or approved equivalent	1-1/2" (38mm) diameter stainless steel type-304 with satin-finish, concealed mounting, vandal resistant set screws.
W8	Dyson Airblade V HU02 Or approved equivalent	Sprayed nickel finish, surface mounted hand dryer, ADA compliant, 120V. Quanty: 1 per universal WC.
W9	Bobrick B-254 Sanitary Napkin Disposal Or approved equivalent	Stainless steel finish, surface mounted, pivoting self-closing lid with continuous hinge. Napkin disposal image embossed on lid.
W10	Frost 950-18 Or approved equivalent	Stainless Steel Shelf, 1 per Universal WC
W11	Bobrick B277 Or approved equivalent	Wall-mounted waste disposal (1 per WC typ., 2 per Preschool WC 143)
W12	Jonti-Craft Changing Table with Stairs – Item Code: 5131	Prefabricated change table, complete with retractable access stairs. Left or right stairs as per drawings.

2.2 MATERIALS

- .1 All cabinets shall be steel construction with white epoxy powder finish.
- .2 All tumbler locks to be fastened to accessories with lock nuts. Fastening locks to units with spring clips is not acceptable

PART 3. EXECUTION

3.1 INSPECTION

- .1 Check wall open for dimensions, plumbness of blocking or frames that would affect installation of recessed accessories. For surface mounted accessories check condition of wall and confirm installation of backing within wall.
- .2 Verify spacing of plumbing fixtures and toilet compartments that affect installation of toilet room accessories.

3.2 INSTALLATION

- .1 Install accessories at locations and heights indicated, straight, plumb and level and in accordance with manufacturer's installation instructions.
- .2 Install items with non-corrosive anchoring devices.
- .3 Installation methods shall conform to manufacturer's recommendations for backing and proper support.
- .4 Conceal evidence of drilling, cutting, and fitting to room finish.
- .5 Fit flanges of accessories snugly to wall surfaces.

3.3 ADJUSTMENT AND CLEANING

- .1 Upon completion of the work, or when directed, remove all traces of protective coatings or paper.
- .2 Adjust accessories for proper operation. Test mechanisms, hinges, locks and latches and where necessary adjust and lubricate.
- .3 Clean and polish exposed surfaces prior to final installation.
- .4 Deliver accessories schedule, keys, and parts manual as part of project closeout documents. For owner's permanent records, provide two sets of the following items of manufacturer's literature:
 - .1 Technical data sheets of each item used for the project.
 - .2 Service and parts manuals.
 - .3 Name of local representative to be contacted in the event of need of field service or consultation.

END OF SECTION

PART 1 - GENERAL

1.1 SECTION INCLUDES

- .1 Manually operated, roll-up fabric interior solar window shades including mounting and operating hardware.
- .2 Quick release blackout blinds for interior sidelights, screens and vision panels for quick deployment during lockdown procedures.

1.2 REFERENCES

- .1 All window coverings offered must meet the HAZARDOUS PRODUCTS ACT, Regulation SOR/2009-112, Sep 8, 2009 - Corded Window Covering Products Regulations
- .2 All window coverings offered must meet the CSA Z600-08 - Safety of Corded Window Covering Products standard including but not limited to meeting the product safety requirements of section 4 and the labeling and information requirements of section 5

1.3 SUBMITTALS

- .1 Submit under provisions of Section 01 33 00 - Submittal Procedures:
- .2 Product Data: Manufacturer's data sheets on each product specified, including:
 - .1 Preparation instructions and recommendations.
 - .2 Installation and maintenance instructions.
 - .3 Styles, material descriptions, dimensions of individual components, profiles, features, finishes and operating instructions.
 - .4 Storage and handling requirements and recommendations.
 - .5 Mounting details and installation methods.
- .3 Window Treatment Schedule: For all roller shades. Use same room designations as indicated on the Drawings, field verified window dimensions, quantities, type of shade, controls, fabric, and color, and include opening sizes and key to typical mounting details.
- .4 Verification Samples: For each finish product specified, two complete sets of shade components, unassembled, demonstrating compliance with specified requirements. Shade fabric sample and aluminum finish sample as selected, representing actual product, color, and patterns. Mark face of material to indicate interior faces.
- .5 Maintenance Data: Methods for maintaining roller shades, precautions regarding cleaning materials and methods, instructions for operating hardware and controls.
- .6 Manufacturer's Certificates: Certify products meet or exceed specified requirements.

1.4 DELIVERY, STORAGE, AND HANDLING

- .1 Do not deliver window shades until building is enclosed and construction within spaces where shades will be installed is substantially complete.
- .2 Deliver products in manufacturer's original, unopened, undamaged containers with labels intact.
- .3 Label containers and shades according to Window Shade Schedule.
- .4 Store products in manufacturer's unopened packaging until ready for installation.

1.5 SEQUENCING

- .1 Ensure that locating templates and other information required for installation of products of this section are furnished to affected trades in time to prevent interruption of construction progress.
- .2 Ensure that products of this section are supplied to affected trades in time to prevent interruption of construction progress.

1.6 PROJECT CONDITIONS

- .1 Install roller shades after finish work and ambient temperature, humidity and ventilation conditions are maintained at levels recommended for project upon completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- .1 SOLARFECTIVE/LEGRAND.
- .2 HUNTER DOUGLAS CANADA.
- .3 Equivalent products as per 01 25 00.

2.2 MANUALLY OPERATED SOLAR WINDOW SHADES

- .1 Manually Operated Window Shades with Independent Control: Manually operated, vertical roll-up, fabric window shade with components necessary for complete installation.
 - .1 Operation: Bead chain and clutch operating mechanism allowing shade to stop when chain is released. Designed never to need adjustment or lubrication. Provide limit stops to prevent shade from being raised or lowered too far.
 - .1 Clutch mechanism: Fabricated from high carbon steel and molded fiberglass reinforced polyester or injected molded nylon.
 - .2 Bead chain loop: Stainless steel bead chain hanging at side of window.
 - .3 Idler Assembly: Provide roller idler assembly of molded nylon with adjustable length idler pin to facilitate easy installation, and removal of shade for service.
 - .2 Mounting:
 - .1 Mounting brackets.
 - .2 Endcaps and headbox.
 - .3 Roller Tube: Fabricated from extruded aluminum, galvanized steel, or enameled steel. Diameter, wall thickness, and material selected by manufacturer to accommodate shade type and size. Fabric connected to the roller tube with LSE (low surface energy) double sided adhesive specifically developed to attach coated textiles to metal. Adhesive attachment to eliminate horizontal impressions in fabric.
 - .4 Endcaps: Stamped steel with universal design suitable for mounting to ceiling, wall, and jamb. Provide size compatible with roller size.
 - .1 Endcap covers: To match fascia or headbox color.
 - .5 Brackets: Plated stamped steel. Provide size compatible with roller size.
 - .1 Mounted to wall.
 - .6 Coupling system: Provide system to operate shades from single crank by coupling shade rollers together. System to consist of endcaps, plus couplings to connect rollers.
 - .1 2 shades operated from single control when indicated on drawings.
 - .7 Fascia/back fascia: aluminum extrusion to conceal shade roller and hardware from both interior and exterior sides.
 - .1 Attachment: Snaps onto endcaps without requiring exposed fasteners of any kind. Fascia can be mounted continuously across two or more shade bands.
 - .2 Finish: Clear anodized.

2.3 SOLAR SHADE FABRIC

- .1 Light Filtering Fabrics

-
- .1 Shade cloth shall be woven of .018 opaque, vinyl coated polyester yarn consisting of approximately 79% vinyl and 21% 500 denier polyester core yarn. The fabric shall be tensioned in the finishing range prior to heat setting to keep the warp ends straight and minimize or eliminate weave distortion to keep the fabric flat. The fabric shall be dimensionally stable. Colour to be as selected from standard range.
 - .2 Average 3% open.
 - .2 Performance – As a “shade cloth” the fabric shall hang flat without buckling or distortion. The edge, when trimmed, shall hang straight without raveling. An unguided roller shade Cloth shall roll true and straight, without shifting sideways more than +1/8” in either direction due to warp distortion, or weave design.
 - .3 Flame Retardance - Fabric shall be certified by an Independent Laboratory to pass the Small Scale Vertical Burn Requirements test CAN and ULC-S109-M87 and NFPA 701.
 - .4 The fabric supplied shall be GREENGUARD certified or approved equivalent.
- 2.4 QUICK RELEASE BLACKOUT SHADES (FOR USE DURING LOCKDOWN)
- .1 A high quality, NFPA 701 compliant blackout fabric roll with weighted hem-bar, rolled and held with a velcro tab which allows the shade to drop into place when released.
 - .1 Basis of design product: Hideaway Helper Lockdown Shade by School Safety Solution or equivalent per specification 01 25 00.
- 2.5 SCHEDULE
- .1 Provide solar rollershades at the following locations:
 - .1 New exterior windows type W1, W2, W3, W4 & W5
 - .2 New interior screen S2
 - .2 Provide lockdown blackout shades at the following locations:
 - .1 Sidelight at Door Type C (all locations)

PART 3 - EXECUTION

3.1 EXAMINATION

- .1 Do not begin installation until substrates have been properly prepared.
- .2 If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 PREPARATION

- .1 Coordinate requirements for blocking and structural supports to ensure adequate means for installation of window shades.

3.3 INSTALLATION

- .1 Install in accordance with manufacturer's instructions.
- .2 Install roller shades level, plumb, square, and true. Allow proper clearances for window operation hardware.
- .3 Install the following items to conceal roller and operating mechanism. Do not use exposed fasteners.
 - .1 Fascias.
 - .2 Closure panels.
 - .3 Endcaps.

3.4 TESTING AND DEMONSTRATION

- .1 Test window shades to verify that operating mechanism, fabric retainer, and other operating components are functional. Correct deficiencies.
- .2 During daylight hours, lower shades and turn off interior lights. Verify that there are no light leaks at perimeter or within shade assembly. Correct deficiencies.

3.5 PROTECTION

- .1 Protect installed products until completion of project.
- .2 Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION

PART 1 - GENERAL

1.1 General Instructions

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

1.2 Section Includes:

- .1 Custom Counters
- .2 Bulkheads/Valance/Wall Panels

1.3 Quality Assurance

- .1 Execute Work of this Section only by a Subcontractor who has adequate plant, equipment, and skilled workers to perform Work expeditiously, and is known to have been responsible for satisfactory installations similar to that specified during a period of at least the immediate past five years.

1.4 Reference Standards

- .1 Do welding work in accordance with CSA W59-M1989 unless specified otherwise.
- .2 Weld structural components in steel, to conform to requirements of CSAW59-M1989, and by a fabricator fully certified by the Canadian Welding Bureau to conditions of CSA Standard W47.1 and W55.3 as applicable.

1.5 Design Criteria

- .1 Work of this Section which functions to resist forces imposed by dead and liveloads shall conform to requirements of jurisdictional authorities.

1.6 Shop Drawings

- .1 Submit shop drawings in accordance with Section 01 33 00.
- .2 Clearly indicate materials, core thicknesses, finishes, connections, joints, method of anchorage, number of anchors, supports, reinforcement, details, and accessories.
- .3 Shop drawings shall be sealed by a qualified professional engineer licensed to designs structures and registered in Place of the Work

1.7 Delivery, Storage and Handling

- .1 Label, tag or otherwise mark Work supplied for installation by other Sections to indicate its function, location in building and shop drawing designation.
- .2 Protect Work from damage during delivery, storage and handling

PART 2 - PRODUCTS

2.1 Materials

- .1 General:
 - .1 Unless detailed or specified otherwise, standard products will be acceptable if construction details and installation meet intent of Drawings and Specifications.
 - .2 Include materials, products, accessories, and supplementary parts necessary to complete assembly and installation of Work of this Section.
 - .3 Incorporate only metals that are free from defects which impair strength or durability, or which are visible. Install only new metals of best quality, and free from rust or waves and buckles, and that are clean, straight, and with sharply defined profiles.
 - .4 All Stainless Steel to be type 304, brushed S Finish, analysis 18-8.

- .2 Metals:
 - .1 Stainless Steel millwork to be as follows:
 - .1 14 GA. (1.8mm) S/S for sinks & countertops, column cladding, baseboards.
 - .2 18 GA. (1.2mm) S/S for body & liners
 - .3 16 GA. (1.5mm) S/S for shelving
 - .4 20 GA. S/S for wall panels
 - .3 Finishes:
 - .1 Brushed Stainless Steel "Blend S" type finish.
 - .2 Fastenings: stainless steel

2.2 Fabrication

- .1 General:
 - .1 Fabricate Work of this Section with machinery and tools specifically designed for intended manufacturing processes and by skilled workers.
 - .2 Fit and assemble Work in shop. When this is not possible make a trial shop assembly.
 - .3 Incorporate anchors at 610 mm (24") o/c or as otherwise required for secure attachment for metal fabrications located in cast-in-place concrete.
 - .4 Incorporate means for fastenings of other Work secured to Work of this Section.
- .2 Construction:
 - .1 Fabricate Work with materials, component sizes, metal gauges, reinforcing, anchors, and fasteners of adequate strength to withstand intended use, and within allowable design factors imposed by jurisdictional authorities. Fabricate items from steel unless otherwise noted.
 - .2 Ensure that Work will remain free of warping, buckling, opening of joints and seams, distortion, and permanent deformation to expansion and contraction forces and loads.
 - .3 Construct items that are part of floor construction, such as gratings and trench covers to support same live loads for which surrounding floors are designed unless indicated otherwise.
 - .4 Drill drainage holes at exterior steel fabrications to permit drainage of trapped moisture.
- .3 Assembly:
 - .1 Accurately cut, machine and fit joints, corners, copes and miters so that junctions between components fit together tightly and in true planes.
 - .2 Fasten Work with concealed methods unless otherwise indicated on Drawings.
 - .3 Weld connections where possible, bolt where not possible, and cut off bolts flush with nuts. Countersink bolt heads, and provide method to prevent loosening of nuts. Ream holes drilled for fastenings.
 - .4 Grind welds smooth where exposed to view.
 - .5 Provide for differential movements within assemblies and at junctions of assemblies with surrounding Work.
- .4 Finish work:
 - .1 Incorporate holes and connections for Work installed under other Sections of this Specification.
 - .2 Cleanly and smoothly finish exposed edges of materials including holes.
 - .3 Cap open ends of sections exposed to view, such as pipes, channels, angles, and other similar Work.
 - .4 Machine or grind floor plates, gratings, covers, or their bearings to provide level support.

PART 3 - EXECUTION

-
- 3.1 Examination
- .1 Take site measurements to ensure that Work is fabricated to fit surrounding construction, around obstructions and projections in place, or as shown on Drawings, and to suit service locations.
- 3.2 Installation
- .1 Install Work plumb, true, square, straight, level, and accurately and tightly fitted together and to surrounding Work and as required for proper performance.
- .2 Include with Work of this Section anchor bolts, high tensile bolts, washers and nuts, expansion bolts, toggles, straps, sleeves, brackets, clips, and other items necessary for secure installation as required by loading and jurisdictional authorities. Weld to CAN/CSA-S16.1-94.
- .3 Countersink holes provided for wood screws where wood is attached to Work of this Section.
- .4 Attach Work to interior concrete and masonry with corrosion resistant expansion bolts to support load with a safety factor of three (3).
- .5 Attach Work to exterior concrete and masonry with non-shrink epoxy grout to support load with a safety factor of three (3).
- .6 Insulate between dissimilar metals or between metal, and masonry or concrete with bituminous paint to prevent electrolytic action.
- .7 Grout metal posts, pickets, balusters, and the like, in metal sleeves cast into concrete, with non-shrink quick setting epoxy anchor cement, unless detailed otherwise. Fabricate sleeves of 75 mm (3") minimum depth.
- .8 Hand items over for casting into concrete or building into masonry to appropriate trades together with setting templates.
- 3.3 Adjustment and Cleaning
- .1 Remove damaged, dented, defaced, defectively finished, or tool marked components and replace with new.
- 3.4 Protection
- .1 Maintain protection of Work of this Section from time of installation until final finishes are applied or to final cleanup.
- .2 Protect prime and finish painted and galvanized surfaces from damage.

END OF SECTION

Mechanical and Electrical Specifications

Issued for Tender
January 14, 2025

**CONSEIL SCOLAIRE VIAMONDE – ECOLE ELEMENTAIRE
RENAISSANCE – CHILDCARE ADDITION**

1226 Lockhart Road
Burlington, Ontario

Consultant:
Quasar Consulting Group

250 Rowntree Dairy Road
Woodbridge, ON, L4L 9J7
Tel: 905.507.0800
Fax: 905.507.0081
Web: www.quasarcg.com

QCG Project No. ED-22-018

February 2023

PROCUREMENT AND CONTRACTING REQUIREMENTS GROUP

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28 01 80.71	Revisions and Upgrades of Fire Detection and Alarm	9
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Division 29

Not Used

SITE AND INFRASTRUCTURE SUBGROUP

Not Used

PROCESS EQUIPMENT SUBGROUP

Not Used

End of Document

1 General

1.01 SECTION INCLUDES

- .1 This Section specifies products, criteria and characteristics, and methods and execution that are common to one or more Sections of Mechanical Divisions. It is intended as a supplement to each Section and is to be read accordingly.

1.02 REFERENCES

- .1 Division 00 and Division 01 apply to and are a part of each Mechanical Division:
 - .1 Division 21 – Fire Suppression;
 - .2 Division 22 – Plumbing;
 - .3 Division 23 – Heating, Ventilating, and Air Conditioning;
 - .4 Division 25 – Integrated Automation.

1.03 SUBMITTALS

- .1 Submit shop drawings/product data sheets for:
 - .1 pressure gauges and thermometers;
 - .2 electric motors (submit with equipment they are associated with).
- .2 Submit weight loads for selected equipment (upon request).
- .3 Submit copy of architectural reflected ceiling plan drawings and elevation drawings to indicate proposed access door locations.
- .4 Submit a list of equipment identification nameplates indicating proposed wording and sizes.
- .5 Submit a list of pipe and duct identification colour coding and wording.
- .6 Submit a proposed valve tag chart and a list of proposed valve tag numbering and identification wording.
- .7 Submit drawings indicating size and location of required sleeves, recesses and formed openings in poured or precast concrete work.
- .8 Submit any other submittals specified in this Section or other Sections of Mechanical Divisions.

1.04 MAINTENANCE MATERIAL SUBMITTALS

- .1 As specified in Part 2 of this Section, submit a spare belt set, tagged and identified, for each belt driven piece of equipment.

2 Products

2.01 PIPE SLEEVES

- .1 Galvanized Sheet Steel – Minimum #16 gauge galvanized steel with an integral flange at one end to secure sleeve to formwork construction.
- .2 Polyethylene – Factory fabricated, flanged, high density polyethylene sleeves with reinforced nail bosses.

- .3 Waterproof Galvanized Steel Pipe – Schedule 40 mild galvanized steel pipe with a welded-on square steel anchor and water stop plate at sleeve midpoint.
- .4 Galvanized Steel or Cast Iron Pipe – Schedule 40 mild galvanized steel, or Class 4000 cast iron.

2.02 FIRESTOPPING AND SMOKE SEAL MATERIALS

- .1 Firestopping and smoke seal system materials for mechanical penetrations through fire rated construction are specified in Section 20 05 17 - Sleeves and Sleeve Seals for Mechanical Piping, and work is to be done as part of mechanical work unless otherwise specified in Division 07.

2.03 WATERPROOFING SEAL MATERIALS

- .1 Modular, mechanical seal assemblies consisting of interlocking synthetic rubber links shaped to continuously fill annular space between pipe and pipe sleeve or wall opening, assembled with stainless steel bolts and pressure plates and designed so when bolts are tightened the links expand to seal the opening watertight. Select seal assemblies to suit pipe size and sleeve size or wall opening size.
- .2 Manufacturers:
 - .1 Thunderline Corp. (Power Plant Supply Co.) "LINK SEAL" Model S-316;
 - .2 The Metraflex Co. "MetraSeal" type ES.

2.04 PIPE ESCUTCHEON PLATES

- .1 One-piece chrome plated brass or #4 finish type 302 stainless steel plates with matching screws for attachment to building surface, each plate sized to completely cover pipe sleeve or building surface opening, and to fit tightly around pipe or pipe insulation.

2.05 PIPING HANGERS AND SUPPORTS

- .1 Pipe hanger and support materials, including accessories, are to be, unless otherwise specified, in accordance with Manufacturers Standardization Society (MSS) Standard Practice Manual SP-58, Pipe hangers and Supports-Materials, Design and Manufacture, and where possible, MSS designations are indicated with each product specified below. Conform to following requirements:
 - .1 unless otherwise specified, ferrous hanger and support products are to be electro-galvanized;
 - .2 hangers and supports for insulated piping are to be sized to fit around insulation and insulation jacket.
- .2 Hangers and supports for horizontal suspended piping as follows:
 - .1 adjustable steel clevis hanger – MSS Type 1;
 - .2 adjustable swivel ring band hanger – MSS Type 10;
 - .3 adjustable roller hanger – MSS Types 41, 43, and/or 45, with MSS Type 39 steel protection saddle.
- .3 Supports for horizontal pipe on vertical surfaces as follows:
 - .1 steel offset pipe clamp – Anvil Fig. 103 or Myatt Fig. 170;
 - .2 heavy-duty steel pipe clip – MSS Type 26;
 - .3 single steel pipe hook – Myatt Fig. 156;

- .4 epoxy coated steel pipe stays are not permitted.
- .4 Floor supports for vertical risers as follows:
 - .1 copper tubing riser clamp – MSS Type 8;
 - .2 heavy-duty steel riser clamp – MSS Type 8.
- .5 Supports for vertical piping on vertical surfaces as follows:
 - .1 steel offset pipe clamp – Anvil Fig. 103 or Myatt Fig. 170;
 - .2 heavy-duty steel pipe bracket or soil pipe bracket – MSS Type 26;
 - .3 extension split pipe clamp – MSS Type 12;
 - .4 epoxy coated steel pipe stays are not permitted.
- .6 Base support for vertical risers in excess of 6 m (20') high extending out from base mounted equipment is to consist of a base elbow support with flange.
- .7 For horizontal pipe on racks, Unistrut or equal galvanized steel pipe racks with pipe securing hardware as follows:
 - .1 standard galvanized steel U-bolts/clamps supplied by rack manufacturer;
 - .2 adjustable roller chair – MSS Type 44 with MSS Type 39 steel protection saddle.
- .8 Special hangers and supports for various applications as follows:
 - .1 vibration isolated riser supports – black steel riser clamps as specified above, complete with neoprene–steel–neoprene sandwich type vibration isolation pads between clamp and floor;
 - .2 for groups of pipes having same slope – MSS Type 32 welded steel brackets, Anvil Fig. 46 universal trapeze assemblies, or Unistrut or equal support assemblies, all with U-bolts, clamps, etc., to secure pipes in place;
 - .3 for sections of piping connected to vibration isolated equipment – hangers and supports as specified above but complete with MSS Type 48 spring cushions;
 - .4 for piping on existing roof – Portable Pipe Hangers (Canada) Inc. "PP" Series prefabricated portable pipe support system components to suit pipe, complete with required accessories including bases, galvanized structural steel frames, and galvanized steel pipe hangers and supports conforming to MSS SP-58;
 - .5 for piping on new roofs – Lexcor "Flash-Tite" or Thaler Roofing Specialties Products Inc. "MERS" Series insulated aluminum support risers with diameter, height, securement method and flashing to suit the application, channel type aluminum cross members, and galvanized steel pipe hangers and supports conforming to MSS SP-58, complete with all required accessories;
 - .6 for glass drain and vent piping – special padded hangers supplied by pipe supplier;
 - .7 for plastic piping – generally as specified above but in accordance with pipe manufacturer's recommendations;
 - .8 for fire protection piping – generally as above but ULC listed and/or FM approved, and in accordance with Chapter requirements of NFPA Standard applicable to piping system;
 - .9 for bare horizontal copper piping – generally as above but factory vinyl coated to prevent direct copper/steel contact;

- .10 for bare copper vertical piping – corrosion resistant ferrous clamps with flexible rubber gasket type material (not tape) to isolate pipe from clamp;
- .11 insulation protection shields to and including 40 mm (1-½") dia. – MSS Type 40 galvanized steel shields with ribs to keep shield centred on hanger.
- .9 Hanger rods are to be electro-galvanized carbon steel (unless otherwise specified), round, threaded, to ASTM A36, complete with captive machine nuts with washers at hangers, sized to suit loading in accordance with Table 3 in MSS SP-58, but in any case minimum 9.5 mm (3/8") diameter.
- .10 Manufacturers:
 - .1 E. Myatt & Co. Inc.;
 - .2 Anvil International Inc.;
 - .3 Empire Industries Inc.;
 - .4 Hunt Manufacturing Ltd.;
 - .5 Unistrut Canada Ltd.;
 - .6 Nibco Inc. "Tolco";
 - .7 Taylor Pipe Supports.

2.06 ACCESS DOORS

- .1 Provide all access doors required for Mechanical work unless otherwise specified in Division 08. Coordinate consistency of look and finish of access doors on project with each Division of Work. Coordinate exact requirements with General Trades Contractor.
- .2 Access doors to be rust resistant steel door panels, with concealed hinges and positive locking and self-opening screwdriver operated lock. Wall type frame to be suitable for wall installation and have integral keys for plaster walls. Doors in tile wall to be stainless steel and in ceilings to be suitable for plaster covering with only frame joint showing. Other doors to be prime painted steel.
- .3 Size access doors to suit the concealed work for which they are supplied, and wherever possible they are to be of standard size for all applications, but in any case they are to be minimum 300 mm x 300 mm (12" x 12") for hand entry and 600 mm x 600 mm (24" x 24") for body entry.
- .4 Lay-in type tiles, properly marked, may serve as access panels. Coordinate marking of ceiling tiles with Consultant. Panels in glazed tile walls to be 12 gauge, 304 alloy stainless steel, No. 4 finish, with recessed frame secured with stainless steel counter-sunk flush head screws.
- .5 Panels in plaster surfaces to have dish-shaped door and welded metal lath, ready to take plaster. Provide a plastic grommet for door key access.
- .6 Other access doors to be welded 12 gauge steel, flush type with concealed hinges, lock and anchor straps, complete with factory prime coat. Submit to Consultant for review, details of non-standard door construction details.
- .7 Access doors in fire rated ceilings, walls, partitions, structures, etc., to be ULC listed and labelled and of a rating to maintain fire separation integrity.
- .8 Where access doors are located in surfaces where special finishes are required, they are to be of a recessed door type capable of accepting finish in which they are to be installed so as to maintain final building surface appearance throughout.
- .9 Manufacturers:

- .1 Le Hage.
- .2 SMS.
- .3 Pedlar.
- .4 Acudor.

2.07 PRESSURE GAUGES AND THERMOMETERS

- .1 Pressure gauges as follows:
 - .1 adjustable, glycerine filled, 100 mm or 115 mm (4" or 4-½") diameter and each accurate to within 1% of scale range;
 - .2 type 304 stainless steel case with relief valve and polished stainless steel bayonet;
 - .3 stainless steel rotary movement with stainless steel bushings and socket;
 - .4 clear acrylic window;
 - .5 dual scale white dial with a scale range such that working pressure of system is at approximate mid-point of scale;
 - .6 black pointer.
- .2 Pressure gauge accessories and additional requirements as follows:
 - .1 a bronze ball type shut-off valve is to be provided in the piping to each pressure gauge;
 - .2 each pressure gauge for piping and equipment with normal everyday flow is to be equipped with a brass pressure snubber;
 - .3 each pressure gauge for steam piping or steam equipment is to be equipped with a steel coil syphon;
 - .4 pressure gauges in fire protection piping must be ULC listed and labelled;
- .3 Thermometers as follows:
 - .1 round, 125 mm (5") diameter, adjustable (90°) angle bimetal dial type thermometers, each accurate to within 1% of full scale;
 - .2 hermetically sealed stainless steel case with stainless steel ring;
 - .3 dampened bimetal coil;
 - .4 calibration adjustment screw;
 - .5 white aluminum dual scale dial with black and blue markings and a range such that working temperature of system is approximate mid-point of the scale;
 - .6 black aluminum pointer;
 - .7 double strength glass window;
 - .8 12 mm (½") NPT connection with 6.4 mm (¼") diameter stainless steel stem;
 - .9 suitable thermowell.

- .4 Manufacturers:
 - .1 H.O. Trerice Co.;
 - .2 Weiss Instruments;
 - .3 Ashcroft.

2.08 EQUIPMENT BELT DRIVES

- .1 ANSI/RMA Standard V-belt type rated at minimum 1.5 times motor nameplate rating, and in accordance with following requirements:
 - .1 belts are to be reinforced cord and rubber, and multiple belts are to be matched sets;
 - .2 sheaves are to be cast iron or steel, secured to shafts with removable keys unless otherwise specified, standard adjustable pitch ($\pm 10\%$ range) for motors under 10 HP, fixed pitch type with split tapered bushing and keyway for motors 10 HP and larger, and, if required, replaced as part of mechanical work to suit system air/water quantity testing and balancing work;
 - .3 motor slide rail adjustment plates are to allow for centre line adjustment.
- .2 Supply a spare belt set (tagged and identified) for each belt drive and hand to Owner upon Substantial Performance of the Work.

2.09 EQUIPMENT DRIVE GUARDS AND ACCESSORIES

- .1 For V-belt drives – removable, 4-sided, fully enclosed, galvanized sheet steel guards to OSHA standards, cleaned, factory primed and painted with yellow equipment enamel, complete with a 2-piece full length hinged front panel to permit belt maintenance or replacement without removing guard, and 40 mm (1-½") diameter tachometer openings at each shaft location.
- .2 For flexible couplings – removable "U" shaped galvanized steel guards to OSHA Standards with a 2.3 mm (3/32") thick frame and expanded mesh face.
- .3 For unprotected fan inlets and outlets – unless otherwise specified, removable 20 mm (¾") galvanized steel wire mesh with galvanized steel frames, all to OSHA Standards.

2.10 ELECTRIC MOTORS

- .1 Unless otherwise specified, motors are to conform to NEMA Standard MG1, applicable IEEE Standards, and applicable CSA C22.2 Standards, and are to meet NEMA standards for maximum sound level ratings under full load. Confirm motor voltages prior to ordering.
- .2 Vertically mounted and submersible motors are to be purposely designed for mounting in this attitude.
- .3 Efficiency of 1-phase motors to 1 HP is to be in accordance with CAN/CSA C747. Efficiency of 3-phase motors 1 HP and larger is to be in accordance with CAN/CSA C390 or IEEE 112B.
- .4 Unless otherwise specified, 1-phase motors smaller than ½ HP are to be 115 volt, continuous duty capacitor start type with an NEMA 48 or 56 frame size, solid base, heavy-gauge steel shell with solid die-cast end shields, dynamically balanced die-cast rotor, integral automatic reset thermal overload protection, Class "B" insulation, and a 1.15 service factor at 40°C (105°F) ambient temperature.
- .5 Explosion-proof 1-phase motors are to be totally enclosed, fan cooled, 115 volt continuous duty capacitor start type in accordance with CSA C22.2 No. 145, as specified for standard 1-phase motors but suitable for use in Class 1 Group D hazardous locations and complete with a rolled steel shell and a 1.0 service factor at 40°C (105°F) ambient temperature.

- .6 Unless otherwise specified, motors ½ HP and larger are to be totally enclosed, fan cooled, 3-phase, T-frame, squirrel cage continuous duty induction motors suitable for voltages indicated on Drawings, NEMA Design "B" for normal starting torque or Design "C" for high starting torque as required by the application, each complete with Class "B" insulation, a 1.15 service factor at 40°C ambient temperature, grease lubricated open ball bearings with grease fittings to permit re-lubrication without dismantling motor, a cast iron frame with cast iron feet where required, cast iron end bracket and precision machined bearing fit, and balanced carbon steel shaft assembly with die-cast aluminum rotor windings.
- .7 Explosion-proof 3-phase motors are to be totally enclosed fan cooled motors in accordance with CSA C22.2 No. 145, generally as specified above for standard 3-phase motors but suitable for use in Class 1 Group D hazardous locations and with a 1.0 service factor at 40°C (105°F) ambient temperature.
- .8 Motor(s) for 2-speed cooling tower(s) are to be as specified above but 2-speed single winding type.
- .9 Motor(s) for 2-speed fan(s) are to be as above but 2-speed double winding type.
- .10 Unless otherwise indicated, motors 30 HP and larger are to be complete with a heat sensing PTC thermistor in the end turn of stator winding for each phase and connected in series inside motor with 2 marked leads brought out to motor conduit box.
- .11 Motors for equipment with variable frequency drives are to be generally as specified above but inverter duty type to NEMA Standard MG-1 Part 31, quantified by CSA for operation from a variable frequency drive of type specified, and complete with Class "H" insulation. Motors are to be equipped with AEGIS, or approved equal, shaft grounding ring system to protect bearings from damage by diverting harmful shaft voltages and bearing currents to ground.
- .12 Motors 150 HP and larger with "wye-delta" reduced voltage starters are to be complete with six leads for connection to motor starter.
- .13 Motors for equipment which is scheduled or specified with a corrosion resistant coating or constructed from corrosion resistant materials are to be factory coated with a primer and epoxy paint finish.
- .14 Manufacturers:
 - .1 TECO-Westinghouse Motors (Canada) Inc.;
 - .2 Canadian General Electric;
 - .3 Baldor Electric Co.;
 - .4 U.S. Electrical Motors;
 - .5 Weg Electric Corp.;
 - .6 Marathon Electric;
 - .7 Toshiba Corp.;
 - .8 Leeson Canada.

2.11 MOTOR STARTERS AND ACCESSORIES

- .1 Motor starters must be capable of starting associated motors under the imposed loads. Confirm starter voltage matches motor prior to ordering.
- .2 Unless otherwise specified, starters for 1-phase motors are to be 115 volt, thermal overload protected manual starting switches with a neon pilot light, a surface or recessed enclosure to suit the application, and, where automatic operation is required, a separate H-O-A switch in an enclosure to match starter enclosure.

- .3 Unless otherwise specified, starters for 3-phase motors less than 50 HP are to be combination "quick-make" and "quick-break" fused disconnects and full voltage non-reversing across-the-line starters, each complete with and overload relay per phase, an enclosure to suit the application, and, a H-O-A switch, pilot lights, control transformer, auxiliary contacts, and other accessories as per motor starter schedule.
- .4 Unless otherwise specified, starters for 3-phase motors 50 HP to 150 HP are to be reduced voltage, non-reversing, auto-transformer type starters complete with one overload relay per phase, an enclosure to suit the application, and, a H-O-A switch, pilot lights, control transformer, auxiliary contacts, and other accessories as per motor starter schedule.
- .5 Unless otherwise specified, starters for 3-phase motors 150 HP and larger are to be reduced voltage, non-reversing, closed transition "wye-delta" starters complete with one overload relay per phase, an enclosure to suit the application, and, a H-O-A switch, pilot lights, control transformer, auxiliary contacts, and other accessories as per motor starter schedule.
- .6 Starters for 2-speed double winding motors are to be generally as specified above but suitable for motor and equipped with a 45 second time delay to permit equipment to coast down to low speed before it is operated at low speed.
- .7 Starters for 2-speed single winding motors are to be generally as specified above but suitable for motor and equipped with a 45 second time delay to permit equipment to coast down to low speed before it is operated at low speed.
- .8 Starters for reversible motors for cooling towers are to be generally as specified above but suitable for motor and equipped with a 45 second time delay to allow fan(s) to coast down to a stop before being operated in reverse rotation.
- .9 Unless otherwise specified, motor starter enclosures are to be in accordance with following NEMA ratings:
 - .1 enclosures located in sprinklered areas – Type 2;
 - .2 enclosures exposed to the elements – Type 3R, constructed of stainless steel;
 - .3 enclosures inside the building in wet areas – Type 3R, constructed of stainless steel;
 - .4 enclosures in explosion rated area – Type 7 with exact requirements to suit the area and application;
 - .5 enclosures except as noted above – Type 1;
 - .6 enclosures located in finished areas – as above but recess type with brushed stainless steel faceplate.
- .10 Motor control centres are to be multi-unit, 2.28 m (9') high, NEMA Class 1, type "B", factory assembled, dead front, floor mounted, free-standing motor control centre with tin plated copper bus and an NEMA Type 1 or Type 2 enclosure as for loose starters specified above. Each motor control centre is to be complete with starters as specified above, load and control wiring terminal boards, and required facilities for line and load side power wiring connections.
- .11 Disconnect switches for motor control centres are to be heavy-duty, CSA certified, front operated switches as per motor starter schedule, each complete with a handle suitable for padlocking in "off" position and arranged so that door cannot be opened with handle in "on" position and an NEMA enclosure as specified for loose starters. Fusible units are to be complete with fuse clips to suit fuse types specified below.
- .12 Fuses are to be, unless otherwise scheduled or specified, English Electric Ltd. HRC fuses, Form I Class "J" for constant running equipment and Form II Class "C" for equipment that cycles on and off.

- .13 Manufacturers:
 - .1 Rockwell Automation Inc. - Allen-Bradley;
 - .2 Eaton Corp. – Cutler-Hammer;
 - .3 Eaton Corp. – Moeller Electric;
 - .4 Siemens Canada;
 - .5 Schneider Electric.

2.12 SPRINKLER PROOFING

- .1 Provide drip shields for protection of surface mounted equipment enclosures from water spray and dripping of liquids. Features of shields include:
 - .1 factory constructed by respective equipment manufacturers;
 - .2 constructed from non-combustible materials (sheet steel);
 - .3 enamel painted to match equipment;
 - .4 surfaces and edges filled/sanded smooth prior to painting;
 - .5 supported from equipment with structural steel rods/metal framing or other method approved by Consultant;
 - .6 structural support finish painted to match shield.
- .2 Include with equipment shop drawings, detailed dimensions of drip shields and methods of supporting.
- .3 Equipment with top cable/conduit entries to include additional sealing of entries with gasketing and/or waterproof sealant to prevent water from entering enclosure.
- .4 Design ventilation louvers such that live components are not exposed to water spray and dripping liquids.
- .5 Above requirements are additional minimum "sprinkler proof" standards for equipment specified as NEMA 1, 2 or 12.
- .6 Obtain CSA approval where required by local governing authorities.

2.13 MECHANICAL WORK IDENTIFICATION MATERIALS

- .1 Confirm with the Owner if an existing mechanical work identification system is in place and, if so, match accordingly.
- .2 If an existing mechanical work identification system is not in place, the following is to be used:
 - .1 Equipment nameplates are to be minimum 1.6 mm (1/16") thick 2-ply laminated coloured plastic plates, minimum 12 mm x 50 mm (½" x 2") for smaller items such as damper motors and control valves, minimum 25 mm x 65 mm (1" x 2-½") for equipment, and minimum 50 mm x 100 mm (2" x 4") for control panels and similar items. Additional requirements are as follows:
 - .1 unless otherwise specified or required, each nameplate is to be white, complete with bevelled edges and black engraved wording to completely identify equipment and its use with no abbreviations;
 - .2 wording is generally to be as per drawings, i.e. Fan EF-1, and is to include equipment service and building area/zone served, but must be reviewed prior to engraving;

- .3 supply stainless steel screws for securing nameplates in place;
- .4 nameplates for equipment suspended above floor level or generally not within easy viewing from floor level are to be increased in size so as to be easily readable from floor level.
- .2 Valve tags are to be coloured, 40 mm (1-½") square, 2-ply laminated plastic with bevelled edges, red-white, green-white, yellow-black, etc., to match piping identification colour, each complete with a 3.2 mm (1/8") diameter by 100 mm (4") long brass plated steel bead chain, and four lines of engraved maximum size identification wording, i.e.:

VALVE V12 200 mm (8") CHILL. WATER NORMALLY OPEN

- .3 Standard pipe identification is to be equal to Smillie McAdams Summerlin Ltd., Brady or Primark Manufacturing Inc. vinyl plastic with indoor/outdoor type vinyl ink lettering and directional arrows, as follows:
 - .1 for pipe less than or equal to 150 mm (6") diameter, coiled type snap-on markers of a length to wrap completely around pipe or pipe insulation;
 - .2 for pipe larger than 150 mm (6") diameter, saddle type strap-on markers with 2 opposite identification locations and complete with nylon cable ties.
- .4 Identification wording and colours for pipe identification materials are to be as follows:

PIPE SERVICE	IDENTIFICATION COLOUR	LEGEND
domestic cold water	green	DOM. COLD WATER
domestic hot water supply	green	DOM. HW SUPPLY
domestic hot water recirculation	green	DOM. HW RECIRC.
tempered domestic water	green	TEMP. DOM. WATER
chilled drinking water	green	CH. DRINK WTR.
storm drainage	green	STORM
sanitary drainage	green	SAN.
plumbing vent	green	SAN. VENT
acid sanitary drainage	yellow	ACID DRAIN
acid drainage vent	yellow	ACID VENT
fire protection standpipe	red	F.P. STANDPIPE
fire protection sprinklers	red	F.P. SPRINKLER
natural gas	to Code	to Code, c/w pressure
natural gas vent	to Code	to Code
propane gas	to Code	to Code, c/w pressure
propane gas vent	to Code	to Code
fuel oil supply	yellow	FUEL OIL SUPPLY

PIPE SERVICE	IDENTIFICATION COLOUR	LEGEND
fuel oil return	yellow	FUEL OIL RETURN
fuel oil vent	yellow	FUEL OIL VENT
heating water supply	yellow	HTG. WTR. SUPPLY
heating water return	yellow	HTG. WTR. RETURN
heating water drain	yellow	HTG. WTR. DRAIN
glycol heating supply	yellow	GLY. HTG. SUPPLY
glycol heating return	yellow	GLY. HTG. RETURN
glycol heating drain	yellow	GLY. HTG. DRAIN
glycol heat reclaim return	yellow	GLY. HTG. RECLAIM R.
glycol heat reclaim supply	yellow	GLY. HTG. RECLAIM S.
heat pump geothermal loop – source side supply	green	GEO. LOOP SOURCE SUPPLY
heat pump geothermal loop – source side return	green	GEO. LOOP SOURCE RETURN
heat pump geothermal loop – load side supply	green	GEO. LOOP LOAD SUPPLY
Heat pump geothermal loop – load side return	green	GEO. LOOP LOAD RETURN
condenser water supply	green	COND. WTR. SUPPLY
condenser water return	green	COND. WTR. RETURN
chilled water supply	green	CH. WTR. SUPPLY
chilled water return	green	CH. WTR. RETURN
chilled water drain	green	CH. WTR. DRAIN
low pressure steam	yellowkPa STEAM
medium pressure steam	yellowkPa STEAM
high pressure steam	yellowkPa STEAM
low pressure condensate	yellow	L.P. CONDENSATE
medium pressure condensate	yellow	M.P. CONDENSATE
high pressure condensate	yellow	H.P. CONDENSATE
pumped condensate	yellow	PUMPED CONDENSATE
steam vent	yellow	STEAM VENT
boiler feedwater	yellow	BLR. FEEDWATER
boiler blowdown	yellow	BLR. BLOW-OFF
refrigerant suction	yellow	REFRIG. SUCTION
refrigerant liquid	yellow	REFRIG. LIQUID
refrigerant hot gas	yellow	REFRIG. HOT GAS

PIPE SERVICE	IDENTIFICATION COLOUR	LEGEND
diesel engine exhaust	yellow	ENGINE EXHAUST
gasoline	yellow	GASOLINE
distilled water	green	DISTILL. WATER
demineralized water	green	DEMIN. WATER
compressed air (< 700 kPa)	greenkPa COMP. AIR
compressed air (>700 kPa)	yellowkPa COMP. AIR
control air	green	CONTROL AIR

- .5 Colours for pipe identification legends and directional arrows are to be as follows:

IDENTIFICATION COLOUR	LEGEND & ARROW COLOUR
yellow	black
green	white
red	white

- .6 Duct identification is to be custom made Mylar stencils with 50 mm (2") high lettering to accurately describe duct service, i.e. "AHU-1 SUPPLY", complete with a directional arrow, and coloured ink with ink pads and roller applicators. Ink colour is generally to be black but must contrast with lettering background.

2.14 FLEXIBLE PIPING CONNECTORS

- .1 Double wall stainless steel flexible connectors for piping connections to vibration isolated equipment, each selected by manufacturer to suit the application. Shop drawings or product data sheets must indicate construction and performance requirements that suit the application.
- .2 Manufacturers:
- .1 Hispan Precision Products Inc.;
 - .2 Senior Flexonics Ltd.;
 - .3 The Metraflex Co.

3 Execution

3.01 GENERAL PIPING AND DUCTWORK INSTALLATION REQUIREMENTS

- .1 Unless otherwise specified, locate and arrange horizontal pipes and ducts above or at ceiling on floors, arranged so that under consideration of all other work in area, maximum ceiling height and/or usable space is maintained. If required to maintain ceiling heights, reroute and/or resize ductwork, with Consultant's approval.
- .2 Unless otherwise specified, install work concealed in finished spaces, and concealed to degree possible in partially finished and unfinished spaces. Refer to and examine Architectural drawings and room finish schedules to determine finished, partially finished, and unfinished areas. Walls which are painted are considered finished.
- .3 Install pipes and ducts parallel to building lines and to each other.

- .4 Neatly group and arrange exposed work.
- .5 Locate work to permit easy access for service or maintenance as required and/or applicable. Locate valves, dampers and any other equipment which will or may need maintenance or repairs and which are to be installed in accessible construction so as to be easily accessible from access doors. Where valves, dampers and similar piping or ductwork accessories occur in vertical services in shafts, pipe spaces or partitions, locate accessories at floor level.
- .6 Make connections between pipes of different materials using adapters suitable for application. Provide cast brass dielectric type adapters/unions at connections between ferrous and copper pipe.
- .7 Comply with equipment and material manufacturer's installation instructions unless otherwise specified herein or on drawings, and unless such instructions contradict governing codes and regulations.
- .8 Carefully clean ducts, pipe and fittings prior to installation. Temporarily cap or plug ends of pipe, ducts and equipment which are open and exposed during construction.
- .9 Install piping and ductwork which are to be insulated so that they have sufficient clearance to permit insulation and finish to be applied continuously and unbroken around pipe or duct, except for ductwork at fire barriers, in which case insulation will be terminated at each side of the duct fire damper.
- .10 Inspect surfaces and structure prepared by other trades before performing work. Verify surfaces or structure to receive work has no defects or discrepancies which could result in poor application or cause latent defects in installation and workmanship. Report defects in writing. Installation of work will constitute acceptance of such surfaces as being satisfactory.
- .11 Any ferrous piping that exhibits in excess of 5% surface rust, either inside or outside or both, is to be wire brush cleaned to bare metal and coated with suitable primer. Steel pipe, fittings and accessories are to be free of corrosion and dirt when work is complete or prior to being concealed from view. Where dirt is evident, clean piping prior to being concealed.
- .12 For factory applied finishes, repaint or refinish surfaces damaged during shipment and installation. Quality of repair work is to match original finish. This requirement also applies to galvanized finishes.
- .13 Where mechanical work is located in high humidity areas where ferrous metal products will be subject to corrosion and protection for such products is not specified, provide finishes on products to protect against corrosion or provide products which will not corrode in the environment, i.e. aluminium ductwork, copper or stainless steel pipe, etc.
- .14 Provide screwed unions or flanges in piping connections to equipment and in regular intervals in long (in excess of 12 m (40')) piping runs to permit removal of sections of piping.
- .15 Unless otherwise specified and except where space limitations do not permit, piping elbows are to be long radius. Eccentric reducers are to be installed with straight side at top of piping.

3.02 PIPE JOINT REQUIREMENTS

- .1 Do not make pipe joints in walls or slabs.
- .2 Ream piping ends prior to making joints.
- .3 Properly cut threads in screwed steel piping and coat male threads only with Teflon tape or paste, or an equivalent thread lubricant. After pipe has been screwed into fitting, valve, union, or piping accessory, not more than 2 pipe threads are to remain exposed.
- .4 Site bevel steel pipe to be welded or supply mill bevelled pipe. Remove scale and oxide from bevels and leave smooth and clean. Use factory made welding tees or welding outlet fittings for piping branches off mains. Do not use shop or site fabricated fittings unless written approval has been obtained.

- .5 Welded joints are to be made by CWB certified licensed journeyman welders qualified in accordance with CSA B51, Boiler Pressure Vessel and Pressure Piping Code, and who are in possession of a proper certificate of qualification for each procedure to be performed. Each weld is to be identified with the welder's identification symbol, and welds are not to be concealed until they have been inspected and approved. Electrodes are to be in accordance with CSA W48 Series, Electrodes, and requirements of CAN/CSA W117.2, Safety in Welding, Cutting and Allied Processes are to be followed.
- .6 Unless otherwise specified, make flanged joints with Garlock 5500 or equivalent gasket materials to suit the application, and bolts and nuts. Bolts are not to be longer than length necessary to screw nut up flush to the end of bolt. Bolts used for flanged connections in piping with a working pressure of 690 kPa (100 psi) and greater are to be ASTM A-193 Grade B-7, with heavy hexagon nuts to ASTM A-194 CL-2H. Provide suitable washers between each bolt head and flange and between each nut and flange.
- .7 A random check of bolted flanged connections will be made to verify flanged connections are properly mated with no shear force acting on bolts. Supply labour to disconnect and reconnect selected flanged joints. If improperly mated joints are found, remove and reinstall affected piping so flanges mate properly. If improperly mated joints are found, additional joints will be checked, and you will be responsible for the repair of any other improper joints discovered.
- .8 Unless otherwise specified make soldered joints in copper piping using flux suitable for and compatible with type of solder being used. Clean the outside of pipe end and inside of fitting, valve, or similar accessory prior to soldering.
- .9 Install mechanical joint fittings and couplings in accordance with manufacturer's instructions.
- .10 Grooves are to be rolled. Make arrangements with coupling and fitting manufacturer for shop and/or site instructions and demonstrations as required, and adhere to manufacturer's instructions with respect to pipe grooving, support, type of gasket required, anchoring and guiding the grooved piping system.
- .11 If pressure crimped couplings and fittings are used, ensure gaskets are fully compatible with piping fluid, and valves and piping accessories are suitable. Use only fitting manufacturer supplied crimping equipment. Comply with manufacturer's latest published specification, instructions, and recommendations with respect to pipe, coupling, and fitting preparation and installation, and support, anchoring and guiding of the piping system.
- .12 Solvent weld PVC piping in 2 parts, primer stage and cementing stage, in accordance with manufacturer's recommendations, ASTM D2855, and CSA requirements.
- .13 Install PVC piping with gasketed joints in accordance with manufacturer's current published specifications, instructions and recommendations, and CSA requirements.

3.03 INSTALLATION OF PIPE SLEEVES

- .1 Where pipes pass through concrete and/or masonry surfaces provide pipe sleeves as follows:
 - .1 in poured concrete slabs – unless otherwise specified, minimum 16 gauge flanged galvanized steel or, where permitted by governing authorities, factory fabricated plastic sleeves;
 - .2 in concrete or masonry walls – Schedule 40 galvanized steel pipe or Class 4000 cast iron pipe.
- .2 Sleeves in waterproofed slabs or walls are to be lengths of Schedule 40 mild galvanized steel pipe with a waterstop plate in accordance with drawing detail. Provide waterproof sleeves in following locations:
 - .1 in mechanical room floor slabs, except where on grade;
 - .2 in slabs over mechanical, fan, electrical and telephone equipment rooms or closets;
 - .3 in floors equipped with waterproof membranes;

- .4 in roof slab;
- .5 in waterproof walls.
- .3 Size sleeves, unless otherwise specified, to leave 12 mm (½") clearance around pipes, or where pipe is insulated, a 12 mm (½") clearance around pipe insulation.
- .4 Pack and seal void between pipe sleeves and pipe or pipe insulation in non-fire rated construction for the length of sleeves as follows:
 - .1 pack sleeves in interior construction with mineral wool and seal both ends of sleeves with non-hardening silicone base caulking compound;
 - .2 pack sleeves in exterior walls above grade with mineral wool and seal both ends of sleeves water-tight with approved non-hardening silicone base caulking compound unless mechanical type seals have been specified;
 - .3 seal sleeves in exterior walls below grade (and any other wall where water leakage may be a problem) with link type mechanical seals as specified.
- .5 Where sleeves are required in masonry work, accurately locate and mark sleeve location, and hand sleeves to mason for installation.
- .6 Terminate piping for sleeves that will be exposed so sleeve is flush at both ends with building surface so sleeve may be completely covered by an escutcheon plate, except for sleeves in waterproof floors which are to terminate 100 mm (4") above finished floor.
- .7 "Gang" type sleeving will not be permitted.
- .8 Where sleeves are provided in non-fire rated construction for future piping, or where piping has been removed from existing sleeves, cap and seal both ends of sleeved opening.

3.04 INSTALLATION OF WATERPROOF MECHANICAL SEALS

- .1 Provide watertight link type mechanical seals in exterior wall openings.
- .2 Assemble and install each mechanical seal in accordance with manufacturer's instructions.
- .3 After installation, periodically check each mechanical seal installation for leakage and, if necessary, tighten link seal bolts until seal is completely watertight.

3.05 DUCT OPENINGS

- .1 Duct openings, air inlet and outlet openings, fire damper and similar openings will be provided in new poured concrete work, masonry, drywall and other building surfaces by trade responsible for particular construction in which opening is required.
- .2 Size openings for fire dampers to suit damper arrangement with folding blade out of air stream.
- .3 For duct openings except where fire dampers are required, pack and seal space between duct or duct insulation and duct opening as specified above for pipe openings in non-fire rated construction.

3.06 SLEEVE AND FORMED OPENING LOCATION DRAWINGS

- .1 Prepare and submit for review, drawings indicating size and location of required sleeves, recesses and formed openings in poured or precast concrete work.
- .2 Such drawings are to be completely and accurately dimensioned and relate sleeve, recesses, and formed openings to suitable grid lines and elevation datum, and are to take into account structural items such as grade beams, column caps, and column drop slabs.

- .3 Begin to prepare such drawings immediately upon notification of acceptance of bid and award of Contract.

3.07 INSTALLATION OF PIPE ESCUTCHEON PLATES

- .1 Provide escutcheon plates suitably secured over exposed piping passing through finished building surfaces. A finished building surface is any surface with a factory finish or that receives a site applied finish.
- .2 Install plates so they are tight against building surface concerned, completely covering pipe sleeves and/or openings, except where waterproof sleeves extend above floors, in which case fit plate tightly around sleeve.

3.08 INSTALLATION OF FASTENING AND SECURING HARDWARE

- .1 Provide fastening and securing hardware required for mechanical work to maintain installations attached to structure or to finished floors, walls and ceilings in a secure and rigid manner capable of withstanding dead loads, live loads, superimposed dead loads, and any vibration of installed products.
- .2 Use fasteners compatible with structural requirements, finishes and types of products to be connected. Do not use materials subject to electrolytic action or corrosion where conditions are liable to cause such action.
- .3 Where floor, wall or ceiling construction is not suitable to support loads, provide additional framing or special fasteners to ensure proper securement to structure that is to support the products. Provide reinforcing or connecting supports where required to distribute loading to structural components.
- .4 Obtain written consent before using explosive actuated fastening devices. If consent is obtained, comply with requirements of CAN/CSA Z166.1 and CAN/CSA Z166.2.
- .5 Do not attach fasteners to steel deck without written consent from Consultant.

3.09 INSTALLATION OF PIPE HANGERS AND SUPPORTS

- .1 Provide required pipe hangers and supports.
- .2 Provide any additional structural steel channels, angles, inserts, beam champs and similar accessories required for hanging or supporting pipe. Unless otherwise shown or specified, hang or support pipes from structure only.
- .3 For insulated pipe, size hanger or support to suit diameter of insulated pipe and install hanger or support on outside of insulation and insulation finish.
- .4 Support requirements for underground piping are as follows:
 - .1 support underground pipe, unless otherwise specified, on a well compacted bed of dry, natural, undisturbed earth free from rocks or protrusions of any kind, or on compacted material as specified;
 - .2 support underground service piping penetrating building exterior walls or foundations to prevent pipe damage if minor building settlement occurs;
 - .3 ensure bedding and supports for underground pipes are flat and true and allowances are made for pipe hubs, couplings, or other protrusions so no voids are left between pipe and bedding.
- .5 Unless otherwise shown or specified, hang and/or support horizontal pipe above ground by means of hangers and/or supports specified in Part 2 of this Section. Unless otherwise shown or specified, hangers for suspended pipe less than or equal to 25 mm (1") dia. are to be clevis type or adjustable ring type, and hangers for suspended pipe greater than or equal to 40 mm (1-½") dia. are to be adjustable clevis type.

- .6 Space hangers and supports in accordance with following:
- .1 cast iron pipe – hang or support at every joint with maximum 2.4 m (8') spacing;
 - .2 plastic pipe – conform to pipe manufacturer's recommended support spacing;
 - .3 glass pipe – conform to pipe manufacturer's recommended support spacing and support requirements;
 - .4 copper and steel pipe – hang or support at spacing in accordance with following schedule:

PIPE DIA.	MAX. SPACING STEEL (meters)	MAX. SPACING COPPER (meters)
to 25 mm (1")	2.4 m (8')	1.8 m (6')
40 mm (1-½")	2.7 m (9')	2.4 m (8')
50 mm (2")	3.0 m (10')	2.7 m (9')
65 mm (2-½")	3.6 m (12')	3.0 m (10')
75 mm (3")	3.6 m (12')	3.0 m (10')
90 mm (3-½")	3.6 m (12')	3.6 m (12')
100 mm (4")	4.2 m (14')	3.6 m (12')
250 mm (10")	6.0 m (20')	
300 mm (12")	6.7 m (22')	

- .5 flexible grooved pipe/coupling joint piping – as above but with not less than one hanger or support between joints;
- .7 Where pipes change direction, either horizontally or vertically, provide a hanger or support on horizontal pipe not more than 300 mm (12") from elbow, and where pipes drop from tee branches, support tees in both directions not more than 50 mm (2") on each side of tee.
- .8 When pipes with same slope are grouped and a common hanger or support is used, space hanger or support to suit spacing requirement of smallest pipe in group and secure pipes in place on common hanger or support.
- .9 Provide roller hangers or supports for heat transfer piping greater than or equal to 150 mm (6") diameter and conveying a material 75°C (170°F) or greater to facilitate pipe movement due to expansion and contraction, and at each hanger or support tack weld a steel protection saddle to pipe to protect piping insulation.
- .10 Unless otherwise shown or specified, support vertical piping by means of supports specified in Part 2 of this Section, spaced in accordance with following:
 - .1 support vertical pipes at maximum 3 m (10') intervals or at every floor, whichever is lesser;
 - .2 for sections of vertical piping with a length less than 3 m (10'), support pipe at least once;
 - .3 for vertical cast iron plain end pipe (mechanical joint type), secure riser or pipe clamp around pipe under a flange integral with pipe for vertical support purposes, or provide a length of hub and spigot pipe to facilitate proper support;
 - .4 for vertical steel pipe risers in excess of 3 m (10'), weld shear lugs to pipe to carry load;

- .5 for vibration isolated piping risers, provide rubber-steel-rubber vibration isolation pads between riser clamps and floor.
- .11 Support piping on the roof as follows:
 - .1 on existing roof – provide support members as specified in Part 2 of this Section spaced as per schedule above and of a type to suit the application, and, for each support, carefully scrape away roofing gravel, bed support in a heavy covering of roofing mastic, then scrape gravel back up around support and secure pipes to supports;
 - .2 on new roof – supply manufactured roof supports as per Part 2 of this Section to accommodate piping involved and support spacing specified above, and hand supports to roofing trade on roof for installation as part of roofing work, then secure piping in place on supports.
- .12 Each hanger, support or securement for horizontal bare copper tubing is to be plastic coated to prevent direct contact between pipe and ferrous hanger. Each wall or floor clamp for vertical bare copper piping is to be isolated from pipe by means of strips of flexible rubber inserts. Use of painted ferrous hangers and supports, including those painted with copper coloured paint, is not acceptable. Site application of tape or other types of isolation is not acceptable.
- .13 For insulated horizontal piping less than or equal to 40 mm (1-½") diameter, provide galvanized steel insulation protection shields between insulation and hanger or support. Install shields immediately after pipe is insulated.
- .14 Do not support piping from steel deck without written consent from Consultant.

3.10 SUPPLY OF ACCESS DOORS

- .1 Supply access doors to give access to mechanical work which may need maintenance or repair but which is concealed in inaccessible construction, except as otherwise specified herein or on drawings.
- .2 Before commencing installation of mechanical work, coordinate with other trades and prepare on a set of reflected ceiling plans and wall elevations, complete layouts of access doors. Submit these layouts for Consultant's review and show exact sizes and locations of such access doors. Locate and arrange mechanical work to suit.
- .3 Access doors will be installed by trade responsible for particular type of construction in which doors are required. Supply access doors to trade installing same at proper time.
- .4 Wherever possible, access doors to be of a standard size for each application. Confirm exact dimensions and minimum size restrictions with Consultant prior to ordering.
- .5 Group piping and ductwork to ensure minimum number of access doors is required.
- .6 Coordinate with Electrical Contractor and General Trades Contractor to ensure access doors on project are provided by a single manufacturer, installed as part of work of General Trades Contractor and work involving both mechanical and electrical services should, where possible, be accessible from common access door. Coordinate work to ensure common location access doors are not supplied by both Mechanical Divisions and Electrical Divisions.

3.11 INSTALLATION OF VALVES

- .1 Generally, valve locations are indicated or specified on drawings or specified in Sections of the Specification where valves are specified, however, regardless of locations shown or specified, following requirements apply:
 - .1 provide shut-off valves to isolate systems, at base of vertical risers, in branch take-offs at mains and risers on floors, to isolate equipment, to permit work phasing as required, and wherever else required for proper system operation and maintenance;

- .2 install shut-off valves with handles upright or horizontal, not inverted, and located for easy access;
- .3 unless otherwise specified, provide a check valve in discharge piping of each pump;
- .4 valve sizes are to be same as connecting pipe size;
- .5 valves are to be permanently identified with size, manufacturer's name, valve model or figure number and pressure rating, and wherever possible, valves are to be product of same manufacturer;
- .6 for valves in insulated piping, design of valve stem, handle and operating mechanism is to be such that insulation does not have to be cut or altered in any manner to permit valve operation.

3.12 INSTALLATION OF PRESSURE GAUGES AND THERMOMETERS

- .1 Provide pressure gauges in following locations where applicable:
 - .1 in valved tubing across suction, suction strainer (if applicable), and discharge piping of each circulating pump;
 - .2 in supply and return piping connections to main mechanical plant equipment such as boilers, chillers, heat exchangers, main coils, etc.;
 - .3 in expansion tank(s);
 - .4 in separate domestic hot water storage tank(s);
 - .5 at top most outlet in each standpipe fire protection system riser;
 - .6 in piping at each side of a pressure reducing valve;
 - .7 in potable water service piping downstream of meter;
 - .8 wherever else shown and/or specified.
- .2 Provide thermometers in following locations where applicable:
 - .1 in supply and return piping connections to main mechanical plant equipment such as boilers, chillers, cooling towers, heat exchangers, main coils, etc., unless temperature indication is supplied with equipment;
 - .2 wherever else shown and/or specified.
- .3 Conform to following installation requirements where applicable:
 - .1 for installation of thermometers in piping wells, provide a coat of metallic base heat transfer paste or grease in piping well;
 - .2 for pressure gauges in piping at equipment locations, install pressure gauge between equipment and first pipe fitting;
 - .3 locate, mount and adjust instruments so they are easily readable;
 - .4 where pressure gauges and/or thermometers are located at high level or in an area where they cannot be easily seen, provide remote reading instruments.

3.13 INSTALLATION OF EQUIPMENT DRIVE GUARDS AND ACCESSORIES

- .1 Provide OSHA guards for exposed accessible rotating parts such as belt drives, couplings, fan wheels, and shaft ends on mechanical equipment.
- .2 Install belt guards to allow movement of motors for adjusting belt tension.
- .3 Provide a means to permit lubrication and use of test instruments with guards in place.
- .4 Secure guards to equipment or equipment base but do not bridge sound or vibration isolation.
- .5 Where equipment oil level gauges, oil reservoirs, grease cups, or grease gun fittings are integral with equipment but are not easily accessible for service, extend to an accessible location using aluminium or copper tubing.

3.14 MECHANICAL WORK IDENTIFICATION

- .1 Identify new exposed piping and ductwork as per Part 2 of this Section in locations as follows:
 - .1 at every end of every piping or duct run;
 - .2 adjacent to each valve, strainer, damper and similar accessory;
 - .3 at each piece of connecting equipment;
 - .4 on both sides of every pipe and duct passing through a floor, wall or partition, unless otherwise specified;
 - .5 at 6 m (20') intervals on pipe and duct runs exceeding 6 m (20') in length;
 - .6 at least once in each room, and at least once on pipe and duct runs less than 6 m (20') in length.
- .2 Unless otherwise specified identify new concealed piping and ductwork as per Part 2 of this Section in locations as follows:
 - .1 at points where pipes or ducts enter and leave rooms, shafts, pipe chases, furred spaces, and similar areas;
 - .2 at maximum 6 m (20') intervals on piping and ductwork above suspended accessible ceilings, and at least once in each room;
 - .3 at each access door location;
 - .4 at each piece of connected equipment, automatic valve, etc.
- .3 Provide an identification nameplate for equipment provided as part of this project, including items such as control valves, motorized dampers, instruments, and similar products. Secure nameplates in place, approximately at eye level if possible, with stainless steel screws unless such a practice is prohibitive, in which case use epoxy cement applied to cleaned surfaces. Locate nameplates in the most conspicuous and readable location.
- .4 Paint new natural and/or propane gas piping with primer and 2 coats of yellow paint in accordance with Code requirements. Identify piping at intervals as specified above.
- .5 Provide an identification nameplate for each motor starter or disconnect switch located in a motor control centre or on a motor starter panel, and on each individually mounted starter provided as part of mechanical work, and on each disconnect switch provided as part of the electrical work for motorized equipment provided as part of mechanical work.
- .6 For electrically traced mechanical work, identification wording is to include "ELECTRICALLY TRACED".

- .7 Tag valves and prepare a valve tag chart in accordance with following requirements:
 - .1 attach a valve tag to each new valve, except for valves located immediately at equipment they control;
 - .2 prepare a digital valve tag chart to list tagged valves, with, for each valve, the tag number, location, valve size, piping service, and valve attitude (normally open or normally closed);
 - .3 if an existing valve tag chart is available at site, valve tag numbering is to be an extension of existing numbering and new valve tag chart is to incorporate existing chart;
 - .4 include a copy of valve tag chart in each copy of operating and maintenance instruction manuals.
- .8 Where shut-off valves, control dampers, sensors, and similar items which will or may need maintenance and/or repair are located above accessible suspended ceilings, provide round coloured ceiling tacks in ceiling panel material, or stickers equal to Brady "Quick Dot" on ceiling grid material to indicate locations of items. Unless otherwise specified, ceiling tack or sticker colours are to be as follows:
 - .1 HVAC piping valves and equipment: yellow
 - .2 fire protection valves and equipment: red
 - .3 plumbing valves and equipment: green
 - .4 HVAC ductwork dampers and equipment: blue
 - .5 control system hardware and equipment: orange

3.15 FINISH PAINTING OF MECHANICAL WORK

- .1 Finish paint exposed mechanical work as specified and/or scheduled in accordance with requirements of Division 09.
- .2 Touch-up paint damaged factory applied finishes on mechanical work products.

3.16 PIPE LEAKAGE TESTING

- .1 Before piping has been insulated or concealed, and before equipment, fixtures and fittings have been connected, test piping for leakage.
- .2 Tests are to be witnessed by Consultant and/or Owner's representative, and, where required, representatives of governing authorities. Give ample notice of tests in writing and verify attendance. Have completed test report sheets dated and signed by those present to confirm proper test results.
- .3 When circumstances prevent scheduled tests from taking place, give immediate and adequate notice of cancellation to all who were scheduled to attend.
- .4 Gravity Drainage and Vent Piping
 - .1 Test piping in accordance with local governing building code.
 - .2 After fixtures and fittings are set and pipes are connected to building drain or drains, turn on water into pipe, fixtures, fittings and traps in order to detect any imperfect material or workmanship. Perform a smoke test if required by local governing authorities.
- .5 Pumped Drainage Piping
 - .1 Test piping with cold water at a pressure of 1-½ times normal working pressure and maintain pressure for a minimum of 2 hours.

- .6 Domestic Water Piping
 - .1 Test piping with cold water at a pressure of 1-½ times normal working pressure and maintain pressure for a minimum of 2 hours.
- .7 Sprinkler System Piping
 - .1 Test system piping in accordance with requirements of NFPA No. 13, "Installation of Sprinkler Systems", and in accordance with any additional requirements of governing authorities.
- .8 Standpipe System Piping
 - .1 Test system piping in accordance with requirements of NFPA No. 14, "Standpipe and Hose Systems", and in accordance with any additional requirements of governing authorities.
- .9 CO2 Fire Extinguishing System Piping
 - .1 Test system piping in accordance with requirements of NFPA No. 12, "Standard on Carbon Dioxide Extinguishing Systems", and in accordance with any additional requirements of governing authorities.
- .10 Clean Agent Fire Extinguishing System Piping
 - .1 Test system piping in accordance with requirements of NFPA No. 2001, "Standard on Clean Agent Extinguishing Systems", and in accordance with any additional requirements of governing authorities
- .11 Heat Transfer (HVAC) System Piping
 - .1 Test piping with cold water at a pressure of 1035 kPa (150 psi) for a minimum of 2 hours.
- .12 Steam and Condensate Piping
 - .1 Test piping with cold water for a minimum of 2 hours at following pressures:
 - .1 0 kPa to 105 kPa (0 psi to 15 psi) low pressure piping – 690 kPa (100 psi);
 - .2 110 kPa to 690 kPa (16 psi to 100 psi) medium pressure piping – 1035 kPa (150 psi);
 - .3 greater than 690 kPa (100 psi) high pressure piping – 1380 kPa (200 psi).
- .13 Natural Gas Piping
 - .1 Test piping in accordance with requirements of CAN/CSA B149.1 and any additional requirements of local governing authorities.
 - .2 After completion of the verification test, locate required tag stating results of the verification test at the point of entry of gas main into building, affixed to the pipe in a secure manner.
 - .3 Check piping joints and connections for leaks with a water/soap solution while piping is under pressure.
- .14 Propane Gas Piping
 - .1 Test piping in accordance with requirements of CAN/CSA B149.2 and any additional requirements of local governing authorities.
 - .2 After completion of the verification test, locate required tag stating results of the verification test at the point of entry of gas main into building, affixed to the pipe in a secure manner.

- .3 Check piping joints and connections for leaks with a water/soap solution while piping is under pressure.
- .15 Compressed Air Piping
 - .1 Test piping with dry compressed air or nitrogen at 690 kPa (100 psi) for a minimum of 2 hours.
 - .2 Test piping joints with a water-soap solution while piping is under pressure to detect leaks.
- .16 Fuel Oil Piping
 - .1 Test piping (not tanks) with dry compressed air or nitrogen for a minimum period of 2 hours at 1035 kPa (150 psi).
 - .2 Check piping joints and connections for leaks with a water/soap solution while piping is under pressure.
- .17 Gasoline Piping
 - .1 Test piping (not tanks) with dry compressed air or nitrogen for a minimum period of 2 hours at 1035 kPa (150 psi) in accordance with TSSA requirements.
 - .2 Check piping joints and connections for leaks with a water/soap solution while piping is under pressure.
- .18 Refrigerant Piping
 - .1 Test refrigerant piping for leakage and dehydrate in accordance with requirements of Chapter 18 of ASHRAE Handbook - Fundamentals.
- .19 Control Air Piping and Tubing
 - .1 Test control air piping and tubing with dry compressed air or nitrogen before concealing and again before connection of instruments.
 - .2 Rough-in test pressure is to be 345 kPa (50 psi) maintained over 24 hours with a pressure drop not to exceed 35 kPa (5 psi).
 - .3 Test joints for leaks with a soap solution.
 - .4 Finish test is to be 205 kPa (30 psi) with a permissible loss of 7 kPa (1 psi) over a 4 hour period. Prior to connecting instruments, blow systems clean and dry, and test component connections for leaks with a water/soap solution.
- .20 Pure Water Piping
 - .1 When piping has been properly flushed and cleaned, test at 690 kPa (100 psi) for 2 hours with only distilled water or filtered dry compressed air. If distilled water is used, drain system when testing is complete.
- .21 Following requirements apply to all testing:
 - .1 ensure piping has been properly flushed, cleaned and is clear of foreign matter prior to pressure testing;
 - .2 temporarily remove or valve off piping system specialties or equipment which may be damaged by test pressures prior to pressure testing systems, and flush piping to remove foreign matter;
 - .3 when testing is carried out below highest level of the particular system, increase test pressure by the hydrostatic head of 7 kPa (1 psi) for every 600 mm (24") below the high point;

- .4 include for temporary piping connections required to properly complete tests;
- .5 piping under test pressure is to have zero pressure drop for length of test period;
- .6 tighten leaks found during tests while piping is under pressure. If this is impossible, remove and refit piping and reapply test until satisfactory results are obtained;
- .7 where leaks occur in threaded joints in steel piping, no caulking of these joints will be allowed under any conditions;
- .8 tests are to be done in reasonably sized sections so as to minimize number of tests required;
- .9 in addition to leakage tests specified above, demonstrate proper flow throughout systems including mains, connections and equipment, as well as proper venting and drainage, and include for any necessary system adjustments to achieve proper conditions.

3.17 SUPPLY OF MOTOR STARTERS AND ACCESSORIES

- .1 Unless otherwise shown or specified, supply a starter for each item of motorized equipment. Refer to Motor Starter Schedule.
- .2 Where 3-phase starters are indicated in motor control centres, supply motor control centres with starters and bolt to a concrete housekeeping pad.
- .3 Where package type equipment with integral starters, or equipment with starters integral in loose power and control panels supplied with equipment is fed from a motor control centre, provide a disconnect switch in motor control centre in lieu of a motor starter.
- .4 Where 3-phase starters are indicated and/or scheduled to be mounted on a motor starter panel, starters will be mounted and connected, complete with panels and splitter trough, as part of electrical work. Hand starters to electrical trade at site when they are required.
- .5 Where package type equipment with integral starters, or equipment with starters integral in loose power and control panels supplied with equipment is fed from a motor starter panel, a disconnect switch will be provided on motor starter panel as part of electrical work.
- .6 Unless otherwise specified or shown on drawings, 1-phase motor starters will be mounted adjacent to equipment they serve and connected complete as part of electrical work. Hand starters to electrical trade at site at the proper time.

3.18 ELECTRICAL WIRING WORK FOR MECHANICAL WORK

- .1 Unless otherwise specified or indicated, following electrical wiring work for mechanical equipment will be provided as part of the electrical work:
 - .1 "line" side power wiring to motor starters or disconnect switches in motor control centres and starters or disconnects on motor starter panels, and "load" side wiring from starters or disconnects to equipment;
 - .2 "line" side power wiring to individual wall mounted starters, and "load" side wiring from starters to equipment;
 - .3 "line" side power wiring to pre-wired power and control panels and variable frequency drives (VFD), and "load" side power wiring from the panels and VFD's to equipment;
 - .4 provision of receptacles for plug-in equipment;
 - .5 provision of disconnect switches for motors in excess of 10 m (30') from starter location, or cannot be seen from starter location, and associated power wiring;

- .6 motor starter interlocking in excess of 24 volts;
 - .7 wiring from motor winding thermistors in motors 30 HP and larger to motor starter contacts;
 - .8 120 volt power connections to electrical receptacles integral with small ceiling exhaust fans, including wiring through light switches or speed controllers;
 - .9 120 volt wiring connections to lighting fixture/switch combinations integral with air handling units;
 - .10 120 volt wiring connections to duplex receptacles integral with air handling unit control panels;
 - .11 120 volt wiring connections to BAS system controllers/panels and other control system or component requiring 120 volt power including, but not limited to, VAV boxes, dampers, low voltage transformers, etc.
- .2 Mechanical wiring work not listed above or specified herein and/or on drawings to be done as part of electrical work; is to be installed in conduit and is to be provided as part of mechanical work in accordance with wiring requirements specified for electrical work.

3.19 INTERRUPTION TO AND SHUT-DOWN OF MECHANICAL SERVICES AND SYSTEMS

- .1 Coordinate shut-down and interruption to existing mechanical systems with Owner. Generally, shut-downs may be performed only between the hours of 12:00 midnight Friday until 6:00 a.m. Monday morning, unless otherwise specified in Division 01. Include for costs of premium time to perform work during nights, weekends or other times outside of normal working hours, which may be necessary to comply with stipulations specified herein this Article. Services for operation of existing non-renovated areas of building are to be maintained.
- .2 Upon award of a Contract, submit a list of anticipated shut-down times and their maximum duration.
- .3 Prior to each shut-down or interruption, inform Owner and Consultant in writing 5 working days in advance of proposed shut-down or interruption and obtain written consent to proceed. Do not shut-down or interrupt any system or service without such written consent. Shutdowns of some essential services may require additional advance notification time.
- .4 Perform work associated with shut-downs and interruptions as continuous operations to minimize shut-down time and to reinstate systems as soon as possible, and, prior to any shut-down, ensure materials and labour required to complete the work for which shut-down is required are available at site.
- .5 Pipe freezing shall be used to connect new piping to existing piping. Alternative methods may be proposed, if site conditions are evaluated and permit, and are approved by the engineer.
- .6 Where existing isolation valves do not hold, pipe freezing shall be used to connect new piping to existing piping.

3.20 EQUIPMENT BASES AND SUPPORTS

- .1 Unless otherwise specified or required, set floor mounted equipment on minimum 100 mm (4") high reinforced concrete housekeeping pads 200 mm (8") clear of equipment on each side and end, or a minimum of 200 mm (8") from centreline of equipment anchor bolts to edge of the base, whichever is larger. Conform to following requirements:
 - .1 supply dimensioned drawings and equipment base templates, and provide anchor bolts for proper setting and securing of equipment on pads;
 - .2 place anchor bolts during concrete pour and be responsible for required levelling, alignment, and grouting of equipment;

- .3 as a minimum, use wire mesh reinforcement, however, for pads for large heavy equipment, use reinforcement as per structural drawing details.
- .2 For equipment not designed for base mounting, where required, provide welded, cleaned and prime coat painted structural steel stands or supports conforming to following requirements:
 - .1 provide stands and supports, except those for small equipment, designed by a structural engineer registered in jurisdiction of the work, and submit stamped and signed design drawings with calculations as shop drawings for review;
 - .2 flange bolt steel stands to concrete housekeeping pads;
 - .3 seismically restrain stands and supports in accordance with applicable requirements.
- .3 Where indicated on mechanical drawings, provide welded, cleaned and prime coat painted structural steel platforms, designed by a structural engineer registered in the jurisdiction of the work, for service access to equipment. Submit stamped and signed design drawings with calculations as shop drawings for review. Conform to following requirements:
 - .1 platforms in accordance with OSHA requirements and adequately sized, braced, anchored, and, as required, seismically restrained;
 - .2 flooring equal to Fisher & Ludlow "Tru-Weld" Type 19-4, Borden type W/B (19-W-4), welded steel bar type grating;
 - .3 support legs constructed of welded Schedule 40 black steel pipe with welded steel cross-bracing, securely anchored and sway braced;
 - .4 safety guard rails, constructed from minimum 32 mm (1-¼") dia. Schedule 40 black steel pipe, for all platforms and complete with vertical stanchions at maximum 1.2 m (48") centres, top and intermediate horizontal railing, and toe plates at floor;
 - .5 vertical ladders constructed of Schedule 40 black steel pipe, 25 mm (1") dia. for equal height rungs, 40 mm (1-½") for stringers, anchored to floors and walls and sway braced as required;
 - .6 ships ladders, used wherever space conditions permit, of welded steel construction, climbing at an approximate 60° angle, and complete with channel iron stringers, open grate equal height risers approximately 165 mm (6-½") wide and factory made by grating manufacturer, handrails, and suitable anchoring and support.

3.21 MECHANICAL SERVICE REQUIREMENTS FOR FLOATING FLOOR SLABS

- .1 Where mechanical services are required to be installed in or through a vibration isolated floating slab, install such services so as not to transmit any vibration to base slab on which floating floor slab is placed.
- .2 Wherever possible, arrange mechanical work to avoid penetrating a floating floor slab.

3.22 CONCRETE WORK FOR MECHANICAL EQUIPMENT BASES/PADS

- .1 Unless otherwise specified in Division 03, provide poured concrete work, including reinforcing and formwork, required for mechanical equipment bases/pads. Perform concrete work in accordance with requirements specified in Division 03.
- .2 Unless otherwise specified in Division 03, concrete is to be minimum 20,700 kPa ready-mix concrete in accordance with CAN/CSA-A23.1 and the Building Code.
- .3 Submit for review, dimensioned shop drawings, prepared and stamped by a professional structural engineer registered in the jurisdiction of the work, for concrete pads or bases for support of large, heavy

equipment. Indicate on shop drawings total weight of pad or base as well as equipment it is provided for, and concrete reinforcing.

- .4 Ensure that bases and pads are keyed into the structure to meet seismic restraint requirements where applicable.

3.23 EXCAVATION AND BACKFILL WORK

- .1 Unless otherwise specified in Division 31, provide all excavation and backfill associated with the mechanical scope of work.
- .2 Before commencement of excavation for work, determine in consultation with Consultant, Owner, Municipality and utilities, presence, if any, of existing underground services at site. Engage local utilities to locate and mark out such services. Ensure trades concerned are aware of their presence.
- .3 Be responsible for any damage done to underground services caused by neglect to determine and mark out location of such services prior to excavation work commences.
- .4 Where Work falls under jurisdiction of local governing utility, confirm requirements and comply with utility requirements.
- .5 Unless otherwise specified in Division 31, provide excavation, backfill and related work required for mechanical work. Obtain a copy of soil test report if available from Consultant. Depth of excavations must accommodate local governing requirements and local standard practices to compensate for local frost levels of Place of the Work.
- .6 Inverts and locations of existing site services may have been site surveyed and approximate location may be shown on drawings. Confirm inverts and locations are correct, prior to commencing excavation and contact Utilities to accurately locate their services. Where discrepancies are found, immediately inform Consultant, and await a direction. Grade bottom of trench excavations as required.
- .7 In firm, undisturbed soil, lay pipes directly on soil, unless otherwise directed.
- .8 Before backfilling, arrange for inspection of work by Consultant. Do not backfill work unless reviewed with Consultant. Failure to do so prior to backfilling will require re-excavating work and re-backfill at no additional cost to Owner.
- .9 Unless otherwise specified, backfill trenches within building with clean sharp sand in individual layers of maximum 150 mm (6") thickness compacted to a density of 100% Standard Proctor. Hand compact first layers up to a compacted level of minimum 300 mm (12") above top of pipe. Hand or machine compact the balance up to grade.
- .10 Unless otherwise specified, backfill trenches outside the building (not under roads, parking lots or traffic areas), up to a compacted level of 450 mm (18") thick above the pipe, hand compacted to a density of 95% Standard Proctor, using granular "A" gravel. Backfill the balance in 150 mm (6") layers with approved excavated material, compacted to 95% Standard Proctor density.
- .11 Unless otherwise specified, backfill trenches outside building under roads, parking lots or traffic areas with crushed stone or granular "A" gravel in layers not exceeding 150 mm (6") thickness, compacted to 100% Standard Proctor density up to grade level.
- .12 Provide minimum 1.37 m (4.5') of cover for underground piping subject to freezing and located outside building.
- .13 Provide minimum 450 mm (18") of cover for underground piping subject to freezing and located inside building.
- .14 After first lift of backfill has been compacted, mark entire path of pipe using continuous 75 mm (3") wide detectable identified marking tape equal to SMS Ltd. D-UGMT.

- .15 Unless otherwise directed in Division 02 and/or Division 31, store and dispose of excavated materials as follows:
 - .1 during progress of contract, place material as directed in such a manner to minimize damage or disfigurement of ground and which in no way impedes progress of work;
 - .2 separately place surplus topsoil and subsoil as directed; leave site clean and unencumbered.
- .16 Perform pumping as required to keep excavations free of water.
- .17 Engage services of independent soils testing agency to test final backfill compaction density of each backfilled location. Compact backfill to satisfaction of testing agency and in accordance with Specification. Submit a copy of testing agency's report to Consultant for review.
- .18 Fill depressions to correct grade level with appropriate material, after an adequate period has passed to reveal any settlement. Use maximum possible compaction. Pay costs required to make good damages caused by settlement.
- .19 Coordinate requirements for final surface toppings (concrete, asphalt, pavers, grass sod, etc.) with General Contractor.

3.24 CUTTING, PATCHING AND CORE DRILLING

- .1 Unless otherwise provided by General Trades, perform cutting, patching, and core drilling of existing building required for installation of mechanical work. Perform cutting in a neat and true fashion, with proper tools and equipment to Consultant's approval. Patching is to exactly match existing finishes and be performed by tradesmen skilled in particular trade or application. Work is subject to review and acceptance by Consultant.
- .2 Criteria for cutting holes for additional services:
 - .1 cut holes through slabs only; no holes to be cut through beams;
 - .2 cut holes 150 mm (6") diameter or smaller only; obtain approval from Structural Consultant for larger holes;
 - .3 keep at least 100 mm (4") clear from beam faces;
 - .4 space at least 3 hole diameters on centre;
 - .5 for holes that are required closer than 25% of slab span from supporting beam face, use cover meter above slab to clear slab top bars;
 - .6 for holes that are required within 50% of slab span, use cover meter underside of slab to clear slab bottom bars;
 - .7 submit sleeving drawings indicating holes and their locations for Structural Consultant's review.
- .3 Do not cut or drill any existing work without approval from Owner and Consultant. Be responsible for damage done to building and services caused by cutting or drilling.
- .4 Where pipes pass through existing construction, core drill an opening. Size openings to leave 12 mm (½") clearance around pipes or pipe insulation.
- .5 Prior to drilling or cutting an opening, determine, in consultation with Consultant and Owner, and by use of non-destructive radar scan (magnetic scan) of slab or wall, presence of any existing services and reinforcement bars concealed behind building surface to be cut and locate openings to suit. Coring is not permitted through concrete beams or girders.

- .6 Where drilling is required in waterproof slabs, size opening to permit snug and tight installation of a pipe sleeve sized to leave 12 mm (½") clearance around pipe or pipe insulation. Provide a pipe sleeve, constructed of Schedule 40 galvanized steel pipe with a flange at one end and of a length to extend 100 mm (4") above slab, in opening. Secure flange to the underside of slab and caulk void between sleeve and slab opening with proper non-hardening silicone base caulking compound to produce a water-tight installation.
- .7 Firestop and seal openings in fire rated construction. Do not leave openings open overnight unless approved by Owner and Consultant.

3.25 PACKING AND SEALING CORE DRILLED PIPE OPENINGS

- .1 Pack and seal void between pipe opening and pipe or pipe insulation for length of opening as follows:
 - .1 non-fire rated interior construction – pack with mineral wool and seal both ends of opening with non-hardening silicone base caulking compound to produce a water-tight seal;
 - .2 exterior walls above grade – pack with mineral wool and seal both ends of sleeves water-tight with non-hardening silicone base caulking compound unless mechanical type seals have been specified;
 - .3 exterior walls below grade (and any other wall where water leakage may be a problem) – seal with link type mechanical seals as specified.

3.26 FLASHING FOR MECHANICAL WORK PENETRATING ROOF

- .1 Unless otherwise specified in Division 07, perform required flashing work, including counter-flashing, for mechanical work penetrating and/or set in roof.
- .2 Perform flashing work in accordance with requirements of drawing details and/or requirements specified in Division 07.

3.27 CLEANING MECHANICAL WORK

- .1 Refer to cleaning requirements specified in Division 01.
- .2 Clean mechanical work prior to application for Substantial Performance of the Work.
- .3 Include for vacuum cleaning interior of air handling units and ductwork systems.

3.28 CONNECTIONS TO OTHER EQUIPMENT

- .1 Carefully examine Contract Documents during bidding period and include for mechanical work piping and/or ductwork connections to equipment requiring such connections.

3.29 SEISMIC RESTRAINT ANCHOR POINTS FOR EQUIPMENT

- .1 Where mechanical equipment requires seismic restraint, it is to be complete with manufacturer designed and rated seismic restraint anchor points and attachments, certified by equipment manufacturers, so equipment may be bolted down or restrained in the field.
- .2 Equipment to be restrained must be designed such that the strength and anchorage of its internal components exceed force level; used to restrain and anchor the equipment to the supporting structure.

3.30 INSTALLATION OF FLEXIBLE CONNECTORS

- .1 Provide flexible connectors in piping connections to seismically restrained equipment, where applicable, and wherever else shown.
- .2 Provide flexible connectors in piping connections to vibration isolated equipment.

3.31 FAN NOISE LEVELS

- .1 Submit sound power levels with fan shop drawings/product data, with levels measured to AMCA 300 and calculated to AMCA 301.

3.32 EQUIPMENT AND SYSTEM MANUFACTURER'S CERTIFICATION

- .1 When equipment/system installation is complete, but prior to start-up procedures, arrange and pay for equipment/system manufacturer's authorized representative to visit site to examine installation, and after any required corrective measures have been made, to certify in writing to Consultant that equipment/system installation is complete and in accordance with equipment/system manufacturer's instructions.

3.33 SYSTEM STARTUP

- .1 When installation of equipment/systems is complete but prior to commissioning, perform start-up for equipment/systems as specified in mechanical work Sections in accordance with following requirements:
 - .1 submit a copy of each equipment/system manufacturer's start-up report sheet to Consultant for review, and incorporate any comments made by Consultant;
 - .2 under direct on-site supervision and involvement of equipment/system manufacturer's representative, start-up equipment/systems, make any required adjustments, document procedures, leave equipment/systems in proper operating condition, and submit to Consultant complete set of start-up documentation sheets signed by manufacturer/supplier and Contractor.

End of Section

1 General

1.01 SECTION INCLUDES

- .1 This Section specifies requirements, criteria, methods and execution for mechanical demolition work that are common to one or more mechanical work Sections, and it is intended as a supplement to each Section and is to be read accordingly.

2 Products – Not Used

3 Execution

3.01 DISCONNECTION AND REMOVAL OF EXISTING MECHANICAL WORK

- .1 Where indicated on drawings, disconnect and remove existing mechanical work, including hangers, supports, insulation, etc. Disconnect at point of supply, remove obsolete connecting services and make system safe. Cut back obsolete piping behind finishes and cap water-tight unless otherwise specified.
- .2 Scope and extent of demolition or revision work is only generally indicated on drawings. Estimate scope, extent and cost of work at site during bidding period site visit(s). Claims for extra costs for demolition work not shown or specified but clearly visible or ascertainable at site during bidding period site visits will not be allowed.
- .3 If any re-design is required due to discrepancies between mechanical drawings and site conditions, notify Consultant who will issue a Site Instruction. If, in the opinion of Consultant, discrepancies between mechanical drawings and actual site conditions are of a minor nature, required modifications are to be done at no additional cost.
- .4 Where existing mechanical services extend through, or are in an area to serve items which are to remain, maintain services in operation. Include for rerouting existing services concealed behind existing finishes and which become exposed during renovation work, so as to be concealed behind new or existing finishes.
- .5 Unless otherwise specified, remove from site and dispose of existing materials which have been removed and are not to be relocated or reused.

3.02 ROOFING WORK

- .1 Where roof revisions and/or replacements are part of project, include for disconnecting, lifting, or temporarily removing mechanical equipment on roof as required to permit completion of roofing work, and for re-installing equipment when roofing work is complete.

End of Section

1 General

1.01 SECTION INCLUDES

- .1 This Section specifies requirements that are common to Mechanical Divisions work Sections and it is a supplement to each Section and is to be read accordingly. Where requirements of this Section contradict requirements of Division 00 or Division 01, conditions of Division 00 or Division 01 to take precedence.
- .2 Be responsible for advising product vendors of requirements of this Section.

1.02 RELATED REQUIREMENTS

- .1 Division 00 and Division 01 apply to and are a part of this Section.

1.03 DEFINITIONS

- .1 "concealed" – means hidden from normal sight in furred spaces, shafts, ceiling spaces, walls and partitions.
- .2 "exposed" – means work normally visible, including work in equipment rooms, service tunnels, and similar spaces.
- .3 "finished" - means when in description of any area or part of an area or a product which receives a finish such as paint, or in case of a product may be factory finished.
- .4 "provision" or "provide" (and tenses of "provide") – means supply and install complete.
- .5 "install" (and tenses of "install") – means secure in position, connect complete, test, adjust, verify and certify.
- .6 "supply" – means to procure, arrange for delivery to site, inspect, accept delivery and administer supply of products; distribute to areas; and include manufacturer's supply of any special materials, standard on site testing, initial start-up, programming, basic commissioning, warranties and manufacturers' assistance to Contractor.
- .7 "delete" or "remove" (and tenses of "delete" or "remove") – means to disconnect, make safe, and remove obsolete materials; patch and repair/finish surfaces to match adjoining similar construction; include for associated re-programming of systems and/or change of documentation identifications to suit deletions, and properly dispose of deleted products off site unless otherwise instructed by Owner and reviewed with Consultant.
- .8 "BAS" – means building automation system; "BMS" – means building management system; "FMS" – means facility management system; and "DDC" means direct digital controls; references to "BAS", "BMS", "FMS" and "DDC" generally mean same.
- .9 "governing authority" and/or "authority having jurisdiction" and/or "regulatory authority" and/or "Municipal authority" – means government departments, agencies, standards, rules and regulations that apply to and govern work and to which work must adhere.
- .10 "OSHA" and "OHSA" – stands for Occupational Safety and Health Administration and Occupational Health and Safety Act, and wherever either one is used, they are to be read to mean local governing occupational health and safety regulations that apply to and govern work and to which work must adhere, regardless if Project falls within either authority's jurisdiction.
- .11 "Mechanical Divisions" – refers to Division 20, Division 21, Division 22, Division 23, Division 25, and other Divisions as specifically noted, and which work as defined in Specifications and/or on drawings is responsibility of Mechanical Contractor, unless otherwise noted.

- .12 "Electrical Divisions" – refers to Division 26, Division 27, Division 28, and other Divisions as specifically noted, and which work as defined in Specifications and/or on drawings is responsibility of Electrical Contractor, unless otherwise noted.
- .13 "Consultant" – means person, firm or corporation identified as such in Agreement or Documents, and is licensed to practice in Place of the Work, and has been appointed by Owner to act for Owner in a professional capacity in relation to the Work.
- .14 Wherever words "indicated", "shown", "noted", "listed", or similar words or phrases are used in Contract Documents they are understood, unless otherwise defined, to mean product referred to is "indicated", "shown", "listed", or "noted" on Contract Documents.
- .15 Wherever words "reviewed", "satisfactory", "as directed", "submit", or similar words or phrases are used in Contract Documents they are understood, unless otherwise defined, to mean that work or product referred to is "reviewed by", "to the satisfaction of", "submitted to", etc., Consultant.

1.04 DOCUMENTS

- .1 Documents for bidding include but are not limited to issued Drawings, Specifications and Addenda.
- .2 Specification is arranged in accordance with CSI/CSC 49 Divisions of MasterFormat.
- .3 Drawings and Specifications are portions of Contract Documents and identify labour, products and services necessary for performance of work and form a basis for determining pricing. They are intended to be cooperative. Perform work that is shown, specified, or reasonably implied on the drawings but not mentioned in Specification, or vice-versa, as though fully covered by both.
- .4 Review Drawings and Specifications in conjunction with documents of other Divisions and, where applicable, Code Consultant's report.
- .5 Unless otherwise specifically noted in Specifications and/or on Drawings, Sections of Mechanical Divisions are not intended to delegate functions nor to delegate work and supply of materials to any specific trade, but rather to generally designate a basic unit of work, and Sections are to be read as a whole.
- .6 Drawings are performance drawings, diagrammatic, and show approximate locations of equipment and connecting services. Any information regarding accurate measurement of building is to be taken on site. Do not scale Drawings, and do not use Drawings for prefabrication work.
- .7 Drawings are intended to convey the scope of work and do not show architectural and structural details. Provide, at your cost, offsets, fittings, transformations and similar products required as a result of obstructions and other architectural and/or structural details but not shown on Drawings.
- .8 Locations of equipment and materials shown may be altered, when reviewed by Consultant, to meet requirements of equipment and/or materials, other equipment or systems being installed, and of building, all at no additional cost to Contract.
- .9 Specification does not generally indicate specific number of items or amounts of material required. Specification is intended to provide product data and installation requirements. Refer to schedules, Drawings (layouts, riser diagrams, schematics, details) and Specification to provide correct quantities. Singular may be read as plural and vice versa.
- .10 Starter/motor control centre (MCC)/variable frequency drive (VFD) schedule drawings are both mechanical and electrical, and apply to work of Mechanical Divisions and Electrical Divisions. Be responsible for reviewing starter, MCC, VFD, and motor specification requirements prior to Bid submission. Confirm and coordinate exact scope of work and responsibility of work between Mechanical Divisions and Electrical Divisions.

- .11 Drawings and Specifications have been prepared solely for use by party with whom Consultant has entered into a contract and there are no representations of any kind made by Consultant to any other party.
- .12 In the case of discrepancies between the drawings and specifications, documents will govern in order specified in “General Conditions”, however, when scale and date of drawings are same, or where discrepancy exists within specification, most costly arrangement will take precedence.

1.05 METRIC AND IMPERIAL MEASUREMENTS

- .1 Generally, both metric and imperial units of measurement are given in Sections of Specification governed by this section. Measurement conversions may be generally "soft" and rounded off. Confirm exact measurements based on application. Where measurements are related to installation and onsite applications, confirm issued document measurements with applicable local code requirements, and/or as applicable, make accurate measurements onsite. Where significant discrepancies are found, immediately notify Consultant for direction.

1.06 EXAMINATION OF DOCUMENTS AND SITE

- .1 Carefully examine Documents and visit site to determine and review existing site conditions that will or may affect work, and include for such conditions in Bid Price.
- .2 Report to Consultant, prior to Bid Submittal, any existing site condition that will or may affect performance of work as per Documents. Failure to do so will not be grounds for additional costs.
- .3 Upon finding discrepancies in, or omissions from Documents, or having doubt as to their meaning or intent, immediately notify Consultant, in writing.

1.07 WORK STANDARDS

- .1 Where any code, regulation, bylaw, standard, contract form, manual, printed instruction, and installation and application instruction is quoted it means, unless otherwise specifically noted, latest published edition at time of submission of Bids adopted by and enforced by local governing authorities having jurisdiction. Include for compliance with revisions, bulletins, supplementary standards or amendments issued by local governing authorities.
- .2 Where regulatory codes, standards and regulations are at variance with Drawings and Specification, more stringent requirement will apply unless otherwise directed by Owner and reviewed with Consultant.
- .3 Supplementary mandatory specification and requirements to be used in conjunction with project include but are not limited to following:
 - .1 Air-Conditioning, Heating and Refrigeration Institute (AHRI);
 - .2 Air Movement and Control Association (AMCA);
 - .3 American Iron and Steel Institute (AISI);
 - .4 American National Standards Institute (ANSI);
 - .5 American Society of Heating, Refrigerating and Air Conditioning Engineers, Inc., (ASHRAE);
 - .6 American Society of Mechanical Engineers (ASME);
 - .7 American Society of Testing and Materials (ASTM);
 - .8 American Water Works Association (AWWA);
 - .9 Associated Air Balance Council (AABC);

- .10 Building Industry Consulting Services, International (BICSI);
- .11 Canadian Gas Association (CGA);
- .12 Canadian General Standards Board (CGSB);
- .13 Canadian Standards Association (CSA);
- .14 Electrical and Electronic Manufacturers Association of Canada (EEMAC);
- .15 Electrical Safety Authority (ESA);
- .16 Electronic Industries Association (EIA);
- .17 Factory Mutual Systems (FM);
- .18 Illuminating Engineering Society (IES);
- .19 Institute of Electrical and Electronic Engineers (IEEE);
- .20 International Standards Organization (ISO);
- .21 Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS);
- .22 National Building Code of Canada (NBC);
- .23 National Electrical Manufacturers Association (NEMA);
- .24 National Environmental Balancing Bureau (NEBB);
- .25 National Fire Protection Association (NFPA);
- .26 National Standards of Canada;
- .27 NSF International;
- .28 Occupational Health and Safety Act (OHSA);
- .29 Ontario Building Code (OBC);
- .30 Ontario Electrical Safety Code (OESC);
- .31 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA);
- .32 Technical Standards and Safety Authority (TSSA);
- .33 Thermal Insulation Association of Canada (TIAC);
- .34 Underwriters' Laboratories of Canada (ULC);
- .35 Workplace Hazardous Materials Information System (WHMIS);
- .36 Material Safety Data Sheets by product manufacturers;
- .37 Local utility inspection permits;
- .38 Codes, standards, and regulations of local governing authorities having jurisdiction;
- .39 Additional codes and standards listed in Trade Sections;
- .40 Owner's standards.

- .4 Provide applicable requirements for barrier free access in accordance with latest edition of local governing building code.
- .5 Where any governing Code, Regulation, or Standard requires preparation and submission of special details or drawings for review they are to be prepared and submitted to appropriate authorities. Be responsible for costs associated with these submittals.
- .6 Unless otherwise specified, install equipment in accordance with equipment manufacturer's recommendations and instructions, and requirements of governing Codes, Standards, and Regulations. Governing Codes, Standards, and Regulations take precedence over manufacturer's instructions.
- .7 Work is to be performed by journeyperson tradesmen who perform only work that their certificates permit, or by apprentice tradesmen under direct on site supervision of experienced journeyperson tradesman. Journeyperson to apprentice ratio is not to exceed ratio determined by the Board as stated in Ontario College of Trades and Apprenticeship Act or local equivalent governing body in Place of the Work.
- .8 Journeyperson tradesmen are to have a copy of valid trade certificates available at site for review with Consultant at any time.
- .9 Experienced and qualified superintendent is to be on-site at times when work is being performed.
- .10 Coordinate work inspection reviews and approvals with governing inspection department to ensure that construction schedule is not delayed. Be responsible for prompt notification of deficiencies to Consultant and submission of reports and certificates to Consultant.
- .11 Properly protect equipment and materials on site from damage due to elements and work of trades, to satisfaction of Owner and reviewed with Consultant. Equipment and materials are to be in new condition upon Substantial Performance of the Work.
- .12 Mechanical piping system work, including equipment, must comply in all respects with requirements of local technical standards authorities and CSA B51, Boiler, Pressure Vessels and Pressure Piping Code. Where required, mechanical work products must bear a CRN number.
- .13 Electrical items associated with mechanical equipment are to be certified and bear stamp or seal of a recognized testing agency such as CSA, UL, ULC, ETL, etc., or bear a stamp to indicate special electrical utility approval.

1.08 PERMITS, CERTIFICATES, APPROVALS, AND FEES

- .1 Contact and confirm with local authorities having jurisdiction including utility providers, requirements for approvals from such authorities. Obtain and pay for permits, certificates, and approvals required to complete Work.
- .2 Be responsible for ensuring that authorities having jurisdiction which require on-site inspection of work, have ample notification to perform inspection, with sufficient lead time to correct deficiencies in a manner that will not impede schedule of completion of Work. If any defect, deficiency or non-compliant is found in work by inspection, be responsible for costs of such inspection, including any related expenses, making good and return to site, until work is passed by governing authorities.
- .3 Obtain and submit to Consultant, approval/inspection certificates issued by governing authorities to confirm that Work as installed is in accordance with rules and regulations of local governing authorities and are acceptable.
- .4 Include in each copy of operating and maintenance instruction manuals, copies of approvals and inspection certificates issued by regulatory authorities.

1.09 REQUIREMENTS FOR CONTRACTOR RETAINED ENGINEERS

- .1 Professional engineers retained to perform consulting services with regard to Project work, i.e. seismic engineer, fire protection engineer or structural engineer, are to be members in good standing with local Association of Professional Engineers, and are to carry and pay for errors and omissions professional liability insurance in compliance with requirements of governing authorities in Place of the Work.
- .2 Retained engineer's professional liability insurance is to protect Contractor's consultants and their respective servants, agents, and employees against any loss or damage resulting from professional services rendered by aforementioned consultants and their respective servants, agents, and employees in regards to the Work of this Contract.
- .3 Unless otherwise specified in Division 00 or 01, liability insurance requirements are as follows:
 - .1 coverage is to be a minimum of \$1,000,000.00 CDN inclusive of any one occurrence;
 - .2 insurance policy is not to be cancelled or changed in any way without insurer giving Owner minimum thirty days written notice;
 - .3 liability insurance is to be obtained from an insurer registered and licensed to underwrite such insurance in the Place of the Work;
 - .4 retained consultants are to ascertain that sub-consultants employed by them carry insurance in the form and limits specified above;
 - .5 evidence of the required liability insurance in such form as may be required is to be issued to Owner, Owner's Consultant, and Municipal Authorities as required prior to commencement of aforementioned consultant's services.

1.10 WORKPLACE SAFETY

- .1 Comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling, storage and disposal of hazardous materials. Submit WHMIS MSDS (Material Safety Data Sheets) for products where required, and maintain one copy at site in a visible and accessible location available to personnel.
- .2 Comply with requirements of Occupational Health and Safety Act and other regulations pertaining to health and safety, including worker's compensation/insurance board and fall protection regulations. When working in confined spaces, comply with requirements of Occupational Health and Safety Act - Ontario Regulation 632, "Confined Spaces" and any other applicable Ministry of Labour requirements.
- .3 If at any time during course of work, hazardous materials other than those identified in Documents and pertaining to Project Scope of Work, are encountered or suspected that were not identified as being present and which specific instructions in handling of such materials were not given, cease work in area in question and immediately notify Consultant. Comply with local governing regulations with regards to working in areas suspected of containing hazardous materials. Do not resume work in affected area without approval from Owner and reviewed with Consultant.

1.11 PLANNING AND LAYOUT OF WORK

- .1 Base installation layout, design, terminations, and supply of accessories, on Contract Documents with specific coordination with reviewed shop drawings.
- .2 Plan, coordinate, and establish exact locations and routing of services with affected trades prior to installation such that services clear each other as well as other obstructions. Generally, order of right of way for services to be as follows:
 - .1 piping requiring uniform pitch;

- .2 piping 100 mm (4") dia. and larger;
 - .3 large ducts (main runs);
 - .4 cable tray and bus duct;
 - .5 conduit 100 mm (4") dia. and larger;
 - .6 piping less than 100 mm (4") dia.;
 - .7 smaller branch ductwork;
 - .8 conduit less than 100 mm (4") dia..
- .3 Unless otherwise shown or specified, conceal work in finished areas, and conceal work in partially finished and/or unfinished areas to extent made possible by the area construction. Install services as high as possible to conserve headroom and/or ceiling space. Notify Consultant where headroom or ceiling space appears to be inadequate prior to installation of work.
- .4 Do not use Contract Drawing measurements for prefabrication and layout of piping, sheet metal work and such other work. Locations and routing are to generally be in accordance with Contract Drawings, however, prepare layout drawings for such work. Use established bench marks for both horizontal and vertical measurements. Confirm inverts, coordinate with and make allowances for work of other trades. Accurately layout work, and be entirely responsible for work installed in accordance with layout drawings. Where any invert, grade, or size is at variance with Contract Drawings, notify Consultant prior to proceeding with work.
- .5 Prepare plan and interference drawings (at a minimum drawing scale of 1:50 or ¼"=1' 0") of work for coordination with each trade Contractor. Arrange for preparation of detailed section drawings of ceiling spaces of corridors and any other congested areas. Sections are to be cross referenced with plan drawings so that trades may make use of section drawings. Section drawings to indicate lateral and elevation dimensions of major services within ceiling space. Lateral dimensions are to be from grid lines and elevations from top of floor slab. Obtain from Consultant, engineering drawings for this use. Contractors' interference drawings are to be distributed among other Trade Contractors. Submit drawings to Consultant for review. Failure of General Contractor to prepare and coordinate overall interface drawings of trades does not relieve respective Division Contractor of responsibility to ensure that work is properly planned and coordinated.
- .6 Carry out alterations in arrangement of work that has been installed without proper coordination, study, and review, even if in accordance with Contract Documents, in order to conceal work behind finishes, or to allow installation of other work, without additional cost. In addition, make necessary alterations in other work required by such alterations, without additional cost.
- .7 Shut-off valves, balancing devices, air vents, equipment and similar products, particularly such products located above suspended ceilings must be located for easy access for servicing and/or removal. Products which do not meet this location requirement are to be relocated to an accessible location at no additional cost.
- .8 Be responsible for making necessary changes, at no additional cost, to accommodate structural and building conditions that were missed due to lack of coordination.

1.12 SCHEDULING

- .1 Include for any and all scheduling, coordination, and construction phasing to suit project, specified in Division 01 and/or as indicated on the drawings. Review exact phasing requirements with Consultant prior to start of Work.
- .2 Phasing and scheduling of Work is required in order to maintain existing building operations. Include costs (including costs for "off hours" work) for scheduling, co-ordination, and construction phasing to suit

this project as specified in Division 01 and on drawings. Review phasing requirements with Consultant prior to start of Work.

- .3 Protect existing areas above, below and adjacent areas of Work from any debris, noise, or interruptions to existing services to satisfaction of Owner and reviewed with Consultant. Maintain in operation existing services to these areas to allow Owner to continue use of these areas. If services that are required to be maintained run through areas of renovations, provide necessary protection to services or reroute, in coordination with Owner and Consultant. Include for required premium time work to meet these requirements.
- .4 Work being performed within occupied spaces and work affecting surfaces adjacent to occupied spaces may need to be performed after regular business hours. For areas where spaces are used by Owner on a 24 hours basis or over various hours, coordinate hours of work with Owner on a regular basis to suit Owner's schedule. Execute work at times confirmed with and agreed to by Owner and reviewed with Consultant, so as not to inconvenience Owner's occupation or in any way hinder Owner's use of building. Include for required premium timework to meet these requirements.
- .5 Project partial occupancy permits may be required throughout project. Provide for each partial permit, required local governing authority certificate and any other testing/verification certificates for systems.

1.13 COORDINATION

- .1 Review Contract Documents and coordinate work with work of each trade. Coordination requirements are to include but not be limited to following:
 - .1 requirements for openings, sleeves, inserts and other hardware necessary for installation of work;
 - .2 concrete work such as housekeeping pads, sumps, bases, etc., required for work, and including required dimensions, operating weight of equipment, location, etc.;
 - .3 depth and routing of excavation required for work, and requirements for bedding and backfill;
 - .4 wiring work required for equipment and systems but not specified to be done as part of mechanical work, including termination points, wiring type and size, and any other requirements.
- .2 Ensure materials and equipment are delivered to site at proper time and in such assemblies and sizes so as to enter into building and be moved into spaces where they are to be located without difficulty.
- .3 Wherever possible, coordinate equipment deliveries with manufacturers and/or suppliers so equipment is delivered to site when it is required, or so it can be stored within building, subject to available space as confirmed with Owner and reviewed with Owner, and protected from elements.
- .4 Ensure proper access and service clearances are maintained around equipment, and, where applicable, access space for future equipment removal or replacement is not impeded. Comply with code requirements with regards to access space provision around equipment. Remove and replace any equipment which does not meet this requirement.
- .5 Where work is to be integrated, or is to be installed in close proximity with work of other trades, coordinate work prior to and during installation.

1.14 PRODUCTS

- .1 Be responsible for ordering of products (equipment and materials) in a timely manner in order to meet project-scheduling timelines. Failure to order products to allow manufacturers sufficient production/delivery time to meet project-scheduling timelines is an unacceptable reason to request for other suppliers or substitutions.
- .2 Provide Canadian manufactured products wherever possible or required and when quality and performance is obtainable at a competitive price. Products are to be supplied from manufacturer's

- authorized Canadian representative, unless otherwise noted. Unless otherwise specified, products are to be new and are to comply with applicable respective Canadian standards. References to UL listings of products to include requirements that products are to be also Underwriters Laboratories of Canada (ULC) listed for use in Canada. Products are to meet or exceed latest ANSI/ASHRAE/IES 90.1 standards, as applicable. Do not supply any products containing asbestos materials or PCB materials.
- .3 Systems and equipment of this Project are to be "State of the Art" and be most recent and up to date series/version of product that is available at time of shop drawing review process. Products that have been stored or "on shelf" for an extended period of time will not be accepted. Software is to be of latest version available and be provided with updates available at time of shop drawing review process. Systems are to be designed such that its software is backwards compatible. Future upgrades are not to require any hardware replacements or additions to utilize latest software.
 - .4 Products scheduled and/or specified have been selected to establish a performance and quality standard, and, in some instances, a dimensional standard. In most cases, base specified manufacturers are stated for any product specified by manufacturer's name and model number. Where manufacturers are listed, first name listed is base specified company. Bid Price may be based on products supplied by any of manufacturers' base specified or named as acceptable for particular product. If manufacturers are not stated for a particular product, base Bid Price on product supplied by base specified manufacturer.
 - .5 Documents have been prepared based on product available at time of Bidding. If, after award of Contract, and if successful manufacturer can no longer supply a product that meets base specifications, notify Consultant immediately. Be responsible for obtaining other manufacturers product that complies with base specified performance and criteria and meets project timelines. Proposed products are subject to review and consideration by Consultant and are considered as substitutions subject to a credit to Contract. In addition, if such products require modifications to room spaces, mechanical systems, electrical systems, etc., include required changes. Such changes are to be submitted in detail to Consultant for review and consideration for acceptance. There will be no increase in Contract Price for revisions. Above conditions supplement and are not to supersede any specification conditions with regards to substitutions or failure to supply product as per issued documents.
 - .6 Listing of a product as "acceptable" does not imply automatic acceptance by Consultant and/or Owner. It is responsibility of Contractor to ensure that any price quotations received and submittals made are for products that meet or exceed specifications included herein.
 - .7 If products supplied by a manufacturer named as acceptable are used in lieu of base specified manufacturer, be responsible for ensuring that they are equivalent in performance and operating characteristics (including energy consumption if applicable) to base specified products. It is understood that any additional costs (i.e. for larger starters, larger feeders, additional spaces, etc.), and changes to associated or adjacent work resulting from provision of product supplied by a manufacturer other than base specified manufacturer, is included in Bid Price. In addition, in equipment spaces where equipment named as acceptable is used in lieu of base specified equipment and dimensions of such equipment differs from base specified equipment, prepare and submit for review accurately dimensioned layouts of rooms affected, identifying architectural and structural elements, systems and equipment to prove that equipment in room will fit properly meeting design intent. There will be no increase in Contract Price for revisions.
 - .8 In addition to manufacturer's products base specified or named as acceptable, other manufacturers of products may be proposed as substitutions to Consultant for review and consideration for acceptance, listing in each case a corresponding credit for each substitution proposed. However, base Bid Price on products base specified or named as acceptable. Certify in writing to Consultant that proposed substitution meets space, power, design, energy consumption, and other requirements of base specified or acceptable product. It is understood that there will be no increase in Contract Price by reason of any changes to associated equipment, mechanically, electrically, structurally or architecturally, required by acceptance of proposed substitution. Consultant has sole discretion in accepting any such proposed substitution of product. Indicate any proposed substitutions in areas provided on Bid Form. Do not order such products until they are accepted in writing by Consultant.

- .9 Where products are listed as "or approved equal", certify in writing that product to be used in lieu of base specified product, at least meets space, power, design, energy consumption, and other requirements of base specified product and is equivalent or better than base specified product. When requested by Consultant, provide full design detail drawings and specifications of proposed products. Acceptance of these "or approved equal" products is at sole discretion of Consultant. It is understood that there will be no increase in Contract Price by reason of any changes to associated equipment, mechanically, electrically, structurally or architecturally, required by acceptance of approved equal product. There must be no increase in Contract price due to Consultant's rejection of proposed equivalent product.
- .10 Whenever use of product other than base specified product is being supplied, ensure corresponding certifications and product information (detailed catalogue and engineering data, fabrication information and performance characteristics) are submitted to Consultant for review. Failure of submission of these documents to Consultant in a timely manner to allow for review will result in base specified product to be supplied at Consultant's discretion, at no additional cost to Contract.
- .11 Products supplied by a manufacturer/supplier other than a manufacturer listed as acceptable may be considered for acceptance by Consultant if requested in writing with full product documentation submitted, a minimum of 10 working days prior to Bid closing date.
- .12 Any proposed changes initiated by Contractor after award of Contract may be considered by Consultant at Consultant's discretion, with any additional costs for such changes if accepted by Owner and reviewed with Consultant, and costs for review, to be borne by Contractor.
- .13 Whenever use of product other than based specified products or named as acceptable is being supplied, time for process of submission of other products and Consultant's review of products will not alter contract time or delay work schedule.

1.15 SHOP DRAWINGS

- .1 At start-up meeting, review with Consultant products to be included in shop drawing submission. Prepare and submit list of products to Consultant for review.
- .2 Submit electronic copies of shop drawings unless otherwise directed by Consultant. Coordinate exact requirements with Consultant.
- .3 Submit for review, drawings showing detail design, construction, and performance of equipment and materials as requested in Specification. Submit shop drawings to Consultant for review prior to ordering and delivery of product to site. Include minimally for preparation and submission of following, as applicable:
 - .1 product literature cuts;
 - .2 equipment data sheets;
 - .3 equipment dimension drawings;
 - .4 system block diagrams;
 - .5 sequence of operation;
 - .6 connection wiring schematic diagrams;
 - .7 functionality with integrated systems.
- .4 Each shop drawing or product data sheet is to be properly identified with project name and product drawing or specification reference. Shop drawing or product data sheet dimensions are to match dimension type on drawings.

- .5 Where any item of equipment is required by Code or Standard or By-Law to meet a specific energy efficiency level, or any other specific requirement, ensure this requirement is clearly indicated on submission.
- .6 Ensure proposed products meet each requirement of Project. Endorse each shop drawing copy "CERTIFIED TO BE IN ACCORDANCE WITH ALL REQUIREMENTS". Include company name, submittal date, and sign each copy. Shop drawings that are received and are not endorsed, dated and signed will be returned to be resubmitted.
- .7 Consultant to review shop drawings and indicate review status by stamping shop drawing copies as follows:
 - .1 "REVIEWED" or "REVIEWED AS NOTED" (appropriately marked) – If Consultant's review of shop drawing is final, Consultant to stamp shop drawing;
 - .2 "RETURNED FOR CORRECTION" – If Consultant's review of shop drawing is not final, Consultant to stamp shop drawing as stated above, mark submission with comments, and return submission. Revise shop drawing in accordance with Consultant's notations and resubmit.
- .8 Following is to be read in conjunction with wording on Consultant's shop drawing review stamp applied to each and every shop drawing or product data sheet submitted:
 - .1 "THIS REVIEW BY CONSULTANT IS FOR SOLE PURPOSE OF ASCERTAINING CONFORMANCE WITH GENERAL DESIGN CONCEPT. THIS REVIEW DOES NOT MEAN THAT CONSULTANT APPROVES DETAILED DESIGN INHERENT IN SHOP DRAWINGS, RESPONSIBILITY FOR WHICH REMAINS WITH CONTRACTOR. CONSULTANT'S REVIEW DOES NOT RELIEVE CONTRACTOR OF RESPONSIBILITY FOR ERRORS OR OMISSIONS IN SHOP DRAWINGS OR OF CONTRACTOR'S RESPONSIBILITY FOR MEETING REQUIREMENTS OF CONTRACT DOCUMENTS. BE RESPONSIBLE FOR DIMENSIONS TO BE CONFIRMED AND CORRELATED AT JOB SITE, FOR INFORMATION THAT PERTAINS SOLELY TO FABRICATION PROCESSES OR TO TECHNIQUES OF CONSTRUCTION AND INSTALLATION, AND FOR COORDINATION OF WORK OF SUB-TRADES."
- .9 Submit each system and each major component as separate shop drawing submissions. Submit together, shop drawings for common devices such as devices of each system are to be submitted together.
- .10 Obtain shop drawings for submission from product manufacturer's authorized representatives and supplemented with additional items specified herein.
- .11 Do not order product until respective shop drawing review process has been properly reviewed with Consultant.
- .12 Where extended warranties are specified for equipment items, submit specified extended warranty with shop drawing submittal.
- .13 Applicable mechanical equipment has been selected to meet energy efficiency requirements of ANSI/ASHRAE/IES 90.1, Energy Standards for Buildings, and shop drawings/product data submittals for such equipment must indicate compliance with this Standard or they will be returned for correction and re-submittal.

1.16 EQUIPMENT LOADS

- .1 Supply equipment loads (self-weight, operating weight, housekeeping pad, inertia pads, etc.) to Consultant, via shop drawing submissions, prior to construction.
- .2 Where given choice of specific equipment, actual weight, location and method of support of equipment may differ from those assumed by Consultant for base design. Back-check equipment loads, location, and supports, and include necessary accommodations.

- .3 Where supporting structure consists of structural steel framing, it is imperative that equipment loads, location, and method of support be confirmed prior to fabrication of structural steel. Review locations of equipment with Consultant prior to construction.

1.17 OPENINGS

- .1 Supply opening sizes and locations to Consultant to allow verification of their effect on design, and for inclusion on structural drawings where appropriate.
- .2 No openings are permitted through completed structure without written approval from Owner and reviewed with Consultant. Show required openings on a copy of structural drawings. Identify exact locations, elevations, and size of proposed openings and submit to Consultant for review, well in advance of doing work.
- .3 Prior to leaving site at end of each day, walk through areas of work and check for any openings, penetrations, holes, and/or voids created under scope of work of project, and ensure that any openings created under scope of work have been closed off, fire-stopped and smoke-sealed. Unless directed by Owner and reviewed with Consultant, do not leave any openings unprotected and unfinished overnight.

1.18 SCAFFOLDING, HOISTING AND RIGGING

- .1 Unless otherwise specified or directed, supply, erect and operate scaffolding, rigging, hoisting equipment and associated hardware required for work, and subject to approval from Owner and reviewed with Consultant.
- .2 Immediately remove from site scaffolding, rigging and hoisting equipment when no longer required.
- .3 Do not place major scaffolding/hoisting equipment loads on any portion of structure without approval from Owner and reviewed with Consultant.

1.19 CHANGES IN THE WORK

- .1 Whenever Consultant proposes in writing to make a change or revision to design, arrangement, quantity or type of work from that required by Contract Documents, prepare and submit to Consultant for review, a quotation being proposed cost for executing change or revision.
- .2 Quotation is to be a detailed and itemized estimate of product, labour, and equipment costs associated with change or revision, plus overhead and profit percentages and applicable taxes and duties.
- .3 Unless otherwise specified in Division 00 or Division 01, allowable maximum percentages for overhead and profit are to be 7% and 5% respectively.
- .4 Unless otherwise specified in Division 00 or Division 01, following additional requirements apply to all quotations submitted:
 - .1 when change or revision involves deleted work as well as additional work, cost of deleted work (less overhead and profit percentages but including taxes and duties) is to be subtracted from cost of additional work before overhead and profit percentages are applied to additional work;
 - .2 material costs are not to exceed those published in local estimating price guides;
 - .3 mechanical material labour unit costs are to be in accordance with Mechanical Contractors Association of America Labor Estimating Manual, less 25%;
 - .4 electrical material labour unit costs are to be in accordance with National Electrical Contractors Association Manual of Labor Units at difficult level, less 25%;
 - .5 costs for journeyman and apprentice labour must not exceed prevailing rates at time of execution of Contract and must reflect actual personnel performing work;

- .6 cost for site superintendent must not exceed 10% of total hours of labour estimated for change or revision, and change or revision must be such that site superintendent's involvement is necessary;
 - .7 costs for rental tools and/or equipment are not to exceed local rental costs;
 - .8 overhead percentage will be deemed to cover quotation costs other than actual site labour and materials, and rentals;
 - .9 quotations, including those for deleted work, to include a figure for any required change to Contract time.
- .5 Quotations submitted that are not in accordance with requirements specified above will be rejected and returned for re-submittal. Failure to submit a proper quotation to enable Consultant to expeditiously process quotation and issue a Change Order will not be grounds for any additional change to Contract time.
- .6 Make requests for changes or revisions to work to Consultant in writing and, if Consultant agrees, will issue Notice of Change.
- .7 Do not execute any change or revision until written authorization for the change or revision has been obtained from Consultant.

1.20 PROGRESS PAYMENT BREAKDOWN

- .1 Prior to submittal of first progress payment draw, submit a detailed breakdown of work cost to assist Consultant in reviewing and approving progress payment claims.
- .2 Payment breakdown is subject to Owner's approval and Consultant's review. Progress payments will not be processed until an approved breakdown is in place. Breakdown is to include one-time claim items such as mobilization and demobilization, insurance, bonds (if applicable), shop drawings and product data sheets, commissioning including testing, adjusting and balancing, system testing and verification, and project closeout submittals.
- .3 Indicate equipment, material and labour costs for site services (if applicable) and indicate work of each trade in same manner as indicated on progress draw.

1.21 NOTICE FOR REQUIRED FIELD REVIEWS

- .1 Whenever there is a requirement for Consultant to perform a field review prior to concealment of any work, to inspect/re-inspect work for deficiencies prior to Substantial Performance of the Work, for commissioning demonstrations, and any other such field review, give minimum 5 working days' notice in writing to Consultant.
- .2 If Consultant is unable to attend a field review when requested, arrange an alternative date and time.
- .3 Do not conceal work until Consultant advises that it may be concealed.
- .4 When Consultant is requested to perform a field review and work is not ready to be reviewed, reimburse Consultant for time and travel expenses.

1.22 PRELIMINARY TESTING

- .1 When directed by Consultant, promptly arrange, pay for, and perform site tests on any piece of equipment or any system for such reasonable lengths of time and at such times as may be required to prove compliance with Specification and governing Codes and Regulations, prior to Substantial Performance of the Work.

- .2 When, in Consultant's opinion, tests are required to be performed by a certified testing laboratory, arrange and pay for such tests.
- .3 These tests are not to be construed as evidence of acceptance of work, and it is agreed and understood that no claim for delays or damage will be made for injury or breakage to any part or parts of equipment or system due to test where such injuries or breakage were caused by faulty parts and/or workmanship of any kind.
- .4 When, in Consultant's opinion, tests indicate that equipment, products, etc., are defective or deficient, immediately remove such equipment and/or products from site and replace them with acceptable equipment and/or products, at no additional cost.

1.23 PROVISIONS FOR SYSTEMS/EQUIPMENT USED DURING CONSTRUCTION

- .1 Permanent building mechanical systems are not to be used for temporary heating or cooling purposes during construction.

1.24 TEMPORARY SERVICES

- .1 Coordinate with Prime Contractor, requirements for temporary services including but not limited to temporary heating, cooling and water. Unless otherwise noted, provide required services in compliance with requirements of local governing building code and local governing inspection authorities.
- .2 Maintain fire protection of areas which may include fire watch during temporary shutdowns of existing systems, in accordance with requirements of local governing code and local governing authorities.

1.25 MAINTAINING EQUIPMENT PRIOR TO ACCEPTANCE

- .1 Maintain equipment in accordance with the manufacturer's printed instructions prior to start-up, testing and commissioning.
- .2 Employ a qualified millwright to check and align shafts, drives, and couplings on all base mounted split coupled motor driven equipment.
- .3 Where equipment lubrication fittings are not easily accessible, extend the fittings to accessible locations using copper or aluminium tubing.
- .4 All filters are to be new upon Substantial Performance of the Work. This is in addition to any spare filters specified.

1.26 RECORD DOCUMENTATION

- .1 Drawings for this project have been prepared on a CAD system using AutoCAD software of release version reviewed with Consultant. For purpose of producing record "as built" drawings, copies of Contract Drawings can be obtained from Consultant.
- .2 As work progresses at site, clearly mark in red in a neat and legible manner on a set of bound white prints of Contract Drawings, changes and deviations from routing of services and locations of equipment shown on Contract Drawings, on a daily basis. Changes and deviations include those made by addenda, change orders, and site instructions. Use notes marked in red as required. Maintain white print red line as-built set at site for exclusive use of recording as-built conditions, keep set up-to-date at all times, and ensure set is always available for periodic review. As-built set is also to include the following:
 - .1 dimensioned location of inaccessible concealed work;
 - .2 locations of control devices with identification for each;

- .3 for underground piping and ducts, record dimensions, invert elevations, offsets, fittings, cathodic protection and accessories if applicable, and locate dimensions from benchmarks to be preserved after construction is complete;
 - .4 for fire protection systems, record actual locations of equipment, sprinkler heads, and valves, drains, and test locations, and deviations of pipe routing and sizing from that shown on the drawings;
 - .5 location of piping system air vents;
 - .6 location of concealed services terminated for future extension and work concealed within building in inaccessible locations.
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- .3 Before applying for a Certificate of Substantial Performance of the Work, update a clean copy of Contract Drawing set in accordance with marked up set of "as-built" white prints including deviations from original Contract Drawings, thus forming an "as-built" drawing set. Submit "as-built" site drawing prints to Consultant for review. Make necessary revisions to drawings as per Consultant's comments, to satisfaction of Consultant.
 - .4 Use final reviewed "as-built" drawing set to provide CAD files of drawings thus forming true "as-built" set of Contract Drawings. Identify set as "Project Record Copy". Load digital copies of final reviewed by Consultant as-built drawings onto USB type flash drive. Provide 2 complete sets of "as-built" drawings on separate USBs. Submit "as-built" sets of white prints and USBs to Consultant.
 - .5 Submitted drawings are to be of same quality as original Contract Drawings. CAD drawing files are to be compatible with AutoCAD software release version confirmed with Consultant.
 - .6 Unless otherwise noted in Division 00 or Division 01, failure to maintain accurate record drawings will incur additional 5% holdback on progress claims until drawings are brought up to date to satisfaction of Owner and reviewed with Consultant.
 - .7 For projects with phased turnover of project (refer to Division 01), review with Consultant completeness of as-built drawings prior to turn over of an area. Interim as-built drawings to be made available to Owner's maintenance personnel.
 - .8 Where part of the Mechanical Scope of Work, retain and pay for services of a land surveyor registered in Place of the Work to measure, verify, and record size, location, invert elevation and pitch of buried piping services, and, when complete, transfer survey work to as-built drawings.

1.27 OPERATING AND MAINTENANCE DATA

- .1 For each item of equipment for which a shop drawing is required (except for simple equipment), supply indexed copies of equipment manufacturers' operating and maintenance (O&M) instruction data manuals. Consolidate each copy of data as a PDF file on a USB drive. Consolidated O&M manual PDF to include:
 - .1 front cover: project name; wording – "Mechanical Systems Operating and Maintenance Manual"; and date;
 - .2 introduction sheet listing Consultant, Contractor, and Subcontractor names, street addresses, telephone and fax numbers, and e-mail addresses;
 - .3 equipment manufacturer's authorized contact person name, telephone number and company website;
 - .4 Table of Contents sheet, and corresponding index tab sheets;
 - .5 copy of each "REVIEWED" or clean, updated "REVIEWED AS NOTED" shop drawing or product data sheet, with manufacturer's/supplier's name, telephone and fax numbers, email address, company website address, and email address for local source of parts and service; when shop

drawings are returned marked "Reviewed As Noted" with revisions marked on shop drawing copies, they are to be revised by equipment supplier to incorporate comments marked on "Reviewed" shop drawings and a clean updated copy is to be included in operating and maintenance manuals;

- .6 Operating data is to include:
 - .1 pressure test reports, and certificates issued by governing authorities;
 - .2 description of each system and its controls;
 - .3 control schematics for equipment/systems including building environmental controls;
 - .4 wiring and connection diagrams;
 - .5 if applicable, BAS architecture and all required operating data;
 - .6 description of operation of each system at various loads together with reset schedules and seasonal variances;
 - .7 operation instruction for each system and each component;
 - .8 description of actions to be taken in event of emergencies and/or equipment failure;
 - .9 valve tag schedule, and flow diagrams to indicate valve locations.
- .7 Maintenance data is to include:
 - .1 operation and trouble-shooting instructions for each item of equipment and each system;
 - .2 schedules of tasks, frequency, tools required, and estimated task time;
 - .3 recommended maintenance practices and precautions;
 - .4 complete parts lists with numbers.
- .8 Performance data is to include:
 - .1 equipment and system start-up data sheets;
 - .2 equipment performance verification test results, and final commissioning report;
 - .3 final testing, adjusting and balancing reports.
- .9 copies of warranties;
- .10 items requested specifically in Section Articles.
- .2 Operating and maintenance instructions are to relate to job specific equipment supplied under this project and related to Owner's building. Language used in manuals is to contain simple practical operating terms and language easy for in-house maintenance staff to understand how to operate and maintain each system.
- .3 Before applying for a Certificate of Substantial Performance of the Work, assemble one copy of O & M Manual and submit to Consultant for review prior to assembling remaining copies. Incorporate Consultant's comments into final submission.

1.28 COMMISSIONING

- .1 After successful start-up and prior to Substantial Performance of the Work, commission the mechanical work. Commissioning work is the process of Contractor demonstrating to Owner and Consultant, for purpose of final acceptance, by means of successful and documented functional performance testing, that systems and/or subsystems are capable of being operated and maintained to perform in accordance with requirements of Contract Documents, as further described below.
 - .1 Retain services of a testing, adjusting, and balancing agency to perform testing and balancing of mechanical system air/fluid flows and capacities, prior to operational performance testing. Refer to Section 20 05 93 – Testing, Adjusting, and Balancing for Mechanical Systems.
 - .2 Test, adjust and operate equipment and systems after start-up but before functional performance testing, to confirm operations are in accordance with requirements of Contract Documents. Verify modes and sequences of control and monitoring, interlocks, and responses to emergency conditions. Complete commissioning data sheets to document successful operational performance testing.
 - .3 Repeat successful operational performance testing with completed commissioning data sheet documentation in the presence of Consultant and Owner to validate and verify equipment and systems are complete in all respects, function correctly, and are ready for acceptance.
 - .4 Submit final commissioning data sheets, TAB reports as specified in Section 20 05 93 – Testing, Adjusting, and Balancing for Mechanical Systems, project closeout documents, and other required submittals.

1.29 WARRANTY

- .1 Unless otherwise specified in Division 00 and Division 01, warrant mechanical work to be in accordance with Contract Documents and free from defects for a period of 1 year from date of issue of a Certificate of Substantial Performance of the Work.
- .2 Where equipment includes extended warranty period, e.g., 5 years, first year of warranty period is to be governed by terms and conditions of warranty in Contract Documents, and remaining years of warranty are to be direct from equipment manufacturer and/or supplier to Owner. Submit signed and dated copies of extended warranties to Consultant.
- .3 Warranty to include parts, labour, travel costs and living expenses incurred by manufacturer's authorized technician to provide factory authorized on-site service.
- .4 Repair and/or replace any defects that appear in Work within warranty period without additional expense to Owner. Be responsible for costs incurred in making defective work good, including repair or replacement of building finishes, other materials, and damage to other equipment. Ordinary wear and tear and damage caused wilfully or due to carelessness of Owner's staff or agents is exempted.
- .5 Do not include Owner deductible amounts in warranties.
- .6 It is understood that warranties are to commence from time of Substantial Performance of the Work, regardless of what is noted within following Sections of Specification. Be responsible for providing whatever "bridging" or additional extended warranty period is required from time that material is purchased until this time.
- .7 Visit building during warranty period with Owner representatives. Owner to organize these visits. At these meetings, Owner representatives are to review performance of systems. If performance is satisfactory, then no further action needs to be taken. If unsatisfactory, then correct deficiencies, as directed by Owner representatives, to satisfaction of Owner's representatives. These site visits to occur:
 - .1 once during 1st month of building operation;

- .2 once during 3rd month of building operation;
- .3 once between 4th and 10th month in a season opposite to 1st and 3rd month visits.

1.30 CLOSEOUT SUBMITTALS

- .1 Prior to application for Substantial Performance of the Work, submit required items and documentation specified, including following as applicable to the project:
 - .1 Operating and Maintenance Manuals;
 - .2 as-built record drawings and associated data;
 - .3 extended warranties for equipment as specified;
 - .4 operating test certificates, i.e. Sprinkler Test Certificate;
 - .5 final commissioning report and TAB report;
 - .6 identified keys for equipment and/or panels for which keys are required, and other items required to be submitted;
 - .7 other data or products specified.

1.31 INSTRUCTIONS TO OWNER

- .1 Refer to equipment and system operational and maintenance training requirements specified in Division 01.
- .2 Train Owner's designated personnel in aspects of operation and maintenance of equipment and systems as specified. Demonstrations and training are to be performed by qualified technicians employed by equipment/system manufacturer/supplier. Supply hard copies of training materials to each attendee.
- .3 Unless where specified otherwise in trade Sections, minimum requirements are for manufacturer/suppliers of each system and major equipment, to provide minimum two separate sessions each consisting of minimum 4 hours on site or in factory training (at Owner's choice), of Owner's designated personnel (for up to 6 people each session), on operation and maintenance procedures of system.
- .4 For each item of equipment and for each system for which training is specified, prepare training modules as specified below. Use Operating and Maintenance Manuals during training sessions. Training modules include but are not limited to:
 - .1 Operational Requirements and Criteria – equipment function, stopping and starting, safeties, operating standards, operating characteristics, performance curves, and limitations;
 - .2 Troubleshooting – diagnostic instructions, test and inspection procedures;
 - .3 Documentation – equipment/system warranties, and manufacturer's/supplier's parts and service facilities, telephone numbers, email addresses, and the like;
 - .4 Maintenance – inspection instructions, types of cleaning agents to be used as well as cleaning methods, preventive maintenance procedures, and use of any special tools;
 - .5 Repairs – diagnostic instructions, disassembly, component removal and repair instructions, instructions for identifying parts and components, and review of any spare parts inventory.
- .5 Before instructing Owner's designated personnel, submit to Consultant for review preliminary copy of training manual and proposed schedule of demonstration and training dates and times. Incorporate Consultant's comments in final copy.

- .6 Obtain in writing from Consultant list of Owner's representatives to receive instructions. Submit to Consultant prior to application for Certificate of Substantial Performance of the Work, complete list of systems for which instructions were given, stating for each system:
 - .1 date instructions were given to Owner's staff;
 - .2 duration of instruction;
 - .3 names of persons instructed;
 - .4 other parties present (manufacturer's representative, consultants, etc.).
- .7 Obtain signatures of Owner's staff to verify they properly understood system installation, operation and maintenance requirements, and have received operating and maintenance instruction manuals and "as-built" record drawings.
- .8 Submit to Consultant copy of electronic version of training materials and include in operating and maintenance manuals submission.

1.32 FINAL INSPECTION

- .1 Submit to Consultant, written request for final inspection of systems. Include written certification that:
 - .1 deficiencies noted during job inspections have been completed;
 - .2 field quality control procedures have been completed;
 - .3 systems have been tested and verified, balanced and adjusted, and are ready for operation;
 - .4 maintenance and operating data have been completed and submitted to, reviewed with Consultant and accepted by Owner;
 - .5 tags and nameplates are in place and equipment identifications have been completed;
 - .6 clean-up is complete;
 - .7 spare parts and replacement parts specified have been provided and acknowledged by Consultant;
 - .8 as-built and record drawings have been completed and submitted to and reviewed with Consultant and accepted by Owner;
 - .9 Owner's staff has been instructed in operation and maintenance of systems;
 - .10 commissioning procedures have been completed.

2 Products – Not Used

3 Execution – Not Used

3.01 CLEANING

- .1 During construction, keep site reasonably clear of rubbish and waste material resulting from work on a daily basis to the satisfaction of Owner and Consultant. Before applying for a Certificate of Substantial Performance of the Work, remove rubbish and debris, and be responsible for repair of any damage caused as a result of work.

- .2 Clean equipment and devices installed as part of this project.

End of Section

1 General

1.01 SECTION INCLUDES

- .1 This Section specifies firestopping and smoke seal requirements that are common to mechanical work Sections of the Specification and it is a supplement to each Section and is to be read accordingly.

1.02 SUBMITTALS

- .1 Submit a product data sheet and a WHIMIS sheet for each firestopping and smoke seal product.
- .2 Submit for review, full company name and experience of proposed firestopping and smoke seal system applicator.

1.03 CLOSEOUT SUBMITTALS

- .1 Submit a letter of proper firestopping and smoke seal certification as specified in Part 3 of this Section.

1.04 QUALITY ASSURANCE

- .1 Applicator is to have a minimum of 3 years of successful experience on projects of similar size and complexity, and applicator's qualifications are to be reviewed by Consultant.
- .2 Comply with firestopping and smoke seal product manufacturer's recommendations regarding suitable environment conditions for product installation.

2 Products

2.01 FIRESTOPPING AND SMOKE SEAL SYSTEM MATERIALS

- .1 Ensure all sealant and fire stopping is low VOC type in accordance with LEED.
- .2 Asbestos-free elastomeric materials tested, listed and labelled by ULC in accordance with ULC S115 and ULC S101 for installation in ULC designated firestopping and smoke seal systems to provide a positive fire, water and smoke seal, and a fire-resistance rating (flame, hose stream and temperature) not less than fire resistance rating of surrounding fire rated construction.
- .3 Materials are to be compatible with abutting dissimilar materials and finishes and complete with primers, damming and back-up materials, supports, and anchoring devices in accordance with firestopping manufacturer's recommendations and ULC tested assembly.
- .4 Pipe insulation forming part of a fire and smoke seal assembly is specified in Section entitled Mechanical Insulation.
- .5 Manufacturers:
 - .1 A/D Fire Protection Systems "FIREBARRIER";
 - .2 Tremco Inc. Fire Protection Systems Group "TREMSTOP";
 - .3 3M Canada;
 - .4 Hilti (Canada) Ltd. Firestop Systems;
 - .5 Specified Technologies Inc.

3 Execution

3.01 INSTALLATION OF FIRESTOPPING AND SMOKE SEAL MATERIALS

- .1 Where mechanical work penetrates fire rated construction, provide ULC listed and labelled firestopping and smoke seal materials installed in accordance with requirements of ULC S115, ULC S101, and other governing authorities to seal penetrations.
- .2 Abide by following requirements:
 - .1 Examine substrates, openings, voids, adjoining construction and conditions under which firestop and smoke seal system is to be installed. Confirm compatibility of surfaces.
 - .2 Verify penetrating items are securely fixed and properly located with proper space allowance between penetrations and surfaces of openings.
 - .3 Report any unsuitable or unsatisfactory conditions to Contractor and Consultant in writing, prior to commencement of work. Commencement of work will mean acceptance of conditions and surfaces.
 - .4 Mask where necessary to avoid spillage and over coating onto adjoining surfaces. Remove stains on adjacent surfaces.
- .3 Conform to following application requirements:
 - .1 Prime substrates in accordance with product manufacturer's written instructions.
 - .2 Provide temporary forming as required and remove only after materials have gained sufficient strength and after initial curing.
 - .3 Tool or trowel exposed surfaces to a neat, smooth, and consistent finish.
 - .4 Remove excess compound promptly as work progresses and upon completion.
 - .5 At fusible link damper locations, seal perimeter of angle iron framing on both sides of wall or slab with ULC listed and labelled sealant materials to provide a positive smoke seal.
- .4 Notify Consultant when work is complete and ready for inspection, and prior to concealing or enclosing firestopping and smoke seal materials and service penetration assemblies. Arrange for final inspection of work by Municipal Building Inspector prior to concealing or enclosing work. Make any corrections required.
- .5 On completion of firestopping and smoke sealing installation, submit a Letter of Assurance to Consultant certifying the firestopping and smoke sealing installation has been carried out throughout the building to mechanical service penetrations and that installation has been done in strict accordance with requirements of Provincial Building Code, any applicable local Municipal Codes, ULC requirements, and manufacturer's instructions.

End of Section

1 General

1.01 SECTION INCLUDES

- .1 This Section specifies vibration isolation product requirements that are common to mechanical work Sections of the Specification and it is a supplement to each Section and is to be read accordingly.

1.02 SUBMITTALS

- .1 Submit copies of manufacturer's product data sheets for products specified in this Section. Product data sheets are to include product characteristics, limitations, dimensions, finishes, and installation recommendations.

1.03 CLOSEOUT SUBMITTALS

- .1 Submit a letter from vibration isolation manufacturer to certify correct installation of products, as specified in Part 3 of this Section.

1.04 SEISMIC RESTRAINT REQUIREMENTS

- .1 Where applicable to the project, refer to Section 20 05 48.16 "Seismic Controls for Mechanical Systems" for requirements for the use of a Seismic Consultant and seismic restraint requirements required for vibration isolated materials and equipment.

2 Products

2.01 GENERAL

- .1 Vibration isolation products are to be in accordance with the most recent edition of the ASHRAE Handbook and/or as indicated on drawings, schedules, details, and as specified below.
- .2 Springs are to be stable, colour coded, selected to operate at no greater than $\frac{2}{3}$ solid load, designed in accordance with Society of Automotive Engineers Handbook Supplement 9 entitled Manual on Design and Application of Helical and Spiral Springs, and with spring diameters in accordance with manufacturer's recommendations to suit static deflection and maximum equipment load.
- .3 Steel components of isolation products not exposed to the weather or moisture are to be zinc plated. Steel components of isolation products exposed to the weather or in a damp, moist environment are to be factory painted with rust inhibiting primer and 2 coats of neoprene.
- .4 Where weight of isolated equipment may change significantly due to draining or filling with a liquid, vibration isolators are to be equipped with limit stops to limit spring extensions.
- .5 Seismic rated isolators and snubbers are to be listed, rated, and approved by State of California Office of Statewide Health and Planning Department (O.S.H.P.D.) and carry an O.S.H.P.D. pre-approved number. Seismic restraints supplied with vibration isolation are to meet requirements specified in Section entitled Seismic Control and Restraint.
- .6 Flexible piping connections to vibration isolated equipment are specified in the appropriate piping sections of the Specification.

2.02 ISOLATION PADS

- .1 Sandwich type pads, 20 mm ($\frac{3}{4}$ " nominal thickness, selected for 3.2 mm (1/8") static deflection unless otherwise specified, consisting of 2 waffle type or ribbed 50 durometer neoprene pads permanently bonded to a minimum #10 gauge steel plate, and complete with rubber bushed bolt holes and equipment anchor bolts with neoprene isolation grommets.
- .2 Manufacturers:

- .1 Vibro-Acoustics Ltd. Type NSN;
- .2 The VMC Group Vibration Mounting & Controls Inc. (Korfund-Dynamics) "SHEAR-FLEX PLATES";
- .3 Kinetics Noise Control Vibron Products Group Type NGS/NGD;
- .4 Mason Industries Inc. Type SW/S/SW with HG Bolt Insertion Washers;
- .5 J. P. America Inc. Type JSJ.

2.03 RUBBER FLOOR ISOLATORS

- .1 Captive, bridge bearing quality neoprene mount selected for a minimum 4 mm (0.15") static deflection unless otherwise specified, with an integral ductile iron housing and integral equipment anchor bolt.
- .2 Manufacturers:
 - .1 Vibro-Acoustics Ltd. Type R;
 - .2 The VMC Group Vibration Mounting & Controls (Korfund-Dynamics) Type RSM;
 - .3 Kinetics Noise Control Vibron Products Group Type RQ;
 - .4 Mason Industries Inc. Type BR;
 - .5 J. P. America Inc. Type TRM.

2.04 SPRING FLOOR ISOLATORS

- .1 Seismically rated captive spring mount isolator complete with levelling bolts, upper and lower neoprene spring cups, neoprene cushion, ductile iron housing, neoprene sound pads, and neoprene isolation grommets for securing bolts.
- .2 Manufacturers:
 - .1 Vibro-Acoustics Ltd. Type SFS;
 - .2 The VMC Group Vibration Mounting & Controls (Korfund-Dynamics) Type AMSR;
 - .3 Kinetics Noise Control Vibron Products Group Type FLSS;
 - .4 Mason Industries Inc. Type SSLFH;
 - .5 J. P. America Inc. Type TSO-C-SC.

2.05 OPEN SPRING MOUNTS

- .1 Base mount free-standing assemblies, each complete with a stable colour coded steel spring welded in place, drilled mild steel mounting plate bonded to a ribbed rubber or neoprene acoustical pad, and an external 16 mm (5/8") diameter level adjustment bolt.
- .2 Manufacturers:
 - .1 Vibro-Acoustics Ltd. Type FS;
 - .2 The VMC Group Vibration Mounting & Controls (Korfund-Dynamics) "Spring-Flex" Type A;
 - .3 Kinetics Noise Control Vibron Products Group Type FDS;

- .4 Mason Industries Inc. Type SLFH;
- .5 J. P. America Inc. Type TSO.

2.06 CLOSED SPRING MOUNTS

- .1 Base mount free-standing enclosed assemblies, each complete with stable colour coded spring(s), 2 piece cast housing, non-binding rubber horizontal stabilizers, a ribbed rubber or neoprene acoustical pad bonded to base of the closed housing, and an external level adjustment bolt.
- .2 Manufacturers:
 - .1 Vibro-Acoustics Ltd. Type CM;
 - .2 The VMC Group Vibration Mounting & Controls (Korfund-Dynamics) "Spring-Flex" Types B and C;
 - .3 Kinetics Noise Control Vibron Products Group Type FLS;
 - .4 Mason Industries Inc. Type C;
 - .5 J. P. America Inc. Type TSC.

2.07 TOTALLY RETAINED SPRING MOUNTS

- .1 Base mount free-standing enclosed and retained assemblies to limit both vertical and lateral movement of mounted equipment, each complete with stable colour coded spring(s), drilled welded steel housing and top plate, ribbed rubber or neoprene acoustical pad bonded to bottom of housing, vertical limit adjusting hardware, and a level adjustment bolt.
- .2 Manufacturers:
 - .1 Vibro-Acoustics Ltd. Type CSR;
 - .2 The VMC Group Vibration Mounting & Controls (Korfund-Dynamics) "Spring-Flex" Type MS;
 - .3 Kinetics Noise Control Vibron Products Group Type SM;
 - .4 Mason Industries Inc. Type SLRSO;
 - .5 J. P. America Inc. Type TSR.

2.08 SPRING HANGERS

- .1 Welded steel plate housing with top and bottom rod mounting holes and spring retainer, neoprene double deflection isolation element, stable colour coded spring, and heavy-duty rubber washers.
- .2 Manufacturers:
 - .1 Vibro-Acoustics Ltd. Type SHR-SN;
 - .2 The VMC Group Vibration Mounting & Controls (Korfund-Dynamics) "Spring-Flex" Series HRSA;
 - .3 Kinetics Noise Control Vibron Products Group. Type SRH;
 - .4 Mason Industries Inc. Type 30N;
 - .5 J. P. America Inc. Type TSH.

2.09 NEOPRENE HANGER ISOLATORS

- .1 Neoprene double deflection rod isolators with steel housing and hanger rod bushing, selected for a minimum 4 mm (0.15") static deflection unless otherwise specified.
- .2 Manufacturers:
 - .1 Vibro-Acoustics Ltd. Type NH;
 - .2 The VMC Group Vibration Mounting & Controls (Korfund-Dynamics) Type HR;
 - .3 Kinetics Noise Control Vibron Products Group Type RH;
 - .4 Mason Industries Inc. Type HD or WHD;
 - .5 J. P. America Inc. Type TRH.

2.10 CONCRETE INERTIA TYPE EQUIPMENT BASE

- .1 Welded steel bases, each complete with a structural black steel channel frame, concrete reinforcing rods, and brackets for spring mounts welded to frame.
- .2 Manufacturers:
 - .1 Vibro-Acoustics Ltd. Type CIB;
 - .2 The VMC Group Vibration Mounting & Controls (Korfund-Dynamics) Type CPF;
 - .3 Kinetics Noise Control Vibron Products Group. Type CIB;
 - .4 Mason Industries Inc. Type KSL;
 - .5 J. P. America Inc. Type BCI.

2.11 STEEL EQUIPMENT BASE

- .1 Fully welded structural steel equipment and motor support bases, each complete with a wide flange steel frame, full depth cross members, brackets for spring mounts, and adjustable motor slide rails.
- .2 Manufacturers:
 - .1 Vibro-Acoustics Ltd. Type SB;
 - .2 The VMC Group Vibration Mounting & Controls (Korfund-Dynamics) Type WFB;
 - .3 Kinetics Noise Control Vibron Products Group Type SFB;
 - .4 Mason Industries Inc. Type WFSL;
 - .5 J. P. America Inc. Type BWS (with motor slide rail).

2.12 COMBINATION STEEL /CONCRETE INERTIA EQUIPMENT BASE

- .1 Welded steel bases with a structural black steel channel frame, concrete reinforcing rods, bottom sheet steel pan, brackets for spring mounts welded to frame and adjustable motor slide rails.
- .2 Manufacturers:
 - .1 Vibro-Acoustics Ltd. Type CIB (with motor slide rails);

- .2 The VMC Group Vibration Mounting & Controls (Korfund-Dynamics) Type WPF (with motor slide rails);
- .3 Kinetics Noise Control Vibron Products Group Type CIB (with motor slide rails);
- .4 Mason Industries Inc. Type BMK or K;
- .5 J. P. America Inc. Type BSI (with motor slide rail).

2.13 SLUNG STEEL BASE

- .1 Slung steel bases of structural members with gusset plates welded to ends and complete with adjustable motor slide rails and vertical section size to suit equipment's motor power output.
- .2 Manufacturers:
 - .1 Vibro-Acoustics Ltd. Type SS;
 - .2 The VMC Group Vibration Mounting & Controls (Korfund-Dynamics) Type CPF;
 - .3 Kinetics Noise Control Vibron Products Group Type CIB-H;
 - .4 Mason Industries Inc. Type MSL.

2.14 CONTINUOUS RAIL TYPE ISOLATION FOR ROOF MOUNTED EQUIPMENT

- .1 Continuous rooftop isolation shipped completely assembled, consisting of:
 - .1 galvanized steel sections formed to fit roof curb and associated equipment with a flexible air and weather seal joining upper and lower rail sections;
 - .2 stable springs, cadmium plated and selected to provide minimum deflection with 50% additional travel to solid;
 - .3 neoprene cushioned and wind restraints allowing 6 mm (¼") movement before engaging and resisting wind loads in any lateral direction.
- .2 Manufacturers:
 - .1 Vibro-Acoustics Ltd. Vibro-Acoustics Type RTR;
 - .2 The VMC Group Vibration Mounting and Controls (Korfund-Dynamics) Type RTIR;
 - .3 Kinetics Noise Control Vibron Products Group Type KSR;
 - .4 Mason Industries Inc. Type RSC;
 - .5 J. P. America Inc. Type BRC.

3 Execution

3.01 INSTALLATION OF VIBRATION ISOLATION MATERIALS

- .1 Unless otherwise stated in the drawings, schedules and/or typical details, vibration isolation is to be provided for all mechanical equipment as per the recommendations contained within in the most recent edition of the ASHRAE Handbook.

- .2 Supply to vibration isolation product manufacturer or supplier a copy of a "reviewed" shop drawing or product data sheet for each piece of equipment to be isolated and dimensioned pipe layouts of associated piping to be isolated.
- .3 Unless otherwise specified, vibration isolation products are to be product of one manufacturer.
- .4 Ensure vibration isolation manufacturer coordinates material selections with equipment provided in order to ensure adherence to performance criteria. Allow for expansion and contraction when material is selected and installed.
- .5 Unless otherwise indicated, install isolation materials for base mounted equipment on concrete housekeeping pad bases which extend at least over the full base and isolated area of the isolated equipment. Additional requirements are as follows:
 - .1 block and shim bases level so ductwork and piping connections can be made to a rigid system at proper operating level, before isolated adjustment is made, and ensure there is no physical contact between isolated equipment and building structure;
 - .2 steel bases are to clear the sub-base by 25 mm (1");
 - .3 concrete bases are to clear the sub-base by 50 mm (2").
- .6 Isolate piping larger than 25 mm (1") dia. directly connected to motorized and/or vibration isolated equipment with 25 mm (1") static deflection spring hangers at spacing intervals in accordance with following:
 - .1 for pipe less than or equal to 100 mm (4") dia. – first 3 points of support;
 - .2 for pipe 125 mm (5") to 200 mm (8") dia. – first 4 points of support;
 - .3 for pipe equal to or greater than 250 mm (10") dia. – first 6 points of support;
- .7 First point of isolated piping support is to have a static deflection of twice the deflection of the isolated equipment but maximum 50 mm (2").
- .8 Secure top of spring hanger frame rigidly to structure, and do not install spring hangers in concealed locations.
- .9 Where it is impossible to use at least 2 spring hangers, provide Senior Flexonics Ltd. Style 102 (or 102-U as required) or equal, twin sphere, moulded rubber flexible connection assemblies, selected by manufacturer and suitable in all respects for intended application, and complete with required nipples and connections to provide proper vibration isolation.
- .10 Isolate designated piping risers at floor support points in accordance with drawing detail and/or where indicated on drawings.
- .11 Erect roof curb vibration isolation in accordance with instructions shipped with assembly. Match vibration isolation with associated roof top unit and orient isolation as identified by manufacturer to ensure proper loading and optimum performance. Caulk top of roof curb with 2 beads of caulking provided and centre isolation assembly onto roof curb and, unless otherwise noted, screw in place with 50 mm (2") lag screws at 900 mm (36") O.C. Position gasket on top rail or alternatively, caulk with 2 beads of caulking provided and orient and lower roof top unit onto isolation rails and, unless otherwise noted, screw unit into top rail with 25 mm (1") lag screws at 900 mm (36") O.C. After roof top unit is secured in place, but before damageable work is installed, spray each isolated equipment assembly with water and correct any water leaks.
- .12 For control wiring connections to vibration isolated equipment ensure flexible metallic conduit with 90° bend is used for conduit 25 mm (1") dia. and smaller, and for conduit larger than 25 mm (1") dia., use Crouse Hinds EC couplings. Connections are to be long enough so that conduit will remain intact if

equipment moves 300 mm (12") laterally from its installed position, and flexible enough to transmit less vibration to structure than is transmitted through vibration isolation. Coordinate these requirements with mechanical trades involved. If electrical power connections are not made in a similar manner as part of the electrical work, report this fact to Consultant.

- .13 Arrange and pay for vibration isolation product manufacturer to visit site to inspect installation of his equipment. Perform revision work required as a result of improper installation. When vibration isolation equipment manufacturer is satisfied with the installation, obtain and submit a letter stating manufacturer has inspected the installation and equipment is properly installed.
- .14 For requirements pertaining to seismically restrained vibration isolation, refer to Section 20 05 48.16 - Seismic Controls for Mechanical Systems.

End of Section

1 General

1.01 SECTION INCLUDES

- .1 This Section specifies mechanical system testing, adjusting, and balancing requirements that are common to mechanical work Sections of the Specification and it is a supplement to each Section and is to be read accordingly.

1.02 DEFINITIONS

- .1 “Agency” – means agency to perform testing, adjusting and balancing work.
- .2 “TAB” – means testing, adjusting and balancing to determine and confirm quantitative performance of equipment and systems and to regulate specified fluid flow rate and air patterns at terminal equipment, e.g., reduce fan speed, throttling, etc.
- .3 “hydronic systems” – includes heating water, chilled water, glycol-water solution, condenser water, and any similar system.
- .4 “air systems” – includes outside air, supply air, return air, exhaust air, and relief air systems.
- .5 “flow rate tolerance” – means allowable percentage variation, minus to plus, of actual flow rate values in Contract Documents.
- .6 “report forms” – means test data sheets arranged for collecting test data in logical order for submission and review, and these forms, when reviewed and accepted, should also form permanent record to be used as basis for required future testing, adjusting and balancing.
- .7 “terminal” – means point where controlled fluid enters or leaves the distribution system, and these are supply inlets on water terminals, supply outlets on air terminals, return outlets on water terminals, and exhaust or return inlets on air terminals such as registers, grilles, diffusers, louvers, and hoods.
- .8 “main” – means duct or pipe containing system’s major or entire fluid flow.
- .9 “submain” – means duct or pipe containing part of the systems’ capacity and serving 2 or more branch mains.
- .10 “branch main” – means duct or pipe servicing 2 or more terminals.
- .11 “branch” – means duct or pipe serving a single terminal.

1.03 SUBMITTALS

- .1 Within 30 days of work commencing at site, submit name and qualifications of proposed testing and balancing agency in accordance with requirements of article entitled Quality Assurance below.
- .2 Submit sample test forms, if other than those standard forms prepared by Associated Air Balance Council (AABC) or National Environmental Balancing Bureau (NEBB), are proposed for use.
- .3 Submit a report by Agency to indicate Agency’s evaluation of mechanical drawings with respect to service routing and location or lack of balancing devices. Include set of drawings used and marked-up by Agency to prepare report.

1.04 CLOSEOUT SUBMITTALS

- .1 Submit a report by Agency after each site visit made by Agency during construction phase of this Project.
- .2 Submit a draft report, as specified in Part 3 of this Section.
- .3 Submit a final report, as specified in Part 3 of this Section.

- .4 Submit a testing and balancing warranty as specified in Part 3 of this Section.
- .5 Submit reports listing observations and results of post construction site visits as specified in Part 3 of this Section.

1.05 QUALITY ASSURANCE

- .1 Employ services of an independent testing, adjusting, and balancing agency meeting qualifications specified below, to be single source of responsibility to test, adjust, and balance building mechanical systems to produce design objectives. Agency is to have successfully completed testing, adjusting and balancing of mechanical systems for a minimum of 5 projects similar to this Project within past 3 years, and is to be certified as an independent agency in required categories by one of following:
 - .1 AABC – Associated Air Balance Council;
 - .2 NEBB – National Environmental Balancing Bureau.
- .2 NBCTA certification in lieu of the above noted organizations is not permitted.
- .3 Testing, adjusting and balancing of complete mechanical systems is to be performed over entire operating range of each system in accordance with 1 of following publications:
 - .1 National Standards for a Total System Balance published by Associated Air Balance Council;
 - .2 Procedural Standards for Testing, Adjusting and Balancing of Environmental Systems published by National Environmental Balancing Bureau;
 - .3 Chapter 37, Testing, Adjusting, and Balancing of ASHRAE Handbook HVAC Applications.

2 Products – Not Used

3 Execution

3.01 SCOPE OF WORK

- .1 Perform total mechanical systems testing, adjusting, and balancing. Requirements include measurement and establishment of fluid quantities of mechanical systems as required to meet design specifications and comfort conditions, and recording and reporting results.
- .2 Mechanical systems to be tested, adjusted and balanced include:
 - .1 TAB of domestic water systems (all piping extended from Municipal main) is to include:
 - .1 domestic hot water recirculation piping;
 - .2 tempered water piping flows.
 - .2 TAB of heating systems is to include piping and equipment fluid temperatures, flows and control, and if TAB is not done during heating season, a follow-up site visit during heating season will be required to confirm proper flows and temperatures, and any required system "fine tuning".
 - .3 TAB of cooling systems is also to include piping and equipment fluid temperatures, flows and control, and if TAB is not done during cooling season, a follow-up site visit during cooling season will be required to confirm proper flows and temperatures, and any required system "fine".
 - .4 TAB of air handling systems is to include equipment and ductwork air temperatures, capacities and flows.

3.02 TESTING, ADJUSTING, AND BALANCING

- .1 Conform to following:
 - .1 as soon as possible after award of Contract, Agency is to carefully examine a set of mechanical drawings with respect to routing of services and location of balancing devices, and is to issue a report listing results of the evaluation;
 - .2 set of drawings examined by Agency is to be returned with evaluation report, with red line mark-ups to indicate locations for duct system test plugs, and required revision work such as relocation of balancing devices and locations for additional devices;
 - .3 after review of mechanical work drawings and specification, Agency is to visit site at frequent, regular intervals during construction of mechanical systems, to observe routing of services, locations of testing and balancing devices, workmanship, and anything else that will affect testing, adjusting and balancing;
 - .4 after each site visit, Agency is to report results of site visit indicating date and time of visit, and detailed recommendations for any corrective work required to ensure proper adjusting and balancing;
 - .5 testing, adjusting and balancing is not to begin until:
 - .1 building construction work is substantially complete and doors have been installed;
 - .2 mechanical systems are complete in all respects, and have been checked, started, adjusted, and then successfully performance tested.
 - .6 mechanical systems to be tested, adjusted and balanced are to be maintained in full, normal operation during each day of testing, adjusting and balancing;
 - .7 obtain copies of reviewed shop drawings of applicable mechanical plant equipment and terminals, and temperature control diagrams and sequences;
 - .8 Agency is to walk each system from system "head end" equipment to terminal units to determine variations of installation from design, and system installation trades will accompany Agency;
 - .9 Agency is to check valves and dampers for correct and locked position, and temperature control systems for completeness of installation before starting equipment;
 - .10 wherever possible, Agency is to lock balancing devices in place at proper setting, and permanently mark settings on devices;
 - .11 Agency is to leak test ductwork as specified in Section entitled HVAC Air Distribution in accordance with requirements of SMACNA "HVAC Air Duct Leak Test Manual", coordinate work with work of aforementioned Sections, provide detailed sketch(es) to Sheet Metal Contractor and Consultant identifying ductwork not in accordance with acceptable leakage values specified in aforementioned Sections, and retest corrected ductwork;
 - .12 Agency is to balance systems with due regard to objectionable noise which is to be a factor when adjusting fan speeds and performing terminal work such as adjusting air quantities, and should objectionable noise occur at design conditions, Agency is to immediately report problem and submit data, including sound readings, to permit an accurate assessment of noise problem to be made;
 - .13 Agency is to check supply air handling system mixing plenums for stratification, and where variation of mixed air temperature across coils is found to be in excess of $\pm 5\%$ of design

- requirements, Agency is to report problem and issue a detail sketch of plenum baffle(s) required to eliminate stratification;
- .14 Agency is to perform testing, adjusting and balancing to within $\pm 5\%$ of design values, and make and record measurements which are within $\pm 2\%$ of actual values;
 - .15 for air handling systems equipped with air filters, test and balance systems with simulated 50% loaded (dirty) filters by providing a false pressure drop;
 - .16 test, adjust and balance air conditioning systems during summer season and heating systems during winter season, including at least a period of operation at outside conditions within 2.8°C (5°F) wet bulb temperature of maximum summer design condition, and within 5.5°C (10°C) dry bulb temperature of minimum winter design condition, and take final temperature readings during seasonal operation.
- .2 Prepare reports as indicated below.
- .1 Upon completion of testing, adjusting, and balancing procedures, prepare draft reports on AABC or NEBB forms. Draft reports may be hand written, but must be complete, factual, accurate, and legible. Organize and format draft reports in same manner specified for final reports and submit for review.
 - .2 Upon verification and approval of draft reports, prepare final reports organized and formatted as specified below. Use units of measurement (SI or Imperial) as used on Project Documents.
 - .3 Report forms are to be those standard forms prepared by the referenced standard for each respective item and system to be tested, adjusted, and balanced. Report forms complete with schematic systems diagrams and other data are to be consolidated in electronic format as a PDF. PDF file to be indexed and organized into sections, as it applies to the project, as follows:
 - .1 General Information and Summary;
 - .2 Air Systems;
 - .3 Hydronic Systems;
 - .4 Temperature Control Systems;
 - .5 Special Systems.
 - .4 Agency is to provide following minimum information, forms and data in report:
 - .1 inside cover sheet to identify Agency, Contractor, and Project, including addresses, and contact names and telephone numbers and a listing of instrumentation used for procedures along with proof of calibration;
 - .2 remainder of report is to contain appropriate forms containing as a minimum, information indicated on standard AABC or NEBB report forms prepared for each respective item and system;
 - .3 Agency is to include for each system to be tested, adjusted and balanced, a neatly drawn, identified (system designation, plant equipment location, and area served) schematic "as-built" diagram indicating and identifying equipment, terminals, and accessories;
 - .4 Agency is to include report sheets indicating building comfort test readings for all rooms.
- .3 After final testing and balancing report has been submitted, Agency is to visit site with Contractor and Consultant to spot check results indicated on balancing report. Agency is to supply labour, ladders, and

instruments to complete spot checks. If results of spot checks do not, on a consistent basis, agree with final report, spot check procedures will stop and Agency is to then rebalance systems involved, resubmit final report, and again perform spot checks with Contractor and Consultant.

- .4 When final report has been accepted, Contractor is to submit to Owner, in name of Owner, a certificate equal to AABC National Guaranty Certification or a NEBB Quality Assurance Program Bond, and in addition, Contractor is to submit a written extended warranty from Agency covering one full heating season and one full cooling season, during which time any balancing problems which occur, with exception of minor revision work done during scheduled site visits, will, at no cost, be investigated by Agency and reported on to Owner, and if it is determined that problems are a result of improper testing, adjusting and balancing, they are to be immediately corrected without additional cost to Owner.

End of Section

1 General

1.01 SECTION INCLUDES

- .1 This Section specifies insulation requirements common to Mechanical Divisions work Sections and it is a supplement to each Section and is to be read accordingly.

1.02 DEFINITIONS

- .1 "concealed" – means mechanical services and equipment above suspended ceilings, in non-accessible chases, in accessible pipe spaces, and furred-in spaces.
- .2 "exposed" – means exposed to normal view during normal conditions and operations.
- .3 "mineral fibre" – includes glass fibre, rock wool, and slag wool.
- .4 "domestic water" or "potable water" – means piping extended from building Municipal supply main.

1.03 SUBMITTALS

- .1 At least 4 weeks prior to insulation work commencing, submit a sample of each type of insulation (and insulation accessories and finish), in applied form, for review. Mount samples on a plywood board. Identify each product with manufacturer's name and insulation type, and proposed use of insulation. When sample board has been approved, mechanical insulation work is to conform to approved sample board.
- .2 Submit a product data sheet for each insulation system product.
- .3 Submit a fabrication drawing for each custom made cover to indicate material and fabrication details, and a 300 mm (12") square sample of proposed cover material.
- .4 Submit a colour chart for coloured lagging adhesive for canvas jacketed insulation.

1.04 CLOSEOUT SUBMITTALS

- .1 In accordance with Part 3 of this Section, submit a letter from fire rated duct wrap supplier to certifying duct wrap has been properly installed.

1.05 QUALITY ASSURANCE

- .1 Mechanical insulation is to be applied by a licensed journeyman insulation mechanic, or by an apprentice under direct, daily, on-site supervision of a journeyman mechanic.
- .2 Do not apply insulation unless leakage tests have been satisfactorily completed.
- .3 Ensure surfaces to be insulated are clean and dry.
- .4 Ensure ambient temperature is minimum 13°C (55°F) for at least 1 day prior to application of insulation, and for duration of insulation work, and relative humidity is and will be at a level such that mildew will not form on insulation materials.
- .5 Company with sub-contract for mechanical insulation work is to be a member in good standing of Thermal Insulation Association of Canada.
- .6 Insulation materials must be stored on site in a proper and dry storage area. Any wet insulation material is to be removed from site.

2 Products

2.01 FIRE HAZARD RATINGS

- .1 Unless otherwise specified, insulation system materials inside building must have a fire hazard rating of not more than 25 for flame spread and 50 for smoke developed when tested in accordance with ULC S102, Surface Burning Characteristics of Building Materials and Assemblies.

2.02 THERMAL PERFORMANCE

- .1 Unless otherwise specified, thermal performance of insulation is to meet or exceed values given in Tables entitled Minimum Piping Insulation Thickness Heating and Hot Water Systems and Minimum Piping Insulation Thickness Cooling Systems, as stated in ANSI/ASHRAE/IES Standard 90.1 version referenced in Ontario Building Code.

2.03 PIPE INSULATION MATERIALS

- .1 Horizontal pipe insulation at hangers and supports are to be equal to Belform Insulation Ltd. "Koolphen K-Block" insulated pipe support inserts consisting of minimum 150 mm (6") long, pre-moulded, rigid, sectional phenolic foam insulation (of same thickness as adjoining insulation) with a reinforced foil and kraft paper vapour barrier jacket and a captive galvanized steel saddle.
- .2 Flexible foam elastomeric is to be closed cell, sleeve type, longitudinally split self-seal, foamed plastic pipe insulation with a water vapour transmission rating of 0.10 in accordance with ASTM E96, Procedure B, and required installation accessories.
 - .1 Manufacturers:
 - .1 Armacell AP/Armaflex SS;
 - .2 IK Insulation Group K-Flex "LS" Self-Seal Pipe Insulation.
- .3 Closed cell foamed glass is to be Pittsburgh Corning "FOAMGLASS", expanded, sectional, rigid sleeve type insulation with a liquid or vapour permeability rating (as per ASTM C240) of 0.00, and a factory applied "PITTWRAP SSII" self-sealing jacket.
- .4 Premoulded mineral wool is to be rigid, sectional, sleeve type, non-combustible, longitudinally split mineral wool or basalt pipe insulation with a reinforced vapour barrier jacket.
 - .1 Manufacturers:
 - .1 Roxul "Tecton 1200";
 - .2 IIG (Johns Manville Inc.) MinWool-1200;
 - .3 Paroc 1200.
- .5 Fire rated pre-moulded mineral wool is to be non-combustible, fire-rated, rigid, sectional, longitudinally split mineral wool or basalt pipe insulation with a reinforced vapour barrier jacket and compatible with ULC S115 and ULC-S101 firestopping.
 - .1 Manufacturers:
 - .1 Roxul "Tecton 1200";
 - .2 IIG (Johns Manville Inc.) MinWool-1200;
 - .3 Paroc 1200.

- .6 Pre-moulded mineral fibre is to be rigid, sectional, sleeve type insulation to ASTM C547, with a factory applied vapour barrier jacket.
 - .1 Manufacturers:
 - .1 Johns Manville Inc. "Micro-Lok AP-T Plus";
 - .2 Knauf Fiber Glass "Pipe Insulation" with "ASJ-SSL" jacket;
 - .3 Manson Insulation Inc. "ALLEY K APT";
 - .4 Owens Corning "Fiberglas" Pipe Insulation.
 - .7 Blanket mineral fibre is to be blanket type roll insulation to CGSB 51-GP-11M, 24 kg/m³ (1-½ lb/ft³) density, with a factory applied vapour barrier facing.
 - .1 Manufacturers:
 - .1 Johns Manville Inc. Microlite FSK Duct Wrap Type 150;
 - .2 Knauf Fiber Glass Blanket Insulation FSK Duct Wrap Type III;
 - .3 Manson Insulation Inc. ALLEY WRAP FSK Duct Wrap Type III;
 - .4 Certainteed Corporation Softtouch FSK Duct Wrap Type 150.
 - .8 Pre-moulded weatherproof jacketed mineral fibre is to be Knauf Insulation "Redi-Klad 1000" sectional, sleeve type pipe insulation with a self-sealing weather-proof jacket and a 100 mm (4") butt joint sealing strip with each section.

2.04 BARRIER-FREE LAVATORY PIPING INSULATION KITS

- .1 Removable, flexible, reusable, white moulded plastic insulation kits for barrier-free lavatory drain piping and potable water supplies exposed under lavatory.
- .2 Manufacturers:
 - .1 Truebo "Lav-Guard 2" E-Z Series;
 - .2 Zeston "SNAP-TRAP";
 - .3 McGuire Manufacturing Co. Inc. "ProWrap".

2.05 EQUIPMENT INSULATION MATERIALS

- .1 Blanket mineral fibre is to be blanket type roll form insulation to ASTM C553, 24 kg/m³ (1-½ lb/ft³) density, with a factory applied vapour barrier facing.
 - .1 Manufacturers:
 - .1 Johns Manville Inc. Microlite FSK Duct Wrap Type 150;
 - .2 Knauf Fiber Glass Blanket Insulation FSK Duct Wrap Type III;
 - .3 Manson Insulation Inc. ALLEY WRAP FSK Duct Wrap Type III;
 - .4 Certainteed Corporation Softtouch FSK Duct Wrap Type 150.

- .2 Semi-rigid mineral fibre board is to be roll form, moulded insulation to ASTM C1393, with a factory applied vapour barrier facing consisting of laminated aluminum foil and kraft paper.
 - .1 Manufacturers:
 - .1 Knauf Fiber Glass Pipe and Tank Insulation;
 - .2 Manson Insulation Inc. "AK FLEX";
 - .3 Johns Manville Inc. Pipe and Tank Insulation "Micro-Flex";
 - .4 Multi-Glass Insulation Ltd. "MULTI-FLEX MF";
 - .5 Owens Corning Pipe and Tank Insulation;
 - .6 Glass-Cell Fabricators Ltd. "R-Flex".
- .3 Semi-rigid mineral wool blanket is to be equal to Roxul "Enerwrap MA 960" flexible, black fibrous scrim faced mineral wool blanket insulation to ASTM C553.
- .4 Closed cell foamed glass is to be Pittsburgh Corning "FOAMGLAS" expanded, rigid board and block type insulation with a liquid or vapour permeability rating (as per ASTM C240) of 0.00.

2.06 REMOVABLE/REUSABLE INSULATION COVERS

- .1 Valve, etc. covers are to be NO SWEAT reusable insulation wraps with vapour barrier jacket and self-sealing ends and longitudinal seam, with a length to suit the application and an insulation thickness equal to adjoining insulation.
- .2 Custom manufactured equipment covers conforming to shape of item to be insulated, designed to be easily removable and replaceable to suit use and maintenance procedures of particular item, and to provide adequate personnel protection. Covers are to be complete with minimum 95 kg/m³ (6 lb/ft³) density ceramic fibre insulation sewn between minimum 542.5 g/m² (1.8 oz/ft²) weight silicone impregnated fibreglass fabric in a quilted pattern using double stitches made with Kelvar or Teflon coated fibreglass thread. Overlap flaps are to be secured using laces, snaps, or Velcro double stitched in place.
- .3 Manufacturers:
 - .1 Crosby Dewar Inc.;
 - .2 Insufab Systems Inc.;
 - .3 ADL Insulflex Inc.;
 - .4 Firwin Corp.;
 - .5 GlassCell Isofab Inc.

2.07 DUCTWORK SYSTEM INSULATION MATERIALS

- .1 Rigid mineral fibre board is to be pre-formed board type insulation to ASTM C612, 48 kg/m³ (3 lb/ft³) density, with a factory applied reinforced aluminum foil and kraft paper facing.
 - .1 Manufacturers:
 - .1 Knauf Fiber Glass Insulation Board with FSK facing;
 - .2 Manson Insulation Inc. "AK BOARD FSK";

- .3 Johns Manville Inc. Type 814 "Spin-Glas";
- .4 Owens Corning 703.
- .2 Semi-rigid mineral fibre board is to be roll form insulation to ASTM C1393, consisting of cut strips of rigid mineral board insulation glued to an aluminium foil and kraft paper facing.
 - .1 Manufacturers:
 - .1 Multi-Glass Insulation Ltd. "Multi-Flex MKF";
 - .2 Glass-Cell Fabricators Ltd. "R-FLEX";
 - .3 Owens Corning Pipe and Tank Insulation;
 - .4 Johns Manville Inc. Pipe and Tank Insulation.
 - .3 Blanket mineral fibre is to be blanket type roll form insulation to ASTM C553, 24 kg/m³ (1½ lb/ft³) density, 40 mm (1-½") thick, with a factory applied vapour barrier facing.
 - .1 Manufacturers:
 - .1 Johns Manville Inc. Microlite FSK Duct Wrap Type 150;
 - .2 Knauf Fiber Glass Blanket Insulation FSK Duct Wrap Type III;
 - .3 Manson Insulation Inc. ALLEY WRAP FSK Duct Wrap Type III;
 - .4 Certainteed Corporation Softtouch FSK Duct Wrap Type 150.
 - .4 Pre-moulded calcium silicate is to be rigid block and sheet insulation.
 - .1 Manufacturers:
 - .1 Johns Manville Inc. "Thermo-12 Gold";
 - .2 Industrial Insulation Group "Thermo-12 Gold".
 - .5 Flexible foam elastomeric sheet is to be sheet form, CFC free, closed cell, self-adhering elastomeric nitrile rubber insulation with a water vapour permeability rating of 0.08 in accordance with ASTM E96 Procedure A.
 - .1 Manufacturers:
 - .1 Armacell "AP/Armaflex SA";
 - .2 IK Insulation Group "K-Flex Duct Wrap", S2S.

2.08 FIRE RATED DUCT WRAP

- .1 Flexible, non-combustible, blanket type mineral fibre duct wrap completely encapsulated in reinforced foil, suitable for installation with zero clearance to combustibles (for grease ducts), and ULC tested and listed (ULC Designs FRD-17 & 23 for ventilation ducts, ULC Design FRD-19 for kitchen exhaust/grease duct) to facilitate a 2 hour fire resistance rating (76 mm (3") thick) to kitchen grease exhaust duct in accordance with requirements of NFPA-96, and/or a 1 or 2 hour fire resistance rating (38 mm (1-½") thick) to ventilation or pressurization ductwork in accordance with requirements of ISO 6944.
- .2 Manufacturers:
 - .1 3M Fire Barrier Duct Wrap 615;

- .2 CL4 Inc. "CL4Fire";
- .3 Unifrax Corp. "FyreWrap Elite 1.5";
- .4 Morgan Thermal Ceramics "FireMaster FastWrap XL".

2.09 INSULATING COATINGS

- .1 Equal to Robson Thermal Manufacturing Ltd. insulating coatings as follows:
 - .1 anti-condensation coating, "No Sweat-FX";
 - .2 thermal insulating coating, "ThermaLite".

2.10 INSULATION FASTENINGS

- .1 Wire – minimum #15 gauge galvanized annealed wire.
- .2 Wire with Mesh – minimum #15 gauge galvanized annealed wire factory woven into 25 mm (1") hexagonal mesh.
- .3 Aluminium Banding – equal to ITW Insulation Systems Canada "FABSTRAPS" minimum 12 mm (½") wide, 0.6 mm (1/16") thick aluminium strapping.
- .4 Stainless Steel Banding – equal to ITW Insulation Systems Canada "FABSTAPS" 0.6 mm (1/16") thick, minimum 12 mm (½") wide type 304 stainless steel strapping.
- .5 Duct Insulation Fasteners – weld-on 2 mm (3/32") diameter zinc coated steel spindles of suitable length, complete with minimum 40 mm (1-½") square plastic or zinc plated steel self-locking washers.
- .6 Tape Sealant – equal to MACtac Canada Ltd. self-adhesive insulation tapes, types PAF, FSK, ASJ, or SWV as required to match surface being sealed.
- .7 Mineral Fibre Insulation Adhesive – clear, pressure sensitive, brush consistency adhesive, suitable for a temperature range of -20°C to 82°C (-4°F to 180°F), compatible with type of material to be secured, and WHMIS classified as non-hazardous.
- .8 Flexible Elastomeric Insulation Adhesive – Armacell "Armaflex" #520 air-drying contact adhesive.
- .9 Closed Cell Foamed Glass Insulation Adhesive – Pittsburgh Corning PC88 multi-purpose 2-component adhesive.
- .10 Lagging Adhesive – white, brush consistency, ULC listed and labelled, 25/50 fire/smoke rated lagging adhesive for canvas jacket fabric, suitable for colour tinting, complete with fungicide and washable when dry.
- .11 Screws – No. 10 stainless steel sheet metal screws.

2.11 INSULATION JACKETS AND FINISHES

- .1 Canvas Jacket Material – ULC listed and labelled, 25/50 fire/smoke rated, roll form, minimum 170 g (6 oz.).
- .2 Roll Form Sheet and Fitting Covers – minimum 15 mm (1/2") thick white PVC, 25/50 fire/smoke rated tested in accordance with ULC S102, complete with installation and sealing accessories.
 - .1 Manufacturers:
 - .1 Proto Corp. "LoSMOKE";

- .2 The Sure-Fit System "SMOKE-LESS 25/50";
- .3 Johns Manville Inc. "Zeston" 300.
- .3 Rigid Aluminium Jacket – equal to ITW Insulation Systems Canada "Lock-on" 0.406 mm (0.016") thick embossed aluminum jacket material to ASTM B209, factory cut to size and complete with polysurlyn moisture barrier and continuous modified Pittsburgh Z-Lock, butt straps with "Fabstraps" to weatherproof the end to end joints, and 2-piece epoxy coated pressed aluminum fittings with weather locking edges.
- .4 Stainless Steel Jacket – equal to ITW Insulation Systems Canada "Lock-on" 0.254 mm (0.010") thick type 304 embossed stainless steel jacket material to ASTM A240, factory cut to size and complete with moisture barrier and continuous modified Pittsburgh Z-Lock, butt straps with "Fabstraps" to cover end to end joints, and 2-piece pressed stainless steel fittings with weather locking edges.
- .5 Adhesive backed flexible aluminium is to be MFM Building Products Corp. "Flex-Clad 400" roll form sheet material with an aggressive rubberized asphalt adhesive backing, high density polyethylene reinforcement, and an embossed aluminum facing.
- .6 Heat resistant, trowel consistency thermal insulating and finishing cement to CAN/CGSB 51.12, and suitable for the application.
- .7 Foamed glass insulation protective coating is to be Pittsburgh Corning "PITTCOTE 404" flexible acrylic latex weather barrier coating, white unless otherwise specified.
- .8 Flexible foam elastomeric insulation protective coating equal to Armacell "WB Armaflex" weatherproof, water-based latex enamel finish.

3 Execution

3.01 GENERAL INSULATION APPLICATION REQUIREMENTS

- .1 Unless otherwise specified, do not insulate following:
 - .1 factory insulated equipment and piping;
 - .2 heating piping within radiation unit enclosures, including blank filler sections of enclosures;
 - .3 heating piping in soffits and/or overhang spaces and connected to bare element radiation in spaces;
 - .4 branch potable water piping located under counters to serve counter mounted plumbing fixtures and fittings, except barrier-free lavatories;
 - .5 exposed chrome plated potable water angle supplies from concealed piping to plumbing fixtures and fittings, except barrier-free lavatories;
 - .6 heated liquid system pump casings, valves, strainers and similar accessories;
 - .7 heating system expansion tanks;
 - .8 fire protection pump casings;
 - .9 manufactured expansion joints and flexible connections;
 - .10 acoustically lined ductwork and/or equipment;
 - .11 factory insulated flexible branch ductwork;
 - .12 fire protection system water storage tanks;

- .13 piping unions, except for unions in "cold" category piping.
- .2 Install insulation directly over pipes and ducts, not over hangers and supports.
- .3 Install piping insulation and jacket continuous through pipe openings and sleeves.
- .4 Install duct insulation continuous through walls, partitions, and similar surfaces except at fire dampers.
- .5 When insulating "cold" piping and equipment, extend insulation up valve bodies and other such projections as far as possible, and protect insulation jacketing from the action of condensation at its junction with metal.
- .6 Insulate, vapour seal, and finish seismic restraints, braces, anchors, hanger rods, and similar hardware directly connected to "cold" piping and/or equipment, for a distance of 300 mm (12") clear of adjacent pipe or equipment finish, to match piping and/or equipment insulation.
- .7 When insulating vertical piping risers 75 mm (3") diameter and larger, use insulation support rings welded directly above lowest pipe fitting, and thereafter at 4.5 m (14.7') centres and at each valve and flange. Insulate as per Thermal Insulation Association of Canada National Insulation Standards, Figure No. 9.
- .8 Where piping and/or equipment is traced with electric heating cable, ensure cable has been tested and accepted prior to application of insulation, and ensure cable is not damaged or displaced during the application of insulation.
- .9 Where existing insulation work is damaged as a result of mechanical work, repair damaged insulation work to Project work standards.
- .10 Where mineral fibre rigid sleeve type insulation is terminated at valves, equipment, unions, etc., neatly cover exposed end of insulation with a purpose made PVC cover on "cold" piping, and with canvas jacket material on "hot" piping.
- .11 Carefully and neatly gouge out insulation for proper fit where there is interference between weld bead, mechanical joints, etc., and insulation. Bevel away from studs and nuts to permit their removal without damage to insulation, and closely and neatly trim around extending parts of pipe saddles.
- .12 Where thermometers, gauges, and similar instruments occur in insulated piping, and where access to heat transfer piping balancing valve ports and similar items are required, create a neat, properly sized hole in insulation and provide a suitable grommet in the opening.

3.02 INSULATION FOR HORIZONTAL PIPE AT HANGERS AND SUPPORTS

- .1 At each hanger and support location for piping 50 mm (2") diameter and larger and scheduled to be insulated, except where roller hangers and/or supports are required, and unless otherwise specified, supply a factory fabricated section of phenolic foam pipe insulation with integral vapour barrier jacket and captive galvanized steel shield. Supply insulation sections to piping installers for installation as pipe is erected.
- .2 For 100 mm (4") diameter and larger heating system piping where roller type hangers and supports are provided, a steel saddle will be tack welded to pipe at each roller hanger or support location. Pack saddle voids with loose mineral wool insulation.

3.03 PIPE INSULATION REQUIREMENTS – MINERAL FIBRE

- .1 Insulate following pipe inside building and above ground with mineral fibre insulation of thickness indicated:
 - .1 domestic cold water piping, less than 100 mm (4") dia. – 25 mm (1") thick;
 - .2 domestic cold water piping, greater than or equal to 100 mm (4") dia. – 40 mm (1-½") thick;

- .3 domestic hot water piping, less than 40 mm (1-½") dia. – 25 mm (1") thick;
- .4 domestic hot water piping, greater than or equal to 40 mm (1½") dia. – 40 mm (1-½") thick;
- .5 tempered domestic water piping, supply and return, less than 40 mm (1-½") dia. – 25 mm (1") thick;
- .6 tempered domestic water piping, supply and return, greater than or equal to 40 mm (1-½") dia. – 50 mm (2") thick;
- .7 storm drainage piping from roof drains to the point where main vertical risers extend straight down, without offsets, and connect to horizontal underground mains – 25 mm (1") thick;
- .8 condensate drainage piping from fan coil unit or any other air conditioning system/unit drain pans to main vertical drain risers or to indirect drainage point – 25 mm (1") thick;
- .9 drainage piping from refrigerated drinking fountains to nearest 75 mm (3") dia. or larger drain pipe – 25 mm (1") thick;
- .10 chilled water piping, supply and return, less than 100 mm (4") dia. – 25 mm (1") thick;
- .11 chilled water piping, supply and return, greater than or equal to 100 mm (4") dia. – 40 mm (1-½") thick;
- .12 chilled glycol solution piping, supply and return, less than 100 mm (4") dia. – 25 mm (1") thick;
- .13 chilled glycol solution piping, supply and return, greater than or equal to 100 mm (4") dia. – 40 mm (1-½") thick;
- .14 hot water heating piping, supply and return, less than 40 mm (1-½") dia. – 40 mm (1-½") thick;
- .15 hot water heating piping, supply and return, greater than or equal to 40 mm (1-½") dia. – 50 mm (2") thick;
- .16 glycol solution heating or heat reclaim piping, supply and return, less than 40 mm (1-½") dia. – 40 mm (1-½") thick;
- .17 glycol solution heating or heat reclaim piping, supply and return, greater than or equal to 40 mm (1-½") dia. – 50 mm (2") thick;
- .18 low pressure (to 140 kPa [20 psi]) steam piping, less than 100 mm (4") dia. – 65 mm (2-½") thick;
- .19 low pressure (to 140 kPa [20 psi]) steam piping, greater than or equal to 100 mm (4") dia. – 80 mm (3") thick;
- .20 medium pressure (140 to 415 kPa [20 to 60 psi]) steam piping, less than 40 mm (1-½") dia. – 100 mm (4") thick;
- .21 medium pressure (140 to 415 kPa [20 to 60 psi]) steam piping, greater than or equal to 40 mm (1-½") dia. – 112 mm (4-½") thick;
- .22 low pressure condensate piping, less than 40 mm (1-½") dia. – 40 mm (1-½") thick;
- .23 low pressure condensate piping, greater than or equal to 40 mm (1-½") dia. – 50 mm (2") thick;
- .24 medium pressure condensate piping, less than 40 mm (1-½") dia. – 40 mm (1-½") thick;
- .25 medium pressure condensate piping, greater than or equal to 40 mm (1-½") dia. – 50 mm (2") thick;

- .26 boiler feedwater piping complete – 25 mm (1") thick;
 - .27 boiler blowdown piping complete – 40 mm (1-½") thick;
 - .28 chilled domestic cold water piping from remote water cooler(s) to drinking fountain(s) – 40 mm (1-½") thick;
 - .29 piping indicated to be traced with electric heating cable – minimum 50 mm (2") thick;
 - .30 drum drip(s) in dry zone standpipe and/or sprinkler system piping – 50 mm (2") thick;
 - .31 refrigerant suction piping (between compressor and evaporator coil) inside building – 25 mm (1") thick;
 - .32 refrigerant hot gas piping (between compressor and condenser) inside building – 25 mm (1") thick;
 - .33 refrigerant hot gas by-pass piping (between compressor discharge and evaporator coil) inside building – 25 mm (1") thick;
 - .34 air compressor set fresh air intake piping – 25 mm (1") thick;
 - .35 heat pump equipment earthloop piping – 25 mm (1") thick.
- .2 Secure overlap flap of the sectional insulation jacket tightly in place. Cover section to section butt joints with tape sealant.
 - .3 Insulate fittings with sectional pipe insulation mitred to fit tightly, and cover butt joints with tape sealant, or, alternatively, wrap fittings with blanket mineral fibre insulation to a thickness and insulating value equal to the sectional insulation, secure in place with adhesive and/or wire, and cover with PVC fitting covers.
 - .4 Unless otherwise specified, insulate unions, valves, strainers, and similar piping system accessories in "cold" piping with cut and tightly fitted segments of sectional pipe insulation with joints covered with tape sealant, or, alternatively, wrap piping union, valve, strainer, etc., with blanket mineral fibre and cover with PVC covers as for paragraph above.
 - .5 Terminate sectional insulation approximately 50 mm (2") from flange or coupling on each side of flange or coupling. Cover flange or coupling with a minimum 50 mm (2") thickness of blanket mineral fibre insulation wide enough to butt tightly to ends of adjacent sectional insulation. Secure blanket insulation in place and cover with a purpose made PVC coupling cover.
 - .6 Drum drips in dry zone sprinkler and/or standpipe system piping will be traced with electric heating cable as part of electrical work, and are generally not shown on drawing(s). Confirm number and size of drum drips required with trade providing piping and include for insulation to suit. Wherever possible drum drips will be located in heated areas.
 - .7 Take special care at concealed water rough-in piping at plumbing fixtures to ensure piping is properly insulated. If necessary due to space limitations, use 12 mm (½") thick sectional pipe insulation in lieu of 25 mm (1") thick insulation.
 - .8 Insulate seismic restraint hardware such as hanger rods, braces, anchors, etc., directly connected to "cold" category piping and equipment for a distance of 300 mm (12") from piping or equipment with insulation and finish to match pipe or equipment insulation. Coat seismic restraint hardware for a distance of 300 mm (12") from the termination of insulation with Robson Thermal "NO-SWEAT-FX" water based anti-condensation coating.

3.04 PIPE INSULATION REQUIREMENTS – MINERAL WOOL

- .1 Insulate following pipe inside building and above ground with high temperature mineral wool insulation of thickness indicated:
 - .1 high pressure (above 415 kPa [60 psi]) steam piping, less than 40 mm (1-½") dia. – 100 mm (4") thick;
 - .2 high pressure (above 415 kPa [60 psi]) steam piping, greater than or equal to 40 mm (1-½") dia. – 115 mm (4-½") thick;
 - .3 high pressure condensate piping – 50 mm (2") thick;
 - .4 engine-generator set exhaust system piping – 75 mm (3") thick.
- .2 Generally, install insulation on piping as specified above for mineral fibre insulation.
- .3 Generally, install insulation on fittings as specified above for mineral fibre insulation but cover with canvas, not PVC fitting covers.

3.05 PIPE INSULATION REQUIREMENTS – FLEXIBLE FOAM ELASTOMERIC

- .1 Install flexible elastomeric pipe insulation in strict accordance with manufacturer's published instructions to suit the application, and using adhesive, joint sealants and finish to produce a water-tight installation. Insulate following pipe with flexible elastomeric pipe insulation of thickness indicated:
 - .1 refrigerant suction and hot gas piping outside building – 25 mm (1") thick.

3.06 PIPE INSULATION REQUIREMENTS – CLOSED CELL FOAMED GLASS

- .1 Install closed cell foamed glass insulation in strict accordance with manufacturer's published instructions to suit the application, and using adhesive, joint sealants, and jacketing to produce a water-tight installation. Insulate following pipe with closed cell foamed glass of thickness indicated:
 - .1 piping located outside building and indicated to be heat traced – minimum 50 mm (2") thick.

3.07 PIPE INSULATION REQUIREMENTS – FIRE RATED INSULATION

- .1 Where pipe (inside building and above ground) which is to be insulated as specified above penetrates fire rated construction, provide fire-rated, non-combustible sectional insulation on portion of pipe in fire barrier and for a distance of 50 mm (2") on either side of fire barrier. Insulation thickness is to be as specified, but in any case minimum 25 mm (1").

3.08 INSTALLATION OF WEATHER-PROOF JACKETED INSULATION

- .1 Install sectional weather-proof jacketed pipe insulation in strict accordance with manufacturer's instructions to produce a water-tight weather-proof installation. Insulate fittings with blanket type glass fibre insulation of a thickness and insulating value equal to the sectional insulation and secured in place with adhesive and wire. Jacket fittings with manufactured aluminium fitting covers sealed water-tight. Insulate following pipe with weather-proof jacketed insulation:
 - .1 [];
 - .2 [].

3.09 INSTALLATION OF BARRIER FREE LAVATORY INSULATION KITS

- .1 Provide manufactured insulation kits to cover exposed drainage and water piping under barrier free lavatories.

3.10 EQUIPMENT INSULATION REQUIREMENTS – BLANKET TYPE MINERAL FIBRE

- .1 Insulate following equipment with mineral fibre blanket type insulation of thickness indicated:
 - .1 chilled water and/or domestic cold water pump casings – 40 mm (1-½") thick;
 - .2 roof drain sumps where inside the building – 25 mm (1") thick;
 - .3 water meter(s) – 40 mm (1-½") thick;
 - .4 top of radiant ceiling panels – 50 mm (2") thick.
- .2 Unless otherwise noted, wrap equipment to a thickness and insulating value equal to an equivalent thickness of rigid sectional pipe insulation. Laminate insulation in place with a full coverage of adhesive and secure with wire. Apply a jacket of insulation vapour barrier material secured in place with adhesive or sealant tape.
- .3 Cover roof drain sumps with purpose made PVC fitting covers.
- .4 Lay fibreglass blanket on radiant ceiling panels after testing is complete.

3.11 EQUIPMENT INSULATION REQUIREMENTS – SEMI-RIGID MINERAL FIBRE

- .1 Insulate following equipment with semi-rigid mineral fibre board insulation of thickness indicated:
 - .1 refrigeration machine water chiller(s) and suction elbow(s) – 50 mm (2") thick;
 - .2 uninsulated domestic hot water storage tank(s) – 40 mm (1-½") thick;
 - .3 shell and tube type heat exchangers – 40 mm (1-½") thick;
 - .4 condensate receiver(s) – 40 mm (1-½") thick;
 - .5 flash tanks – 40 mm (1-½") thick;
 - .6 hot well tank – 40 mm (1-½") thick;
 - .7 deaerating feedwater heater – 40 mm (1-½") thick;
 - .8 blow-down tank – 40 mm (1-½") thick;
 - .9 chilled water or chilled glycol solution storage tank – 50 mm (2") thick;
 - .10 heating main air separator – 40 mm (1-½") thick;
 - .11 chilled water expansion tank – 40 mm (1-½") thick.
- .2 Install insulation as required to fit shape and contour of equipment. Secure insulation in place with adhesive, and with aluminum straps on 450 mm (18") centres. Apply a 6 mm (¼") thick skim coat of insulating cement, then, when insulating cement has dried, apply a 6 mm (¼") thick coat of cement trowelled smooth.
- .3 For "cold" equipment, prime insulation with suitable sealer and apply a jacket of glass thread reinforced foil and kraft paper vapour barrier jacket material laminated in place with a full coverage of adhesive.
- .4 Provide removable and replaceable insulated metal covers for equipment with removable heads to permit heads to be removed and replaced without damaging adjacent insulation work.

3.12 EQUIPMENT INSULATION REQUIREMENTS – SEMI-RIGID MINERAL WOOL

- .1 Insulate following equipment with calcium silicate equipment insulation of thickness indicated:
 - .1 engine-generator set exhaust system silencer(s) – 75 mm (3") thick;
 - .2 uninsulated boiler breeching where inside the building – 75 mm (3") thick.
- .2 Cut or mitre insulation (or use factory scored type insulation) to fit shape and contour of equipment and secure insulation in place with aluminum straps on 450 mm (18") centres. Point joints, mitres, scores and gaps with insulating cement. Apply a 12 mm (½") thick coat of insulating cement and trowel smooth.

3.13 EQUIPMENT INSULATION REQUIREMENTS – CLOSED CELL FOAMED GLASS

- .1 Insulate following equipment with closed cell foam glass insulation of thickness indicated:
 - .1 [];
 - .2 [].
- .2 Install insulation in strict accordance with manufacturer's published instructions using adhesive, wrap, sealant, etc., to secure insulation in place, to secure and seal joints, and to produce a 100% water-tight installation.

3.14 EQUIPMENT INSULATION REQUIREMENTS – REMOVABLE/REUSABLE TYPE

- .1 Provide custom designed and manufactured removable and reusable insulation covers for following:
 - .1 plate type heat exchanger(s);
 - .2 150 mm (6") dia. and larger piping strainers, backflow preventers, etc.;
 - .3 diesel engine exhaust manifolds;
 - .4 150 mm (6") dia. and larger steam traps and similar equipment.
- .2 Provide "wrap type" removable and reusable insulation covers for "cold" circuit balancing valves, backflow preventers, and similar items, and for steam traps and similar items requiring service in piping less than 150 mm (6") dia.

3.15 DUCTWORK INSULATION REQUIREMENTS – MINERAL FIBRE

- .1 Insulate following ductwork systems inside building and above ground with mineral fibre insulation of thickness indicated:
 - .1 outside air intake ductwork, casings and plenums from fresh air intakes to and including mixing plenums or sections, or, if mixing plenums or sections are not provided, to first heating coil, or if both mixing plenums or sections and heating coil sections are not provided, and fresh air is not tempered, then the fresh air ductwork system complete – minimum 40 mm (1-½") thick as required;
 - .2 mixed supply air or preheated supply air casings, plenums and sections to and including the fan section where not factory insulated – minimum 25 mm (1") thick rigid board or minimum 40 mm (1-½") thick flexible blanket as required;
 - .3 supply air ductwork outward from fans, except for supply ductwork exposed in area it serves – minimum 25 mm (1") thick rigid board or minimum 40 mm (1-½") thick flexible blanket as required;

- .4 exhaust discharge ductwork for a distance of 3 m (10') downstream (back) from exhaust openings to atmosphere, including any exhaust plenums within the 3 m (10') distance – minimum 25 mm (1") thick rigid board or minimum 40 mm (1-½") thick flexible blanket as required;
 - .5 any other ductwork, casings, plenums or sections specified or detailed on drawings to be insulated – thickness as specified.
- .2 Provide rigid board type insulation for casings, plenums, and exposed rectangular ductwork. Provide blanket type insulation for round ductwork and concealed rectangular ductwork.
 - .3 Liberally apply adhesive to surfaces of exposed rectangular ducts and/or casings. Accurately and neatly press insulation into adhesive with tightly fitted butt joints. Provide pin and washer insulation fasteners at 300 mm (12") centres on bottom and side surfaces. Secure and seal joints with 75 mm (3") wide tape sealant. Additional installation requirements as follows:
 - .1 at trapeze hanger locations, install insulation between duct and hanger;
 - .2 provide drywall type metal corner beads on edges of ductwork, casings and plenums in equipment rooms, service corridors, and any other area where insulation is subject to accidental damage, and secure in place with tape sealant.
 - .4 Liberally apply adhesive to surfaces of concealed rectangular or oval ductwork, and wrap insulation around duct with a top butt joint and tight section to section butt joints. Provide pin and washer insulation fasteners at 300 mm (12") centres on bottom surfaces. Secure and seal joints with 75 mm (3") tape sealant. At each trapeze type duct hanger, provide a 100 mm (4") wide full length piece of rigid mineral fibre board insulation between duct and hanger.
 - .5 Accurately cut sections of insulation to fit tightly and completely around exposed and concealed round or oval ductwork. Liberally apply adhesive to surfaces of duct, and wrap insulation around duct with a top butt joint and tight section to section butt joints. Seal joints with tape sealant. At duct hanger locations install insulation between duct and hanger. At each hanger location for concealed ductwork where flexible blanket insulation is used, provide a 100 mm (4") wide full circumference strip of semi-rigid board type duct insulation between duct and hanger.
 - .6 Insulation application requirements common to all types of rigid ductwork are as follows:
 - .1 at duct connection flanges, insulate flanges with neatly cut strips of rigid insulation material secured with adhesive to side surfaces of flange with a top strip to cover exposed edges of the side strips, then butt the flat surface duct insulation up tight to flange insulation, or, alternatively, increase insulation thickness to depth of flange and cover top of flanges with tape sealant;
 - .2 installation of fastener pins and washers is to be concurrent with duct insulation application;
 - .3 cut insulation fastener pins almost flush to washer and cover with neatly cut pieces of tape sealant;
 - .4 accurately and neatly cut and fit insulation at duct accessories such as damper operators (with standoff mounting) and pitot tube access covers;
 - .5 prior to concealment of insulation by either construction finishes or canvas jacket material, patch vapour barrier damage by means of tape sealant.

3.16 DUCTWORK INSULATION REQUIREMENTS – FLEXIBLE ELASTOMERIC

- .1 Insulate exposed exterior ductwork (except fresh air intake ductwork) and associated plenums and/or casings outside building with minimum 40 mm (1-½") thick flexible elastomeric sheet insulation as required, applied in 2 minimum 20 mm (¾") thick layers with staggered tightly butted joints.

- .2 Install with adhesive in strict accordance with manufacturer's instructions to produce a weather-proof installation. Ensure sheet metal work joints are sealed watertight prior to applying insulation.

3.17 DUCTWORK INSULATION REQUIREMENTS – CALCIUM SILICATE

- .1 Insulate following kitchen exhaust ductwork with minimum 40 mm (1-½") thick calcium silicate block insulation:
 - .1 kitchen exhaust ductwork from exhaust hood to masonry shaft – 2 hour rating;
 - .2 stairwell pressurization ductwork from fan to stairwell – 1 hour rating;
 - .3 Trauma Room and Operating Room supply and exhaust ductwork complete – 1 hour rating.
- .2 Secure insulation in place with adhesive and with wire on 450 mm (18") centres. Point gaps and joints with insulating cement. Where ductwork is exposed, cover insulation with wire mesh secured to wire and with edges laced together and apply a coat of finishing cement trowelled smooth. Use drywall type metal corner bead for duct edges where finishing cement is applied.

3.18 DUCT WRAP REQUIREMENTS – FIRE RATED MATERIAL

- .1 Provide blanket type fire rated duct wrap system material for following ductwork to produce fire rating indicated:
 - .1 kitchen exhaust ductwork from exhaust hood to masonry shaft – 2 hour rating;
 - .2 stairwell pressurization ductwork from fan to stairwell – 1 hour rating;
 - .3 Trauma Room and Operating Room supply and exhaust ductwork complete – 1 hour rating.
- .2 Install duct wrap material in accordance with ULC design requirements and supplier's/manufacturer's instructions.
- .3 Coordinate installation of duct wrap with installation of ductwork.
- .4 Arrange and pay for duct wrap supplier to examine completed duct wrap system at site. Submit a letter from supplier to certifying duct wrap system has been properly installed.

3.19 APPLICATION OF INSULATING COATINGS

- .1 Apply, in accordance with manufacturer's instruction, insulating coatings to following bare metal surfaces:
 - .1 paint bare metal surfaces clear of "cold" piping and/or equipment insulation for a distance of from 300 mm (12") to 600 mm (24") clear of pipe or equipment insulation, with "No Sweat-FX" anti-condensation coating;
 - .2 paint bare metal surfaces associated with mechanical systems with an operating temperature 60°C (140°F) with "ThermaLite" insulating coating.
- .2 Apply coatings with a brush. Remove any splatter or excess coating from adjacent surfaces.

3.20 INSULATION FINISH REQUIREMENTS

- .1 Unless otherwise shown and/or specified, jacket exposed mineral fibre insulation, and calcium silicate duct insulation work inside building with canvas secured in place with a full covering coat of lagging adhesive. Accurately cut canvas with scissors or a knife. Do not rip or tear canvas to size. Remove lagging adhesive splatter from adjacent uninsulated surfaces.
- .2 Unless otherwise shown or specified, jacket exposed mineral fibre insulation listed below with canvas jacket secured in place with a full covering coat of coloured lagging adhesive. Accurately cut canvas with

scissors or a knife. Do not rip or tear canvas to size. Remove lagging adhesive splatter from adjacent surfaces. Insulated services to receive coloured lagging adhesive are as follows:

- .1 Chilled Water Piping;
 - .2 Chilled Glycol Piping
 - .3 Condenser Water Piping;
 - .4 Domestic Cold Water Piping;
 - .5 Domestic Hot Water Piping;
 - .6 Domestic Hot Water Recirculation Piping;
 - .7 High Temperature Heating Water Piping;
 - .8 High Temperature Heating Glycol Piping;
 - .9 Heating Water Piping;
 - .10 Condensate Drain Piping;
 - .11 Low Pressure Steam Piping;
 - .12 High Pressure Steam Piping;
 - .13 Indoor Ductwork;
 - .14 [].
- .3 Jacket exposed pipe insulation work inside building with white sheet PVC and fitting covers. Install sheet PVC and fitting covers tightly in place with overlapped circumferential and longitudinal joints arranged to shed water. Seal joints to produce a neat water-tight installation. Provide slip-type expansion joints where required by manufacturer's instructions.
- .4 Install rigid aluminum jacket material tightly in place with overlapped circumferential joints positioned to shed water and covered with butt straps supplied with the jacket. Provide aluminum jacket for following insulation:
- .1 Chilled Water Piping;
 - .2 Chilled Glycol Piping
 - .3 Condenser Water Piping;
 - .4 High Temperature Heating Water Piping;
 - .5 High Temperature Heating Glycol Piping;
 - .6 Heating Water Piping;
 - .7 Condensate Drain Piping;
 - .8 Refrigerant Piping;
 - .9 Outdoor Ductwork;
 - .10 [].

- .5 Install adhesive backed flexible aluminum to cleaned and primed metal surfaces which are between -23°C and 74°C (-10°F and 165°F) in strict accordance with manufacturer's published instructions and details, including shingle type overlap joints to shed water, and use of a hand roller to concentrate pressure on seams. Provide adhesive backed flexible aluminum jacket for following insulation:
 - .1 Chilled Water Piping;
 - .2 Chilled Glycol Piping
 - .3 Condenser Water Piping;
 - .4 High Temperature Heating Water Piping;
 - .5 High Temperature Heating Glycol Piping;
 - .6 Heating Water Piping;
 - .7 Condensate Drain Piping;
 - .8 Refrigerant Piping;
 - .9 Outdoor Ductwork;
 - .10 [].
- .6 Install rigid stainless steel jacket material tightly in place with overlapped circumferential joints positioned to shed water and covered with butt straps supplied with jacket. Provide stainless steel jacket for following:
 - .1 Chilled Water Piping;
 - .2 Chilled Glycol Piping
 - .3 Condenser Water Piping;
 - .4 High Temperature Heating Water Piping;
 - .5 High Temperature Heating Glycol Piping;
 - .6 Heating Water Piping;
 - .7 Condensate Drain Piping;
 - .8 Refrigerant Piping;
 - .9 Outdoor Ductwork;
 - .10 [].
- .7 Apply 2 heavy coats of "PITTCOTE 404" coating with 24 hr. between coats to foamed glass insulation exposed above grade.
- .8 Apply 2 coats (with 24 hr. between coats) of specified coating to flexible elastomeric insulation outside building.

End of Section

1 General

1.01 SECTION INCLUDES

- .1 This Section specifies commissioning requirements that are common to Mechanical Divisions work Sections and it is a supplement to each Section and is to be read accordingly. When requirements of this Section contradict requirements of Division 00 or Division 01, conditions of Division 00 or Division 01 to take precedence.

1.02 REFERENCES

- .1 Refer to commissioning requirements specified in Division 01.

1.03 COMMISSIONING AGENT INVOLVEMENT VERSUS WARRANTY OBLIGATIONS

- .1 Involvement of Commissioning Agent performing duties as described in this Section is not in any way to void or alter any Contractual warranty obligations.

1.04 SUBMITTALS

- .1 Submit to Commissioning Agent, at same time as submittal to Consultant, one copy of each shop drawing or product data sheet associated with equipment or systems to be commissioned.
- .2 Submit for review, a Commissioning Plan with schedule, commissioning procedures for commissioning events, and a copy of Commissioning Agent's commissioning data sheets for equipment/systems to be commissioned.
- .3 Submit a list of commissioning instruments and for each instrument, indicate purpose of instrument and include a recent calibration certificate.
- .4 Submit equipment and system manufacturer's start-up and test report sheets for review a minimum of 1 month prior to equipment and system start-up procedures.

1.05 CLOSEOUT SUBMITTALS

- .1 After start-up and successful pre-functional performance testing and submittal of completed forms, submit, for each system or subsystem, a letter confirming pre-functional performance testing has been successfully completed and system or subsystem is ready for functional performance testing and commissioning process to commence.

1.06 DEFINITIONS

- .1 Commissioning: process of demonstrating to Owner and Consultant, for purpose of final acceptance, by means of successful and documented functional performance testing, that systems and/or subsystems are capable of being operated and maintained to perform in accordance with requirements of Contract Documents, all as further described below.
- .2 Commissioning Agent: commissioning authority who will supervise commissioning process, and who will recommend final acceptance of commissioned mechanical work.
- .3 Start-Up and Adjusting: process of equipment manufacturer's/supplier's technical personnel, with Contractor, starting and operating equipment and systems, making any required adjustments, documenting process, and submitting manufacturer's/supplier's start-up reports to confirm equipment has been properly installed and is operational as intended.
- .4 Pre-Functional Performance Testing: testing, adjusting and operating of components, equipment, systems and/or subsystems, by Contractor, after start-up but before functional performance testing, to confirm components, equipment, systems and/or subsystems operate in accordance with requirements of Contract Documents, including modes and sequences of control and monitoring, interlocks, and

responses to emergency conditions, and including submittal of pre-functional performance testing documentation sheets.

- .5 Functional Performance Testing: a repeat of successful pre-functional performance testing by Contractor, in presence of Commissioning Agent and Consultant with completed Commissioning Agent's commissioning documentation sheets to document, validate and verify equipment, systems and subsystems are complete in all respects, function correctly, and are ready for acceptance.
- .6 Commissioning Documentation Sheets: prepared sheets for pre-functional performance testing and for functional performance testing supplied by Commissioning Agent for each piece of equipment/system to be commissioned, each sheet or set of sheets complete with Project name and number, date of commissioning, equipment/system involved, equipment/system name and model number, equipment tag in accordance with drawings, and, for each commissioning procedure listed, a column giving expected data in accordance with Contract Documents, a column to fill in observed data during commissioning, and space for signatures of Contractor and Commissioning Agent.
- .7 Systems Operating Manual: a manual prepared by Commissioning Agent to present an overview of building mechanical systems and equipment to be used by building maintenance personnel to assist them in daily operation of systems.
- .8 Validate: to confirm by examination and witnessing tests correctness of equipment and system operation.

1.07 QUALITY ASSURANCE

- .1 Commissioning work is to be in accordance with requirements of following:
 - .1 CSA Z320, Building Commissioning Standard and Check Sheets;
 - .2 ASHRAE Guideline 0, The Commissioning Process;
 - .3 ASHRAE Guideline 1.1, The HVAC Commissioning Process;
 - .4 ASHRAE Guideline 1.2, The Commissioning Process for Existing HVAC&R Systems;
 - .5 ASHRAE Guideline 1.5, Commissioning Smoke Control Systems;
 - .6 Owner designated Commissioning Agent.

1.08 COMMISSIONING OBJECTIVES

- .1 Objectives of commissioning process:
 - .1 to support quality management by means of monitoring and checking installation;
 - .2 to verify equipment/system performance by means of commissioning of completed installation;
 - .3 to move completed equipment/systems from "static completion" state to "dynamic" operating state so as to transfer a complete and properly operating installation from Contractor to Owner.

1.09 TESTING EQUIPMENT

- .1 Supply instruments and test equipment required to conduct start-up, testing and commissioning procedures.

2 Products – Not Used

3 Execution

3.01 COMMISSIONING

- .1 Commission work in accordance with requirements of this Section and as required by Commissioning Agent.
- .2 Prerequisites to successful completion of commissioning:
 - .1 submittal of signed start-up and test reports;
 - .2 completion of system testing, adjusting and balancing (TAB), and acceptance of TAB reports;
 - .3 permanent electrical and control connections of equipment;
 - .4 successful completion and documentation of pre-functional performance testing;
 - .5 submittal of letters to Consultant certifying systems and subsystems have been started, tested, adjusted, successfully pre-functional performance tested, are ready for functional performance testing, and are in accordance with requirements of Contract Documents.

3.02 PHASING OF COMMISSIONING

- .1 If Project will be constructed in phases, phase commissioning accordingly to suit progress and phases of Work.

3.03 DEFICIENCIES LISTED DURING COMMISSIONING

- .1 Correct deficiencies listed by Consultant and Commissioning Agent during commissioning process within 15 calendar days of notification unless agreed otherwise with Consultant, and when deficiencies have been corrected, notify Consultant and Commissioning Agent immediately.

3.04 SYSTEMS TO BE COMMISSIONED

- .1 Mechanical systems to be commissioned include, but are not to be limited to, systems described below. Specific commissioning procedures are to be as directed by Commissioning Agent.
- .2 Commissioning of water systems (all piping extended from Municipal main) includes:
 - .1 commissioning of piping specialties such as backflow preventers, mixing valves, and similar components;
- .3 Commissioning of heating systems includes piping, piping specialties, equipment, and control, as well as checking and validating temperature and flow documentation contained in TAB reports. If TAB is not done during heating season, a follow-up site visit during heating season will be required to confirm proper flows and temperatures, and any required system "fine tuning".
- .4 Commissioning of cooling systems includes piping, piping specialties, equipment, and control, as well as checking and validating temperature and flow documentation contained in TAB reports. If TAB is not done during cooling season, a follow-up site visit during cooling season will be required to confirm proper flows and temperatures, and any required system "fine tuning".
- .5 Commissioning of air handling systems includes equipment, ductwork, ductwork specialties, controls, interlocks, and checking and validating air capacities and flows in accordance with TAB reports.

- .6 Control work commissioning includes confirmation of proper operation of individual control components, and overall operation of controls in conjunction with operation of connected building systems, including heating season/cooling season testing requirements specified above.
- .7 Commissioning of BAS includes confirmation of proper operation of components, input/output points, hardware and software, and demonstration of system performing required procedures.
- .8 Commissioning of special usage room controls includes confirmation of proper operation of individual components, and proper operation of overall control system, all in accordance with governing Codes and Standards.
- .9 Commissioning of noise and vibration control equipment includes noise and vibration measurements to confirm proper operation of equipment.

3.05 COMMISSIONING PROCESS

- .1 Perform commissioning process in stages and include, but not be limited to, following:
 - .1 Stage 1: Commissioning of equipment/systems as listed in this Section, which is a prerequisite to an application for Substantial Performance of the Work and includes supervising and validating results of functional performance testing, and submittal of reviewed Systems Operating Manual.
 - .2 Stage 2: Commissioning work performed 12 months after issue of a Certificate of Substantial Performance and which includes supervision of Contractor's "fine tuning" of equipment/systems through seasonal occupancy, and any other such work to achieve optimal comfort and performance conditions.
 - .3 Stage 3: Successful completion of satisfactory equipment/system operation during 1st month after issue of a Certificate of Total Performance of the Work.
 - .4 Stage 4: Successful completion of satisfactory equipment/system operation during 3rd month after issue of a Certificate of Total Performance of the Work.
 - .5 Stage 5: Successful seasonal commissioning of building.

3.06 RESPONSIBILITIES OF CONTRACTOR

- .1 During construction phase, Contractor is to:
 - .1 prepare and submit an installation schedule which includes a time schedule for each activity with lead and lag time allowed and indicated, shop drawing and working detail drawing submissions, and major equipment factory testing and delivery dates;
 - .2 prepare and submit a commissioning schedule which is to include a time schedule coordinated with installation schedule referred to above and Commissioning Agent, and allowances for additional time for re-tests as may be required, and update schedule on a monthly basis as required;
 - .3 when requested by Commissioning Agent, arrange site commissioning meetings with Owner, Consultant, and applicable subcontractors present, to be chaired by Commissioning Agent who will also prepare and distribute meeting minutes;
 - .4 promptly correct reported deficient work, and report when corrective work is complete;
 - .5 where required by Codes and/or Specification, retain equipment manufacturers/suppliers or independent 3rd parties to certify correct installation of equipment/systems;
 - .6 under supervision of equipment manufacturers/suppliers, start-up and adjust equipment to design requirements, and submit start-up sheets which include equipment data such as manufacturer

- and model number, serial number where applicable, and performance parameters, all signed by equipment manufacturer/supplier and Contractor;
- .7 complete Commissioning Agent's commissioning data sheets for multiple items of smaller equipment such as air terminal boxes, fan coil units, backflow preventers, etc., submit sheets to Commissioning Agent, accompany Commissioning Agent for an on-site check of 30% of data sheet information for each type of equipment, and perform any corrective action required as a result of site checks;
 - .8 perform system testing, adjusting and balancing and, when complete, issue a copy of final report to Commissioning Agent for review and a site check of results, and perform any corrective work required as a result of site checks by Commissioning Agent;
 - .9 in accordance with updated commissioning schedule and actual progress at site, certify in writing to Consultant and Commissioning Agent that equipment and/or systems are complete, have been checked, started and adjusted, successfully pre-functional performance tested and documented, and are ready for functional performance testing and commissioning procedures, giving Consultant and Commissioning Agent a minimum of 5 working days' notice;
 - .10 perform system and subsystem functional performance testing under supervision of Commissioning Agent, and submit to Consultant and Commissioning Agent, completed and signed functional performance testing and commissioning data sheets (issued by Commissioning Agent) and also signed by Commissioning Agent.
- .2 During post construction phase, Contractor is to:
- .1 optimize system operation in accordance with building occupant's needs and comments using System Operation Manual prepared by Commissioning Agent as reference;
 - .2 complete commissioning procedures, activities, and performance verification procedures that were delayed or not concluded during construction phase;
 - .3 accompanied by Commissioning Agent, complete system checks and "fine tuning" with signed documentation as follows:
 - .1 once during 1st month of building operation;
 - .2 once during 3rd month of building operation;
 - .3 once between 4th and 10th months in a season opposite to 1st and 3rd month visits.
 - .4 correct deficiencies revealed by system checks described above, and, where required, involve equipment manufacturers/suppliers during corrective actions, and report completion of corrective work;
 - .5 3 months after Substantial Completion conduct a question and answer session(s) at building with Owner's operating and maintenance personnel, with duration of session(s) dictated by number of questions and concerns that have to be addressed.

End of Section

1 General

1.01 SUBMITTALS

- .1 Submit shop drawings/product data sheets to regulatory authority for review and approval prior to submitting to the Consultant. Conform to following requirements:
 - .1 submit shop drawings/product data sheets for all products specified in this Section except pipe and fittings;
 - .2 sprinklers shall be referred to on drawings and product submittals, and be specifically identified by the manufacturer's listed model or series designation. Trade names and other abbreviated listings are not allowed;
 - .3 submit complete CAD layout drawings indicating source of water supply with test flow and pressure, "head-end" equipment piping schematic, pipe routing and sizing, and zones, all signed and sealed by a qualified professional mechanical engineer registered in jurisdiction of the work as specified below;
 - .4 submit copies of all calculations, including hydraulic calculations, stamped and signed by same engineer who signs layout drawings, and a listing of all design data used in preparing the calculations, system layout and sizing, including occupancy-hazard design requirements;
 - .5 in addition to submitting shop drawings to regulatory authority as specified above, shop drawings must be approved by Owner's insurer prior to being submitted to the Consultant for review.

1.02 CLOSEOUT SUBMITTALS

- .1 Submit a complete sprinkler system test certificate as specified in Part 3 of this Section.

1.03 SPARE PARTS

- .1 Fill spare sprinkler head cabinet complete with spare heads.

1.04 QUALITY ASSURANCE

- .1 Fire protection sprinkler system work is to be in accordance with following Codes and Standards:
 - .1 NFPA 13, Standard for the Installation of Sprinkler Systems;
 - .2 CSA B137.2, Polyvinylchloride (PVC) Injection-Moulded Gasketed Fittings for Pressure Applications;
 - .3 CSA B137.3, Rigid Polyvinylchloride (PVC) Pipe for Pressure Applications;
 - .4 ASTM A53, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated, Welded and Seamless;
 - .5 ASTM A135, Standard Specification for Electric-Resistance-Welded Steel Pipe;
 - .6 ASTM A234, Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service;
 - .7 ASTM A536, Standard Specification for Ductile Castings;
 - .8 ASTM A795, Standard Specification for Black and Hot-Dipped Zinc Coated (Galvanized) Welded and Seamless Steel Pipe for Fire Protection Use;
 - .9 ANSI/ASME B16.4, Grey Iron Threaded Fittings (Classes 125 and 250);

- .10 CAN/CSA B64.10, Backflow Preventers and Vacuum Breakers.
- .2 Fire protection sprinkler work is to be performed by a sprinkler company who is a member in good standing of the Canadian Automatic Sprinkler Association. Site personnel are to be licensed in jurisdiction of the work and under the continuous supervision of a foreman who is an experienced fire protection system installer and a journeyman pipe fitter licensed in jurisdiction of the work.
- .3 Check and verify dimensions and conditions at site and ensure work can be performed as indicated. Coordinate work with trades at site and accept responsibility for and cost of making adjustments to piping and/or spacing to avoid interference with other building components.
- .4 Verify working condition of existing sprinkler system equipment which has direct interface with project work and is to remain. Replace with new equipment where necessary.
- .5 System components must be ULC listed and labelled.
- .6 All grooved couplings, and fittings, valves and specialties shall be the products of a single manufacturer. Grooving tools shall be of the same manufacturer as the grooved components.
- .7 All castings used for coupling housings, fittings, valve bodies, etc., shall be date stamped for quality assurance and traceability.

1.05 DESIGN REQUIREMENTS

- .1 Fire protection sprinkler work is to be designed in accordance with NFPA 13 and Provincial Standards, and, where required, local building and fire department requirements and standards of Owner's Insurer. If water supply flow and pressure test data is not available, conduct Municipal main water flow and pressure tests at nearest fire hydrant to obtain criteria to be used in system design. Include hydrant location and flow and pressure test data with system design calculations.
- .2 Include for a qualified mechanical professional engineer registered and licensed in the jurisdiction of the work to design the fire protection standpipe work. For requirements regarding Contractor retained engineers, refer to Section 20 05 10 – Mechanical Work General Instructions.
- .3 Sprinkler /System Occupancy – Hazard Design requirements: In accordance with NFPA 13 occupancy-hazard density requirements, unless otherwise specified.

2 Products

2.01 PIPE, FITTINGS, AND JOINTS

- .1 Pipe, fittings and joints are to be as follows, with exceptions as specified in Part 3 of this Section:
 - .1 PVC
 - .1 Class 200, DR14, rigid, hub and spigot pattern PVC pipe and CSA certified fittings to CAN/CSA B137.2 and B137.3 and complete with gasketed joints.
 - .2 Schedule 40 Steel – Grooved Coupling Joints
 - .1 Schedule 40 mild black carbon steel, ASTM A53, Grade B, complete with grooved ends and mechanical fittings and couplings equal to Victaulic "FireLock" fittings and Victaulic Style 009N, 107H, and 107N QuickVic and 005 rigid coupling joints. Strap type outlet fittings such as Victaulic "Snap-Let" are not acceptable.
 - .3 Schedule 40 Steel – Screwed and Welded Joints
 - .1 Schedule 40 mild black carbon steel, ASTM A53, Grade B. Screwed piping complete with Class 125 cast iron screwed fittings to ANSI/ASME B16.4. Welded piping complete with

factory made seamless carbon steel butt welding fittings to ASTM A234, Grade WPB, long sweep pattern wherever possible.

- .4 Schedule 10 Steel – Grooved Coupling Joints
 - .1 Schedule 10 mild black carbon steel, ASTM A53, Grade B, complete with grooved ends and fittings and couplings equal to Victaulic "FireLock" fittings and Victaulic Style 009N, 107H, and 107N QuickVic and 005 rigid coupling joints.
- .5 Schedule 10 Steel – Screwed Joints
 - .1 Schedule 10 mild black carbon steel, ASTM A53, Grade B, complete with mill or site threaded ends, Class 125 cast iron screwed fittings to ANSI/ASME B16.4, and screwed joints.
- .6 "Lightwall" Steel – Grooved Coupling Joints
 - .1 Commercial quality. "Lightwall" rolled mild carbon steel pipe to ASTM A135, Grade A, complete with a galvanized exterior, grooved ends, and fittings and couplings equal to Victaulic "Fire Lock" grooved fittings and Victaulic Style 009N QuickVic or 005 rigid coupling joints.
- .7 "Lightwall" Steel – Screwed Joints
 - .1 Commercial quality, "Lightwall" rolled mild carbon steel pipe to ASTM A135, Grade A, ULC listed, mill or site threaded, complete with galvanized exterior, Class 125 cast iron screwed fittings to ANSI/ASME B16.4, and screwed joints.
- .8 Flexible Pipe – Equal to Victaulic "VicFlex"
 - .1 The drop system shall consist of a braided type 304 stainless steel flexible tube, zinc plated steel 1" NPT Male threaded nipple for connection to branch-line piping, and a zinc plated steel reducer with a 1/2" or 3/4" NPT female thread for connection to the sprinkler head.
 - .2 Option: Victaulic FireLock IGS Groove Style 108 coupling for connection to branch-line piping, and a zinc plated steel reducer with a female thread for connection to the sprinkler head.
 - .3 The drop shall include a cULus/FM approved Series AH2 braided hose with a bend radius to 2" to allow for proper installation in confined spaces.
 - .4 The hose shall be listed for:
 - .1 (4) bends at 31" length;
 - .2 (5) bends at 36" length;
 - .3 (8) bends at 48" length;
 - .4 (10) bends at 60" length;
 - .5 (12) bends at 72" length.
 - .5 Union joints shall be provided for; ease of installation, prevention of hose torque stresses and on site changing of factory 5.75" straight reducing nipple in reduced spaces under obstructions (optional reducing nipples; 4.83" or 6.57" reducing 90 and 9" or 13" straight reducer x 1/2 or 3/4" outlet) All VicFlex assemblies and related accessories to be installed as per the guidelines and listings in Victaulic submittal 10.85.

- .6 On T Bar ceiling grid with drop in tile application, the flexible drop shall attach to the ceiling grid using a one-piece open gate Series AB1 bracket. The bracket shall allow installation before the ceiling tile is in place.
 - .7 On T Bar ceiling grid designed for hard lid drywall application; the flexible drop shall attach to the ceiling grid using a one-piece open gate Series AB2 bracket. The bracket shall allow for the vertical adjustment of the reducer/head from below the drywall, post drywall installation.
 - .8 On Hat Furring Channel grid with hard lid drywall application; the flexible drop shall attach to the ceiling grid using a one-piece open gate Series AB4 bracket. The bracket shall allow for the vertical adjustment of the reducer/head from below the drywall, post drywall installation.
 - .9 The braided drop system shall be cULus listed and FM Approved for sprinkler services to 175 psi (1206 kPA).
 - .10 For dry sprinkler heads Victaulic VicFlex dry sprinkler model VS1. The sprinkler shall provide a vertical or horizontal flexible connection with a bend radius to 2", and allow for up to 4 bends. The sprinkler body shall be die cast brass with brass deflector, supplied finished to match application and to architectural direction, and glass bulb with glycerin solution. The product shall consist of a braided type 300 stainless steel flexible hose with a swivel type branch line threaded connection, EPDM gasket seal, with PTFE-coated Beryllium Nickel and stainless-steel spring-seal assembly. The bracket shall be open gate or metal strap to provide for sprinkler placement and alignment. The flexible dry sprinkler and bracket system is UL listed for sprinkler services to 175 psi.
- .9 Copper – Solder Joint
- .1 Type "L" hard drawn seamless copper to ASTM B88, complete with copper solder type fittings to ASME/ANSI B16.18 and soldered joints.
- .10 CPVC Pipe
- .1 Equal to IPEX BlazeMaster solvent weld, orange, SDR 13.5 pipe and Schedule 80 fittings, ULC listed for use in wet pipe automatic sprinkler systems, with a flame spread rating less than 25 and a smoke developed rating less than 50 when tested in accordance with CAN/ULC S102.2, and in accordance with NFPA 13 requirements.
 - .2 Victaulic Standard Mechanical Couplings: Manufactured in two segments of cast ductile iron, conforming to ASTM A-536, Grade 65-45-12. Gaskets shall be pressure-responsive synthetic rubber, grade to suit the intended service, conforming to ASTM D-2000. Mechanical Coupling bolts shall be zinc plated (ASTM B-633) heat treated carbon steel track head conforming to ASTM A-449 and ASTM A-183. Couplings shall comply with ASTM F1476 - Standard Specification for Performance of Gasketed Mechanical Couplings for Use in Piping Applications.
 - .3 Rigid Type: Coupling housings with offsetting, angle-pattern bolt pads shall be used to provide system rigidity and support and hanging in accordance NFPA-13. Couplings shall be fully installed at visual pad-to-pad offset contact. Couplings that require exact gapping of bolt pads at specific torque ratings are not permitted.
 - .4 Flexible Type: Use in locations where vibration attenuation and stress relief are required. Victaulic Style 177 (Quick-Vic™), Installation ready flexible coupling.

2.02 SERVICE MAIN DOUBLE CHECK VALVE ASSEMBLIES

- .1 Minimum 1205 kPA (175 psi) rated dual check valve backflow preventer assembly to CAN/CSA B64, complete with tight-closing resilient seated shut-off valves, test cocks and strainer.

- .2 Manufacturers:
 - .1 Watts Industries Canada;
 - .2 Zurn/Wilkins;
 - .3 Apollo Valves (Conbraco Industries).

2.03 SHUT-OFF VALVES

- .1 Minimum 2070 kPA (300 psi) rated full port brass or bronze body screwed ball valves and lug body or grooved end type butterfly valves.
- .2 Butterfly valves shall include a pressure responsive seat, and the stem shall be offset from the disc centerline to provide complete 360-degree circumferential seating.
- .3 Basis of Design: Victaulic Style 705.
- .4 OS&Y Gate Valves: 1725 kPA (250 psi), grooved ends. Ductile iron body, yoke, and handwheel conforming to ASTM A-536; EPDM coated ASTM A-126-B cast iron disc; ASTM B16 brass rising stem; flanged and epoxy coated ductile iron bonnet; EPDM O-ring stem seals and body gasket. Victaulic Series 771H (Grooved ends) and Series 771F (Grooved x Flanged).
- .5 Supervised closed applications:
 - .1 Basis of Design: Victaulic Series 707C supervised closed butterfly valve.

2.04 CHECK VALVES

- .1 Minimum 1725 kPA (250 psi) resilient seat check valves, suitable for vertical or horizontal installations.
- .2 Basis of Design: Victaulic Series 717.
- .3 Check valves associated with Fire Department connections and fire pump test connection are to be tapped for site installation of a 20 mm (¾") diameter ball drip.

2.05 BALL DRIPS

- .1 Equal to National Fire Equipment Ltd. Model #A58, 20 mm (¾") diameter automatic ball drip.

2.06 SHUT-OFF VALVE SUPERVISORY SWITCHES

- .1 Tamper-proof supervisory switches, each arranged to activate a fire alarm system trouble alarm condition if the valve is closed or tampered with, each suitable in all respects for the application, and each complete with all required mounting and connection hardware.
- .2 Actuator housings shall be weatherproof.

2.07 FIRE DEPARTMENT CONNECTIONS

- .1 Wall mounting polished brass clapper type dual inlet Fire Department connection with 2, 65 mm (2-½") diameter inlets threaded to Fire Department hose requirements and equipped with caps and chains, an outlet sized as shown, and a faceplate.
- .2 Faceplate is to be polished brass and complete with "AUTO-SPKR" "STANDPIPE" cast-in raised lettering.
- .3 Exposed metal parts of Fire Department connection are to be chrome plated.
- .4 At the low point near each fire department connection, install a 90-degree elbow with drain connection to allow for system drainage to prevent freezing.

- .5 Basis of Design: Victaulic #10-DR.

2.08 SPRINKLER MAIN "LOSS OF PRESSURE" ALARM SENSORS

- .1 Piping mounted adjustable pressure sensor designed to actuate an alarm upon sensing a loss of pressure in the fire protection main. Switch is to be low voltage or line voltage as required.

2.09 WATER FLOW ALARM SWITCHES

- .1 Pipe mounting water flow alarm switch, minimum 1725 kPa (250 psi) rated, designed to actuate two 7 ampere rated (at 125/250 VAC) SPDT snap action switches when water flow exceeds 0.758 L/sec. (10 Imp gpm), complete with a tamper-proof cover with conduit connection opening, a piping saddle and U-bolt, and an automatic rest pneumatic retard device with field adjustable (0 to 70 second) switch actuation delay to reduce false alarms caused by a single or series of transient water flow surges.

2.10 ALARM CHECK VALVES

- .1 Equal to Victaulic Series 751 FireLock, enamelled cast iron check valve assembly designed for either vertical or horizontal mounting and to actuate alarms when wet type sprinkler system is activated. Assembly is to be minimum 1205 kPa (175 psi) cold water rated with all moving parts constructed of brass, bronze, stainless steel or EPDM, and is to be complete with:
 - .1 pipe, fittings and accessories for site connection of an excess pressure pump;
 - .2 basic trim including piping materials and check valve for an external by-pass, potable water supply and system water supply pressure gauges with gauge test ports and shut-off valves, an angle type main drain valve, and fittings for mounting an alarm test by-pass;
 - .3 alarm test by-pass piping with ball valve to permit alarm testing without operation of alarm valve;
 - .4 alarm trim with pipe and fittings for connection to a water motor alarm, and an adjustable pressure switch for electrical connection to an alarm system upon flow through valve.

2.11 EXCESS PRESSURE PUMPS

- .1 Close coupled, 1750 RPM, all bronze gear pump sized to maintain sufficient pressure in fire protection main to prevent alarm check valve(s) from initiating flow alarms during fluctuations in pressure of Municipal water supply. Pump is to be complete with:
 - .1 stainless steel shaft with maintenance free seal;
 - .2 lifetime lubricated carbon bearings;
 - .3 TEFC motor conforming to requirements specified in Section 20 05 00 – Common Work Results for Mechanical, and secured to a mounting base;
 - .4 accessory package consisting of flexible suction and discharge connection hoses, a Monel inlet strainer, relief valve factory set at 862 kPa (120 psi), and a steel mounting plate designed to mount pump to alarm check valve flange;
 - .5 power and control panel.
- .2 Factory pre-wired power and control panel, CSA certified, designed to automatically start and stop pump in response to water pressure variations in the main and consisting of a surface wall mounting NEMA 2 enamelled steel panel with hinged front door equipped with Corbin catch, and following:
 - .1 door interlock fused disconnect with HRC fuses;
 - .2 protected type pump starter;

- .3 door mounted H-O-A rotary selector switch;
- .4 fused control transformer;
- .5 115 volt adjustable pressure switch to suit the application;
- .6 set of NO/NC dry contacts for connection of lack of power availability alarm;
- .7 door mounted "POWER ON" LED.

2.12 WATER MOTOR ALARMS

- .1 Surface wall mounting water motor driven alarm device consisting of a water motor assembly with 20 mm ($\frac{3}{4}$ ") diameter inlet and 25 mm (1") or 32 mm (1- $\frac{1}{4}$ ") diameter drain connections, inlet strainer, a red enamelled steel exterior wall mounting strike and gong assembly, a drive shaft sleeve with drive shaft to connect water motor and gong assembly and, at the exterior gong, identification to read "SPRINKLER FIRE ALARM - WHEN BELL RINGS CALL FIRE DEPARTMENT OR POLICE".

2.13 DRY PIPE VALVES

- .1 Equal to a Victaulic Series 768-NXT:
 - .1 Series 746-LPA accelerator quick opening device;
 - .2 Series 757 regulated air maintenance trim assembly;
 - .3 Required air pressure shall be 90 kPA (13 psig);
 - .4 The valve shall be externally resettable;
 - .5 Provide valve complete with internal components that are replaceable without removing valve from installed position;
 - .6 Systems requiring a quick opening device must use a regulated, tank mounted air supply;
 - .7 Series 757 Regulated Air Maintenance Trim Assembly.

2.14 DRY PIPE ZONE AIR COMPRESSOR

- .1 Equal to a Victaulic 7C7 CSA certified, oil-less, piston type direct driven compressor with a motor conforming to requirements specified in Section 20 05 00 – Common Work Results for Mechanical, and a mounting bracket.
- .2 Equal to General Air Products OLT Series, package type, oil-free, piston type, tank mounted air compressor set complete with horizontal, ASME rated and stamped steel tank with support feet, pressure gauge with gauge cock, tank drain, flexible compressor to tank and tank to piping flexible connections supplied loose for field installation, and a motor conforming to requirements specified in Section 20 05 00 – Common Work Results for Mechanical.
- .3 Compressor set capacity and performance must suit final dry pipe system design and reviewed piping and sprinkler head layout shop drawings. If a larger compressor set than that specified is required, provide larger set at no additional cost, and include any additional costs for a larger size motor starter and associated wiring.

2.15 PREACTION VALVE AND ACCESSORIES

- .1 Equal to Series 745 FirePac - Provide a pre-assembled [Dry] [Preaction] [Deluge] fire protection valve mounted completely within a steel cabinet for sizes 1 $\frac{1}{2}$ " [DN 40] through 8" [DN 200]. Cabinet shall be coated with red ASA-61 electrostatically applied polyester powder coating. Cabinet shall have field removable access panels on three sides to allow for ease of valve maintenance, servicing, and

- installation. Unit shall be UL Listed and FM-Global Approved with all materials and wiring conforming to NFPA requirements. Unit shall be provided with Series 728 ball valve or Series 705 butterfly shutoff valve with pre-wired supervisory switches, the sprinkler system fire protection valve, alarm line pressure switches, air supervisory pressure switches, alarm pressure switch and pressure gauges for proper operation and shall be pre-wired to Model RP-2001 control panel. All external electrical connections shall be able to be connected through a factory provided conduit connection to an enclosure inside of the cabinet. Water inlet, system supply, and drain connections shall be grooved for ease of installation. Victaulic FireLock® Series 745 Fire-Pac.
- .2 [Dry] [Preaction] [or] [Deluge] valve [with specified configuration], valve shall be low differential, latched clapper design with a black enamel coated ductile iron body conforming to ASTM A536, aluminum bronze clapper, stainless steel spring and shaft, EPDM diaphragm and seal, brass seat with nitrile seat o-rings. Valve internal parts shall be replaceable without removing the valve from the installed position and shall be externally resettable. 300 psi pressure rating in sizes 1½" [DN 40] through 8" [DN 200] and shall be grooved ends for vertical installation only. Victaulic FireLock® NXT [Series 768N (Preaction)] [and] [or] [Series 769N Deluge].
 - .3 Trim configurations:
 - .1 Dry Valve: Pneumatic operation.
 - .2 Preaction Valve:
 - .1 Non-interlock; [Pneumatic] [and] [or] [Electric].
 - .2 Single interlock; [Pneumatic] [or] [Electric].
 - .3 Double interlock; [Pneumatic] [and] [Electric].
 - .3 Deluge Valve:
 - .1 Electric release.
 - .2 Wet pilot.
 - .3 Dry pilot.
 - .4 Electric Release Panel: Notifier Model RP-2001 is a compact single enclosure unit containing power supply, two 12Amp-hr batteries and availability to have factory installed all accessory options.
 - .5 Options: Preassembled cabinet shall have factory options to have pipe penetrations sealed to meet NEMA 4 protection of equipment inside of the enclosure with respect to the ingress of water, whether rain, sleet, snow, splashing water or hose directed water.
 - .6 Options: Preassembled cabinet shall have nitrogen fill options as well as a factory installed low nitrogen pressure alarm to augment low air alarms as needed in certain trim applications.
 - .7 Manufacturers:
 - .1 Victaulic Co.;
 - .2 FireFlex System Inc.
 - .8 Smoke detectors, each complete with a red LED that pulses during normal standby conditions and illuminates steadily during an alarm condition.
 - .9 Surface wall mounting (to a recessed box) non-break glass pull station with test/reset key.

2.16 ZONE CONTROL RISER MODULES

- .1 Equal to Victaulic Co. "FireLock" Series 747M factory assembled zone control riser modules, each complete with a painted cast ductile iron grooved end body, a ball type shut-off valve, a test and drain combination with properly sized orifice, a flow alarm switch, a pressure gauge with cock, and a pressure relief valve kit.
- .2 Zone flow test and drain assembly cabinets are to be equal to National Fire Equipment Ltd. Model CV-200 recessed cold rolled steel cabinets, sized to suit assemblies, with a baked enamel finish, #18 gauge with universal knockouts for tubs, #14 gauge for doors and trim, with all metal edges ground and rounded. Doors are to be complete with:
 - .1 hollow channel reinforcement;
 - .2 full length semi-concealed piano hinge with paint stop feature and designed to permit 180° door opening;
 - .3 flush stainless steel door latch.

2.17 SPRINKLER HEADS

- .1 Sprinkler heads, unless otherwise specified, are to be as scheduled in Part 3 of this Section.
- .2 Sprinkler body shall be die-cast, with a hex-shaped wrench boss integrally cast into the sprinkler body to reduce the risk of damage during installation. Wrenches shall be provided by the sprinkler manufacturer that directly engage the wrench boss.
- .3 For locations where corrosive resistant coatings are required, body shall be coated with UL listed and FM approved anti-corrosion VC-250 coating (silver coloring).
- .4 Sprinkler heads for healthcare facilities are to be quick response type.
- .5 Provide quick response sprinkler heads unless standard response required to suit the hazard class.
- .6 Recessed sprinkler heads in finished areas are to be chrome plated unless otherwise specified. Concealed sprinkler head ceiling plates are to match ceiling colour.
- .7 Where exposed pendent heads occurs in areas with suspended ceilings, they are to be complete with chrome plated escutcheon plates. Similarly, sidewall heads with concealed piping are to be complete with chrome plated escutcheon plates.
- .8 Sprinkler heads which are exposed in areas where they may be subject to damage are to be complete with wire guards, chrome plated where in finished areas.
- .9 Escutcheons and guards shall be listed, supplied, and approved for use with the sprinkler by the sprinkler manufacturer.
- .10 Sprinkler heads located in areas or over equipment where high ambient temperature is present are to be, unless otherwise specified, 74°C (165°F) heads. All other heads, unless otherwise specified or required, are to be 57°C (135°F) rated.
- .11 Manufacturers:
 - .1 Victaulic Co.;
 - .2 Tyco Fire Suppression & Building Products;
 - .3 The Viking Corporation;

- .4 The Reliable Automatic Sprinkler Co.

2.18 SPARE SPRINKLER HEAD CABINETS

- .1 Surface wall mounting, red enamelled steel, identified cabinet with hinged door, shelves with holes for mounting sprinkler heads, a wrench or wrenches suitable for each type of sprinkler head, and a full complement of spare sprinkler heads.
- .2 Cabinet is to be sized to accommodate a minimum of 4 spare heads for each type of head used on the project, however, each cabinet is to be full of spare heads.

2.19 INDICATOR POST AND VALVES

- .1 Cast iron, bronze trim, resilient seat, OS&Y gate valve with non-rising stem in accordance with AWWA 200W, minimum 1380 kPA (200 psi) cold water rated and complete with a square operating nut and ends to suit connecting piping.
- .2 Adjustable indicator post assembly with a cast iron valve box of a length to suit valve depth and flange bolted to the valve, a cast iron lower barrel bolted to the valve box and of a length to suit valve location, and a cast iron upper housing bolted to the lower barrel and complete with wrench and operating mechanism with steel extension shaft and coupling nut sized to suit, operating handle, and valve "OPEN" and "CLOSED" identification visible through a clear polycarbonate window.

3 Execution

3.01 MONITORING OF SYSTEMS

- .1 Daily monitor and supervise existing sprinkler system serving renovated areas to ensure that each respective system is left in proper operating condition at end of each working day. Include for but not be limited to performing following:
 - .1 Under presence of Owner's representative, check each morning and evening (start and end of work) of each day, sprinkler system to ensure that it is in proper working condition;
 - .2 If portions of sprinkler system is not in proper working order, provide temporary provisions subject to approval of local fire authority or local governing authority, to ensure that proper sprinkler coverage is provided and/or provide supervisory personnel to monitor areas where sprinkler system is not operational;
 - .3 Document and sign off with Owner's representative signing off also, each respective daily check condition;
 - .4 Ensure that work to sprinkler system does not affect portion of system serving areas outside of renovation areas.

3.02 DEMOLITION

- .1 Refer to demolition requirements specified in Section 20 05 05 – Selective Demolition for Mechanical.

3.03 PIPING INSTALLATION REQUIREMENTS

- .1 Provide required sprinkler system piping.
- .2 Perform piping work in accordance with requirements of NFPA 13, governing regulations, and "Reviewed" shop drawings.
- .3 Piping, unless otherwise specified, is as follows:

- .1 for underground piping inside or outside building – Class 200, DR14 rigid PVC, braced and secured at bends and tees with concrete blocks in accordance with Municipal standards and details;
 - .2 for piping inside building and above ground except as noted below – Schedule 40 grooved end black steel with Victaulic or equal fittings and coupling joints, or, for piping to and including 50 mm (2") diameter, screwed fittings and joints, or, for piping 65 mm (2-½") diameter and larger, welding fittings and welded joints;
 - .3 for wet system piping inside building and above ground – at your option, CPVC sprinkler pipe and fittings;
 - .4 for piping downstream of "head end" alarm valve(s) and equipment – Schedule 10 or "Lightwall" black steel pipe with Victaulic or equal fittings and coupling joints or screwed fittings and joints;
 - .5 for branch piping to heads in suspended ceilings, etc. – at your option, flexible piping installed in accordance with manufacturer's instructions;
 - .6 for branch piping to heads in MRI suites – copper pipe, fittings, and sprinkler head adapters with stainless steel hangers and support hardware.
- .4 Exceptions to piping requirements specified above are as follows:
- .1 dry pipe zone steel piping, fittings, unions, couplings and flanges are to be galvanized;
 - .2 wet zone steel piping, fittings, unions, couplings and flanges for sprinkler work exposed to weather either inside or outside building (including parking garages), are to be galvanized;
 - .3 PVC piping is not to be used above grade;
 - .4 ferrous pipe hangers, supports, and similar hardware used for galvanized steel piping are to be electro-galvanized.
- .5 Pipe sizes, pipe routing, sprinkler head quantities and locations, and layout of work shown on drawings are to assist during the tendering period. Ensure adequate head coverage, head quantities and pipe sizing as specified in Part 1 of this Section. Do not reduce size of sprinkler main or re-route the main unless approved by Consultant.
- .6 Pipe, fittings, couplings, flanges and similar components are to be clean after erection is complete. Wire brush clean any ferrous pipe, fitting, coupling, flange, hanger, support and similar component which exhibits rust and carefully coat with suitably coloured primer.
- .7 Where sprinklers are not protected by a dry system and may be subject to freezing, provide non-freeze, glycol-water solution filled sprinkler piping. Install piping complete with a CSA certified reduced pressure backflow preventer, valves and glycol solution fill facilities in accordance with requirements of Chapter 3 of NFPA 13. Fill piping with a solution of 50% Union Carbide Canada Ltd. "UCAR THERMO-FLUID 17" or Dow Chemical Co. "Dowtherm SR1" propylene glycol with corrosion inhibitors, and 50% clean water. Prior to filling piping, check the specific gravity of the solution using a hydrometer with proper scale. Specific gravity is to be approximately 1.069 at 15.6°C.
- .8 When sprinkler work is complete, test system components and overall system(s) and submit completed test certificate and other documentation in accordance with Chapter 8 of NFPA 13.
- .9 Grooved joints shall be installed in accordance with the manufacturer's latest published installation instructions. Grooved ends shall be clean and free from indentations, projections, and roll marks. Gaskets shall be molded and produced by the coupling manufacturer, and shall be verified as suitable for the intended service. A factory-trained field representative of the mechanical joint manufacturer shall provide on-site training for contractor's field personnel in the proper use of grooving tools and installation of grooved piping products. The factory-trained representative shall periodically review the product

installation and ensure best practices are being followed. Contractor shall remove and replace any improperly installed products.

3.04 INSTALLATION OF DOUBLE CHECK VALVE ASSEMBLY

- .1 Provide a double check valve assembly in sprinkler main inside the building.
- .2 Equip assembly with inlet and outlet shut-off valves with supervisory switches as specified below.
- .3 Support each end of assembly from floor by means of flanged pipe supports with saddles.

3.05 INSTALLATION OF SHUT-OFF VALVES AND CHECK VALVES

- .1 Provide shut-off valves and check valves in piping where shown and wherever else required.
- .2 Locate valves for easy operation and maintenance.
- .3 Confirm exact locations prior to roughing-in.

3.06 INSTALLATION OF SHUT-OFF VALVE SUPERVISORY SWITCHES

- .1 Equip each shut-off valve with a supervisory switch.
- .2 Identify each supervised valve with a 150 mm (6") square, engraved, laminated red-white plastic tag to correspond with supervised valve numbering specified and/or shown as part of the electrical work fire alarm system.

3.07 INSTALLATION OF FIRE DEPARTMENT CONNECTION

- .1 Provide an exterior Fire Department connection. Confirm exact location prior to roughing-in. Confirm finish prior to ordering.
- .2 Equip connection with a check valve. Equip check valve with a ball drip to drain piping between Fire Department connection and check valve, and extend drainage piping from outlet of ball drip to nearest suitable floor drain.

3.08 INSTALLATION OF LOSS OF PRESSURE SENSOR

- .1 Supply and mount a pressure sensor in the fire protection piping main to activate a "LOSS OF PRESSURE" trouble alarm should Municipal water service pressure fall below the acceptable level.
- .2 Locate sensor for easy access and maintenance, and set alarm pressure to suit site conditions. Confirm setting on site.
- .3 Identify pressure sensor and its normal setting with a 150 mm (6") square red-white laminated plastic tag engraved to read "LOSS OF WATER PRESSURE SENSOR - NORMAL SETTING 210 kPA". Confirm wording prior to engraving.

3.09 INSTALLATION OF FLOW ALARM SWITCHES

- .1 Provide water flow alarm switches in accessible locations in zone piping.
- .2 Adjust to suit site water pressure conditions. Check and test operation.
- .3 Identify each switch with a 150 mm (6") square red-white laminated engraved plastic tag. Confirm wording prior to engraving.

3.10 INSTALLATION OF ALARM CHECK VALVES

- .1 Provide alarm check valves, complete with trim, for wet zone fire protection sprinkler piping.

- .2 Check and test operation of each valve and adjust as required to suit site water pressure conditions.
- .3 Identify each valve with a 150 mm (6") square red-white laminated engraved plastic tag. Confirm wording prior to engraving.

3.11 INSTALLATION OF EXCESS PRESSURE PUMP AND CONTROLS

- .1 Provide an excess pressure pump in wet fire protection sprinkler system piping, arranged to prevent activation of alarm check valve water flow alarms during normal water pressure fluctuations in the main. Locate pump on a steel mounting plate assembly at alarm check valve(s) and install accessories supplied with pump. Provide a pressure gauge in valved tubing across pump suction and discharge connections.
- .2 Supply a starter and control panel for pump and surface wall mount adjacent to pump. Connect panel pressure switch with copper tubing in accordance with pump manufacturer's instructions. Adjust pressure switch to suit site conditions.
- .3 Start-up the pump, test operation and adjust as required.

3.12 INSTALLATION OF WATER MOTOR ALARMS

- .1 Provide a water motor alarm. Secure gong on the exterior wall, impeller and motor assembly on the interior wall, and connect with drive assembly in accordance with manufacturer's instructions. Install inlet strainer supplied loose with assembly.
- .2 Provide a galvanized steel drain pipe from impeller-motor assembly down the interior wall and terminate piping back out through the wall with a 45° piping elbow and wall plate located 600 mm (24") above finished grade.
- .3 Confirm exact location of alarm gong prior to roughing-in.
- .4 When installation is complete, check and test alarm operation and adjust as required.

3.13 INSTALLATION OF DRY PIPE VALVES

- .1 Provide dry pipe valves for zones.
- .2 Connect compressed air piping to each valve, as well as all compressed air piping trim.
- .3 When installation is complete, check and test valve operation and adjust as required.
- .4 Provide drum drips in dry type fire protection sprinkler zone piping where shown or required. Wherever possible locate drum drips in heated areas. Where drum drips are located in unheated areas ensure trades performing thermal insulation work and electric heating cable pipe tracing work are aware of the number of drum drips required, and the size and location. Identify each drum drip. Locate drum drips in heated areas wherever possible.

3.14 INSTALLATION OF DRY ZONE AIR COMPRESSORS

- .1 Provide an air compressor with air maintenance device and pressure control for the dry pipe zone and dry pipe valve. Secure compressor to a piping main by means of a mounting bracket supplied with compressor. Adjust to suit site conditions.
- .2 Provide an air compressor set with receiver and secure in place on rubber-steel-rubber vibration isolation pads on a concrete housekeeping pad.
- .3 Install flexible piping connections supplied loose with set.
- .4 Extend valved drain piping from receiver to a floor drain.
- .5 Connect receiver and control panel pressure switch with copper tubing.

- .6 When installation is complete, check and test air compressor set, including automatic operation, and adjust as required.

3.15 INSTALLATION OF PREACTION SPRINKLER SYSTEMS

- .1 Provide a preaction sprinkler system.
- .2 Install preaction deluge valve cabinet assembly with control panel and air compressor as indicated but confirm exact location prior to roughing-in.
- .3 Provide required water supply, compressed air, sprinkler, and drain piping. Terminate drain piping over a funnel floor drain.
- .4 Provide detection devices and install in accordance with manufacturer's instructions. Connect to control panel with wiring in conduit.
- .5 Supply detection devices and hand to electrical trade on site for installation.
- .6 Include for 4 hours of on-site operation demonstration and training session. Training is to be a full review of all components including but not limited to a full operation and maintenance demonstration, with abnormal events.

3.16 INSTALLATION OF ZONE CONTROL RISER MODULES

- .1 Provide zone control riser modules with drain piping where required. Terminate drainage piping over a funnel floor drain unless otherwise shown or specified. Identify each assembly.

3.17 INSTALLATION OF ZONE CONTROL RISER MODULE CABINETS

- .1 Provide flush wall mounting cabinets for zone control and inspector's test connection assemblies where required in finished areas. Confirm exact locations prior to roughing-in.
- .2 Identify each cabinet with a nameplate in accordance with requirements of Section 20 05 00 – Common Work Results for Mechanical.

3.18 INSTALLATION OF SPRINKLER HEADS

- .1 Provide required sprinkler heads in accordance with following schedule:

Application	Sprinkler HEAD TYPE
Healthcare Facility Type I rooms/areas as per CAN/CSA-Z317.2, Table 1, HVAC Design Criteria, first two columns	Victaulic V38/V39 or Tyco Series RFII "Royal Flush II" concealed pendent
Healthcare Facility Type II rooms/area as per CAN/CSA-Z317.2, Table 1, HVAC Design Criteria, first two columns	Victaulic V27 or Tyco Series TY-FRB recessed pendent
Healthcare Facility Type III rooms/areas as per CAN/CSA-Z317.2, Table 1, HVAC Design Criteria, first two columns	Victaulic V27 or Tyco Series TY-FRB recessed pendent
Healthcare patient unit without a suspended ceiling but with a ceiling bulkhead	Victaulic V27 or Tyco Series TY-FRB recessed horizontal sidewall Victaulic V38/V39 or Tyco Series RFII "Royal Flush II" concealed pendent or Victaulic V27 or Tyco Series TY-FRB recessed pendent in bottom of bulkhead if bulkhead is greater than 200 mm (8") deep

Application	Sprinkler HEAD TYPE
Healthcare Facility mental health room/areas	Tyco "RAVEN" institutional, tamper-resistant pendent or horizontal sidewall as required
Healthcare Facility MRI Suite	Reliable Model F4FR-NF non-ferrous concealed pendent
Rooms/areas with a suspended ceiling	Victaulic V38/V39 or Tyco Series RFI "Royal Flush II" concealed pendent Victaulic V27 or Tyco Series TY-FRB recessed pendent Victaulic V27 or Tyco Series TY-FRB pendent with escutcheon plates
Rooms/areas without a suspended ceiling	Victaulic V27 or Tyco Series TY-FRB pendent
Elevator shafts	Victaulic V27 or Tyco Series TY-FRB horizontal sidewall
Unheated exterior stairwells	Victaulic V36 or Tyco Series DS-1 dry pipe horizontal sidewall Victaulic V36 or Tyco Series DS-3 wet pipe horizontal sidewall
Air handling system outdoor air and relief air plenums (unheated)	Tyco Series DS-3 ECOH dry horizontal sidewalls in wet piping Victaulic V27 or Tyco Series TY-FRB upright or horizontal sidewall in dry pipe or anti-freeze piping
Unheated and unfinished areas	Victaulic V36 or Tyco Series DS-3 ECOH dry horizontal sidewall in wet piping Victaulic V27 or Tyco Series TY-FRB upright or horizontal sidewall in dry pipe or anti-freeze piping
Heated areas with overhead doors	Victaulic V27 or Tyco Series TY-FRB horizontal sidewall
Unheated parking garage	Victaulic V34 or Tyco Series EC-11 or EC-14 ECOH upright or Victaulic V27 or Series TY-FRB upright for dry piping
Heated parking garage	Victaulic V34 or Tyco Series EC-11 or EC-14 ECOH upright or Victaulic V27 or Series TY-FRB upright for wet piping
Parking garage ramp	Victaulic V34 or Tyco Series EC-11 or EC-14 ECOH upright or Series TY-FRB upright or Victaulic V27 or Series ELO SW-20 or SW-24 ECOH sidewall
At non-rated windows in rated walls	Tyco Model WS horizontal and pendent vertical sidewall

- .2 Sprinkler head manufacturers indicated on schedule are for type indication purposes. Manufacturers are listed in Part 2 of this Section.
- .3 Provide quick response type sprinkler heads for healthcare facilities.
- .4 Coordinate sprinkler head locations with all drawings, including architectural reflected ceiling plan drawings, and, where applicable, electrical drawings. Coordinate sprinkler head locations in areas with suspended ceilings with the location of lighting, grilles, diffusers, and similar items recessed in or surface mounted on the ceiling as per the reflected ceiling plans. In areas with lay-in tile, centre the sprinkler head both ways in the lay-in tile wherever possible. Confirm locations prior to roughing-in.
- .5 Maintain maximum headroom in areas with no ceilings.

- .6 Provide guards for heads where they are subject to damage.
- .7 Provide high temperature heads in equipment rooms and similar areas over heat producing or generating equipment.

3.19 INSTALLATION OF SPARE SPRINKLER HEAD CABINETS

- .1 Supply a full complement (to fill cabinet) of spare sprinkler heads of types used (minimum 4 of each type) and place in a wall mounting storage cabinet located adjacent to sprinkler system "head end" equipment where later directed.

3.20 INSTALLATION OF INDICATOR POST VALVES

- .1 Provide a shut-off valve in underground sprinkler main piping outside building. Equip valve with a valve box and an indicator post assembly.
- .2 Confirm valve box length and steel shaft length prior to ordering and confirm exact location prior to roughing-in.
- .3 When installation is complete, check and test operation of assembly and adjust as required.

End of Section

1 General

1.01 REFERENCES

- .1 Domestic water piping and valves are to comply with following codes, regulations and standards (as applicable):
 - .1 applicable local codes and regulations;
 - .2 CAN/CSA B125.1, Plumbing Supply Fittings;
 - .3 CAN/CSA B125.3, Plumbing Fittings;
 - .4 CAN/CSA B137 Series, Thermoplastic Pressure Piping Compendium;
 - .5 NSF/ANSI 14, Plastics Piping System Components and Related Materials;
 - .6 NSF/ANSI 61, Drinking Water System Components – Health Effects;
 - .7 NSF/ANSI 372, Drinking Water System Components – Lead Content.

1.02 SUBMITTALS

- .1 Submit shop drawings/product data sheets for all products specified in Part 2 of this Section except for pipe, fittings, and chlorine solution.

1.03 CLOSEOUT SUBMITTALS

- .1 Submit laboratory water purity test results indicating chlorine residual prior to application for Substantial Performance of the Work.
- .2 Prior Substantial Performance of the Work, submit a minimum of 3 identified keys for key operated hydrants.
- .3 Submit signed test results and inspection and test log cards for each backflow preventer as specified in Part 3 of this Section.
- .4 Submit anchor drawing(s) to detail fabrication and installation of water piping anchors. Drawing(s) are to be prepared and stamped by a professional structural engineer registered and licensed in jurisdiction of the work.
- .5 As specified in Part 3 of this Section, submit a letter from anchor design engineer stating anchor installation has been examined at site and anchors are properly fabricated and installed.

2 Products

2.01 PIPE, FITTINGS, AND JOINTS

- .1 PVC
 - .1 ULC listed, rigid, Class 150, DR18, 1035 kPa (150 psi) pressure rated bell and spigot pattern PVC pipe to CAN/CSA B137.3, and CSA certified fittings to CAN/CSA B137.2, and AWWA C900, complete with gasket joints, and Ford "Uni-Flange" or equal restraint collars as per Part 3 of this Section.
- .2 Soft Copper
 - .1 Type "K" soft copper to ASTM B88, supplied in a continuous coil with no joints if possible, and complete with, if joints are required, compression type flared joint couplings.

- .3 Stainless Steel
 - .1 Schedule 10S type 304 stainless steel, ASTM A312, factory or site roll grooved, complete with Victaulic or equal type 304 stainless steel roll grooved end fittings and, unless otherwise specified, Victaulic Style 807, 877 or 889 couplings color coland coupling gaskets equal to Victaulic Grade P fluoroelastomer.
- .4 Copper - Solder Joint
 - .1 Type "L" hard drawn seamless copper to ASTM B88, complete with copper solder type fittings to ASME/ANSI B16.18 and soldered joints using The Canada Metal Co. Ltd. "SILVABRITE 100" or equal lead-free solder for cold water pipe, and 95% tin / 5% Antimony or "SILVABRITE 100" solder for other services.
- .5 Copper - Pressure Coupled Joint
 - .1 Type "L" hard drawn seamless copper to ASTM B88 with Viega "ProPress with Smart Connect feature" copper fittings with EDPM seals, and pressure type crimped joints made by use of manufacturer recommended tool.
- .6 Copper - Grooved
 - .1 Type "L" hard drawn seamless copper to ASTM B88 with Victaulic QuickVic Style 607 non-reducing, bolted connection type suitable and approved for application intended, 2" - 8" for copper tubing consisting of ductile iron cast housings, complete with a Grade P fluoroelastomer gasket of a pressure-responsive design, with plated nuts and bolts to secure unit together.
- .7 Semi-Rigid Polyethylene Tubing
 - .1 Versa Fittings and Mfg. Inc. 12 mm (½") dia., high density, semi-rigid polyethylene tubing, 1380 kPa (200 psi) rated.
- .8 Flexible Polyethylene
 - .1 Flexible polyethylene pipe to CAN/CSA B137.1, 690 kPa (100 psi) rated, complete with insertion type fittings secured with Series 300 stainless steel gear type clamps.
- .9 Cross-Linked Polyethylene (PEX) Tubing
 - .1 Non-barrier type PEX piping in accordance with CAN/CSA B137.5, ASTM F876 and tested for compliance by an independent third-party agency, 25/50 flame spread/smoke developed rated when tested to CAN/ULC S102.2 and complete with brass inserts and crimp-ring or cold-expansion joint fittings and couplings.

2.02 SHUT-OFF VALVES

- .1 Ball Valves
 - .1 Class 600, 4140 kPa (600 psi) WOG rated, lead-free, full port ball type valves, each complete with a forged brass body with solder ends, forged brass cap, blowout-proof stem, solid forged brass chrome plated ball, "Teflon" or "PTFE" seat, and a removable lever handle. Valves in insulated piping are to be complete with stem extensions.
 - .2 Manufacturers:

- .1 Toyo Valve Co. Fig. 5049A-LF;
 - .2 Milwaukee Valve Co. #UPBA485B;
 - .3 Kitz Corporation Code 859;
 - .4 Apollo Valves #77LF-200;
 - .5 Watts Industries (Canada) Inc. #LFFBVS-3C.
- .2 Butterfly Valves - Flanged Joint
- .1 Non-corrosive, minimum 1200 kPa (175 psi) cold water pressure rated, resilient seated butterfly valves, each complete with a coated cast ductile iron lug type body, stainless steel shaft, bronze disc, and EPDM seat, and each suitable for domestic water bubble-tight dead end service with valve in position and either side of connecting piping removed. Butterfly valves to and including 100 mm (4") dia. are to be equipped with lever handles. Butterfly valves larger than 100 mm (4") dia. are to be equipped with worm gear operators.
 - .2 Manufactures:
 - .1 DeZurik #632L Series;
 - .2 Kitz Corporation Code #6122EL/EG;
 - .3 Toyo Valve Co. #918BESL/EG;
 - .4 Bray Valve and Controls Canada Series 31;
 - .5 Apollo Valves #141 Series;
 - .6 Watts Industries (Canada) Inc. #BF-03.
- .3 Butterfly Valves – Grooved End
- .1 Equal to Victaulic Series 608N, for copper pipe rated to 300 psi and be both bi-directional and dead-end service capable to full rated pressure. Seat material shall be EPDM UL Classified in accordance with ANSI/NSF 61 for ambient +86°F and hot +180°F potable water service and ANSI/NSF 372.
 - .2 Victaulic Series 461, for stainless steel pipe rated to 300 psi and be both bi-directional and dead-end service capable to full rated pressure. Seat material shall be EPDM UL Classified in accordance with ANSI/NSF 61 for ambient +86°F and hot +180°F potable water service and ANSI/NSF 372.

2.03 CHECK VALVES

- .1 Horizontal
 - .1 Lead-free, Class 125, bronze, 1380 kPa (200 psi) WOG rated horizontal swing type check valves with solder ends.
 - .2 Manufacturers:
 - .1 Toyo Valve Co. Fig. 237A-LF;
 - .2 Milwaukee Valve Co. #UP1509;
 - .3 Kitz Corporation Code 823;

- .4 Apollo Valves #61LF Series.
- .2 Vertical
 - .1 Equal to Kitz Corp. Code 826, lead-free, 1725 kPa (250 psi) WOG rated vertical lift check valve with soldering ends.

2.04 DRAIN VALVES

- .1 Minimum 2070 kPa (300 psi) water rated, 20 mm ($\frac{3}{4}$ " dia., straight pattern full port bronze ball valves, each complete with a threaded outlet suitable for coupling connection of 20 mm ($\frac{3}{4}$ " dia. garden hose, and a cap and chain.
- .2 Manufacturers:
 - .1 Toyo Valve Co. Fig. 5046;
 - .2 Dahl Brothers Canada Ltd. Fig. No. 50. 430;
 - .3 Kitz Corporation Code 58CC;
 - .4 Apollo Valves #78-104-01;
 - .5 Watts Industries (Canada) Inc. #B6000.

2.05 DOMESTIC HOT WATER PIPING BALANCING VALVES

- .1 Equal to Victaulic Series 76X Low Lead Balancing Valve, lead-free and compliant with NSF-61 and NSF-372 for use in potable water applications, automatic flow limiting balancing valve (+/-5% over rated operating pressure range), complete with removable flow cartridge.
- .2 Equal to Victaulic TA Series 78BL, solder or flange end type as required, ball valve style, lead-free and compliant with NSF-61 and NSF-372 for use in potable water applications, circuit balancing valves designed to facilitate precise flow measurement, precision flow balancing, and positive shut-off, complete with capped and valved drain connection, and valved ports for connection to a differential pressure meter.

2.06 PARTITION STOPS

- .1 Equal to Dahl Brothers Canada Ltd. Fig. E2300 Series or equal lead-free partition stops with EDPM packing, slotted spindles, extension tubes, stainless steel access plates, and 3 identified keys.

2.07 PRESSURE REDUCING VALVES

- .1 For piping less than or equal to 50 mm (2") diameter, lead-free, non-corrosive, non-ferrous direct spring acting pressure reducing valves to CAN/CSA B356, each factory set at 345 kPa (50 psi) unless otherwise specified or required, each field adjustable from 175 kPa (25 psi) to 520 kPa (75 psi) and each complete with an integral inlet strainer.
 - .1 Manufacturers:
 - .1 Apollo Valves #36HLF Series;
 - .2 Zurn/Wilkins #600XL Series;
 - .3 Watts Industries (Canada) Inc. #LF25AUB-Z3 Series;
 - .4 Cash-Acme EB-25 Series;
 - .5 Bermad Series 935-H

- .2 For piping greater than or equal to 65 mm (2-½") diameter, lead-free, non-corrosive pilot operated pressure reducing valve to CAN/CSA B356, factory set at required pressure, field adjustable, and complete with a bronze body and trim, screwed or flanged connections, and brass body pilot valve with stainless steel seat.
 - .1 Manufacturers:
 - .1 Singer Valve #106 PR;
 - .2 Zurn/Wilkins #ZW209;
 - .3 Watts Industries (Canada) Inc. #LFN223 Series;
 - .4 Bermad Series 972.

2.08 DOMESTIC HOT WATER THERMOSTATIC MIXING VALVES

- .1 Lawler Manufacturing Co. Inc. 800 Series "High-Low Thermostatic Mixer" factory assembled rough bronze thermostatic mixing valve assembly complete with rotatable union end inlet piping with check stops and stainless steel strainer screens, union outlet piping with thermometer connection, all sized as shown, and following:
 - .1 mixing valve with liquid motor, stainless steel piston and liner, tamper-resistant control adjustment, and 3-way protection against runaway temperatures, thermal shock, and scalding;
 - .2 dial type thermometer conforming to requirement specified in Section 20 05 00 – Common Work Results for Mechanical;
 - .3 ball type outlet shut-off valve conforming to valve requirements specified in this section;
 - .4 surface wall mounting enamelled steel cabinet with hinged door, key lock, and permanent identification;
 - .5 recessed wall mounting type 304 stainless steel cabinet with a #4 finish, hinged door, key lock, and permanent identification.
- .2 Manufacturers:
 - .1 Lawler Manufacturing Co. Inc.;
 - .2 Leonard Valve Co.;
 - .3 Symmons Industries Inc.

2.09 CHLORINE

- .1 Sodium hypochlorite to AWWA B300.

2.10 WATER METER

- .1 Equal to Neptune Technology Group (Canada) Ltd. "Neptune T-10" tamper-proof, in line serviceable meter in accordance with requirements of AWWA C701 and NSF/ANSI 61, suitable for connection of a remote automatic reading and billing unit and complete with a cast bronze main case, a roll sealed register, and a positive displacement nutating disc measuring chamber.
- .2 Equal to Neptune Technology Group (Canada) Ltd. "Neptune High Performance Turbine" tamper-proof, in-line serviceable meter in accordance with requirements of AWWA C701 and NSF/ANSI 61, suitable for connection of a remote automatic reading and billing unit and complete with a cast bronze main case, a roll-sealed magnetic drive register, and a turbine measuring element.

- .3 Equip meter with a Neptune Technology Group (Canada) Ltd. or equal "ARB-V" surface wall mounting automatic meter reading and billing unit with encoder register, polycarbonate housing, roll-sealed copper shell, and ABS plastic receptacle.
- .4 Meter is also to be complete with Neptune Technology (Canada) Ltd. or equal "Tricon" hardware for interface connection to building automation system for water flow and consumption monitoring.

2.11 INTERIOR HOSE BIBBS

- .1 Flush-Concealed
 - .1 Recessed, 92 mm (3-5/8") deep, recessed, encased wall hydrant with lockable bronze or stainless steel box with hinged cover identified "WATER", bronze interior parts, a screwdriver operated stop in the supply, key operated control valve, 20 mm (3/4") dia. hose connection, and a vacuum breaker.
 - .2 Manufacturers:
 - .1 Watts Industries (Canada) Inc. #HY-330.
 - .2 Jay R. Smith #5509QT-CL-SAP;
 - .3 Zurn #Z1350;
 - .4 Mifab #MHY-55;
 - .2 Semi-Recessed - Finished Areas
 - .1 Anti-siphon type, 100 mm (4") deep hose bibb with stainless steel face with operating key, bronze interior parts, 20 mm (3/4") dia. solder inlet, 20 mm (3/4") dia. hose connection, and integral vacuum breaker.
 - .2 Manufacturers:
 - .1 Watts Industries (Canada) Inc. #HY-430.
 - .2 Jay R. Smith #5619-SAP-98;
 - .3 Zurn #Z1333 "ECOLOTRON";
 - .4 Mifab #MHY-30;
 - .3 Surface – Exposed – Cold Water – Unfinished Areas
 - .1 Brass or bronze hose bibb with hose end vacuum breaker.
 - .2 Manufacturers:
 - .1 Watts Industries (Canada) Inc. #SC8-1;
 - .2 Jay R. Smith #5609QT-SAP.
 - .3 Zurn/Wilkins # Z1341 with hose end vacuum breaker;
 - .4 Chicago Faucets #293-E27CP;
 - .4 Exposed – Unfinished Areas – Hot and Cold Water
 - .1 Mixing faucet for surface mounting.

- .2 Manufacturers:
 - .1 Watts Industries (Canada) Inc. #HY-300-2-VB.
 - .2 Jay R. Smith #5560QT-LB-SAP;
 - .3 Zurn #Z841L1-RC;
 - .4 Delta Commercial #28T8083;

2.12 EXTERIOR NON-FREEZE WALL HYDRANTS

- .1 Flush-Concealed
 - .1 Recessed, encased, self-draining hydrants, each complete with a copper casing, operating rod assembly to suit wall thickness, polished nickel bronze box with hinged locking cover, 20 mm ($\frac{3}{4}$ " dia. threaded hose connection outlet, vacuum breaker, and a loose tee handle operating key.
 - .2 Manufacturers:
 - .1 Watts Industries (Canada) Inc. #HY-725.
 - .2 Jay R. Smith #5519-98;
 - .3 Zurn #Z1320;
 - .4 Mifab #MHY-26;
- .2 Semi-Recessed
 - .1 Self-draining hydrants, each complete with a copper casing, operating rod assembly to suit the wall thickness, 20 mm ($\frac{3}{4}$ " dia. threaded hose connection outlet, vacuum breaker, and a loose tee handle operating key.
 - .2 Manufacturers:
 - .1 Watts Industries (Canada) Inc. #HY-420.
 - .2 Jay R. Smith #5619-98;
 - .3 Zurn #Z1321;
 - .4 Mifab #MHY-16;

2.13 EXTERIOR NON-FREEZE GROUND HYDRANTS

- .1 Flush
 - .1 Flush with grade mounting, encased head, self-draining bronze hydrants, each complete with a casing and operating rod assembly to suit the depth of piping bury, valve housing with drain port, grade box with hinged lockable cover and drain port, 20 mm ($\frac{3}{4}$ " dia. threaded hose connection, and a loose tee handle operating key.
 - .2 Manufacturers:
 - .1 Watts Industries (Canada) Inc. #HY-500.
 - .2 Jay R. Smith #5810-N-NV;
 - .3 Zurn #Z1360;

- .4 Mifab #MHY-60;
- .2 Exposed
 - .1 Self-draining exposed head bronze post hydrants, each complete with a casing and operating rod assembly to suit the height of hose outlet above grade and the depth of piping bury, valve housing with drain port, 20 mm (¾") dia. threaded hose connection assembly with vacuum breaker and gravel guard, and a loose tee handle operating key.
 - .2 Manufacturers:
 - .1 Watts Industries (Canada) Inc. #HY-600.
 - .2 Jay R. Smith #5910-NV-H;
 - .3 Zurn #Z1385;
 - .4 Mifab #MHY-65;

2.14 NON-FREEZE ROOF HYDRANT

- .1 Woodford Mfg. Model RHY2-MS non-freeze roof hydrant with 25 mm (1") diameter inlet connection, 20 mm (¾") diameter hose end outlet with dual check backflow preventer, a 3.2 mm (1/8") diameter inlet connection drain hole to automatically drain hydrant when shut-off, a mounting system with cast iron support and under deck flange, and required mounting hardware and accessories.

2.15 FLOOR DRAIN TRAP SEAL PRIMERS

- .1 Primer Valve Type
 - .1 Precision Plumbing Products Inc. Model P2-500 trap primer valve, constructed of brass, adjustable to high or low water pressures and complete with "O" ring seals, 12 mm (½") threaded inlet and outlet connections, and, for priming two traps from the same primer, a DU-2 dual outlet distribution unit.
 - .2 Primer Valve Type with Manifold
 - .1 Precision Plumbing Products Inc. Model P1-500 trap primer valve constructed as specified above for the Model P2-500 primer valve, complete with a Model DU-3 or DU-4, 3 or 4 outlet distribution unit for priming 3 or 4 traps, and at Model "YS-8" supply tube with combinations of Model DU-3 and DU-4 distribution units for priming from 5 to 6 traps.
- .3 Electronic Type
 - .1 Precision Plumbing Products #PT Series surface wall mounting, CSA certified, 115 volt, 1-phase, 60 Hz., electronic, automatic trap priming manifolds, each sized to suit the number of drain traps or interceptors serviced, and each complete with:
 - .1 galvanized steel cabinet with door;
 - .2 20 mm (¾") dia. NPT copper pipe inlet with shut-off valve and water hammer arrestor;
 - .3 solenoid valve, an atmospheric vacuum breaker, and a discharge manifold with 12 mm (½") dia. compression type copper tube connections on 40 mm (1-½") centres with quantity to suit the number of items to be primed;
 - .4 control panel with circuit breaker, 5 ampere fuse, 24 hour timer, and manual override toggle switch.

2.16 SHOCK ABSORBERS

- .1 Type 304 stainless steel piping shock absorbers, each complete with a nesting type bellows and a casing of sufficient displacement volume to dissipate kinetic energy generated in piping system, and each sized to suit connecting potable water pipe and equipment it is provided for.
- .2 Manufacturers:
 - .1 Watts Industries (Canada) Inc. "SG" Series.
 - .2 Jay R. Smith 5000 Series "HYDROTROL";
 - .3 Zurn #Z1700 "SHOKTROL";
 - .4 Mifab "HAMMERGUARD" WHB Series;

2.17 WATER HAMMER ARRESTORS

- .1 Piston type, sealed, all stainless steel construction, pressurized water hammer arrestors suitable for either vertical or horizontal installation, each complete with a pressurized compression chamber, welded nesting-type expansion bellows surrounded by non-toxic mineral oil, and a male treaded nipple connection.
- .2 Manufacturers:
 - .1 Jay R. Smith 5000 Series;
 - .2 Precision Plumbing Products "SS" Series.
- .3 Piston type, sealed, pressurized water hammer arrestors suitable for either horizontal or vertical installation, each complete with a hard drawn copper body, "O"-ring piston seals, an air charge, and an inlet opening equal to diameter of pipe in which arrestor is required.
- .4 Manufacturers:
 - .1 Watts Industries (Canada) Inc.;
 - .2 Zurn #Z1705;
 - .3 Precision Plumbing Products Inc. #SC;
 - .4 Mifab MWH Series.

2.18 BACKFLOW PREVENTERS

- .1 Double Check Valve Assembly
 - .1 Minimum 1205 kPa (175 psi) rated lead-free dual check valve assembly backflow preventer to CAN/CSA B64 (including supplements), complete with tight-closing resilient seated shut-off valves, test cocks and strainer.
 - .2 Manufacturers:
 - .1 Watts Industries Canada;
 - .2 Zurn/Wilkins;
 - .3 Apollo Valves (Conbraco Industries).

- .2 Reduced Pressure Zone Assembly
 - .1 Lead-free reduced pressure zone assembly backflow preventer in accordance with CAN/CSA B64 (including supplements), each of bronze or epoxy coated cast iron bronze fitted construction depending on size, and complete with inlet strainer, inlet and outlet shut-off valves, an intermediate relief valve, ball valve type test cocks, and a proper air gap fitting.
 - .2 Manufacturers:
 - .1 Watts Industries #LF009QT-S for 12 mm (½") size, #LF909QT-S for 20 mm to 50 mm (¾" to 2") size, and #LF909-NRS-S for 65 mm (2-½") and larger size;
 - .2 Zurn/Wilkins 975XL2 and 375 Series;
 - .3 "Apollo" Valves manufactured by Conbraco Industries Inc. Series 4ALF;
 - .4 Danfoss Flomatic Corp. Series RPZ.

2.19 PIPING EXPANSION COMPENSATORS AND GUIDES

- .1 Pressurized type, selected to withstand system pressure and to suit calculated movement from -5°C (23°F) to maximum operating temperature plus 25% safety factor, complete with stainless steel bellows and shroud, copper tube sweat type female ends, anti-torque device, and proper and suitable alignment guides for both sides of each compensator.
- .2 Manufacturers:
 - .1 Senior Flexonics Series HB;
 - .2 Hispan Precision Products Series 8500.

2.20 PIPE ANCHORS

- .1 Welded structural black steel anchors of a design, size, and type to securely anchor pipe at point shown. Each anchor is to withstand 150% axial thrust, and is to be designed and detailed by a professional structural engineer registered and licensed in jurisdiction of the work. Submit anchor design and fabrication shop drawings, stamped by design engineer.

2.21 LAVATORY SUPPLY FITTING TEMPERING VALVES

- .1 Equal to Powers "HydroGuard" Series 490, model LM490 12 mm (½") dia. or model LM491 20 mm (¾") dia. as required, each CSA B125 certified, forged brass, tamper-proof thermostatic mixing valves, adjustable for water supply between 29°C and 49°C (85°F and 120°F), sized to suit number of lavatories in grouping, and complete with a stop and check valve and a lockable handle.
- .2 Each mixing valve is to be complete with a stainless steel flush wall mounting cabinet with vandal-proof hinged door.

2.22 AIR VENTS

- .1 Equal to ITT Hoffman Specialty No. 78 cast brass, 1035 kPa (150 psi) rated, 20 mm (¾") straight water main vent valves, each tapped at the top for a 3.2 mm (1/8") safety drain connection.

2.23 DOMESTIC WATER THERMAL EXPANSION TANK

- .1 Pre-charged domestic water thermal expansion tank in accordance with Section VIII of the ASME Boiler and Pressure Code, carbon steel outer shell construction and complete with fixed butyl rubber bladder to prevent water from contacting shell interior, top NPT stainless steel system connection, 7.6 mm to 813 mm (0.301" to 32") charging valve connection and prime painted exterior.

- .2 Manufacturers:
 - .1 Watts Industries (Canada) Inc. Series DETA;
 - .2 Zurn/Wilkins Model WTTA.

3 Execution

3.01 DEMOLITION

- .1 Refer to demolition requirements specified in Section 20 05 05 – Selective Demolition for Mechanical.

3.02 UNDERGROUND MUNICIPAL SERVICE CONNECTION

- .1 Make required arrangements with Municipality for installation of domestic water service piping from Municipal main to property line.
- .2 Pay charges levied by Municipality for service connection work.
- .3 Municipal charges for underground street service connection work will be paid out of a prime cost allowance. Submit original copies of invoices issued by Municipality for street service connection work.

3.03 PIPING INSTALLATION REQUIREMENTS

- .1 Provide required domestic water piping.
- .2 Piping, unless otherwise specified, is as follows:
 - .1 for underground piping 100 mm (4") dia. and larger outside and/or inside the building – rigid PVC;
 - .2 for underground piping less than 100 mm (4") dia. inside building – Type "K" soft copper;
 - .3 for pipe 75 mm (3") dia. and larger inside building and above ground – Schedule 10 stainless steel;
 - .4 for 12 mm (½") dia. trap seal primer tubing located underground or in concrete or masonry construction – semi-rigid polyethylene;
 - .5 for pipe inside building and aboveground in sizes to 100 mm (4") dia., except in vertical shafts and through fire barriers – rigid CPVC;
 - .6 for branch hot and cold piping aboveground from mains and risers to fixtures, fittings, and equipment where fire rated construction is not penetrated – at your option, PEX tubing installed and joined in strict accordance with manufacturer's instructions;
 - .7 for underground piping outside building to fixtures/outlets at grade level – flexible polyethylene, snaked in the trench and in a continuous length wherever possible;
 - .8 for pipe inside building and aboveground in sizes to 100 mm (4") dia. – Type "L" hard copper with solder joints.
 - .1 Option: Type "L" hard copper with pressure coupled mechanical joints.
 - .2 Option: Type "L" hard copper with grooved end mechanical joints.
 - .1 Grooved pipe ends shall be clean and free from indentations, projections and roll marks in the area from pipe end to groove for proper gasket sealing. All couplings will meet Victaulic standards for visual inspection sizes 2" to 8". The gasket style and elastomeric material (grade) shall be verified as suitable for the

intended service as specified. Install in accordance with manufacturer's latest recommendations. A Victaulic factory trained representative shall periodically visit the job site and review the installation for best practices. The installing Contractor shall correct any identified deficiencies. Victaulic product that has been examined and has not met the visual inspection criteria for proper installation must be corrected and re-examined by Victaulic prior to the completion of the project.

- .3 Brace and secure underground water service pipe at bends, tees and similar fittings with restraint devices, and provide concrete thrust blocks in accordance with Municipal standards and details. Regardless of what is specified elsewhere in this Specification regarding provisions of concrete, provide thrust block concrete. Paint restraint devices with 2 coats of corrosion resistant black asphalt base coating prior to backfilling.
- .4 Lay pipes true to line and grade with bells upgrade. Fit sections together so that, when complete, pipe has a smooth and uniform invert. Keep pipe thoroughly clean so jointed compound will adhere. Inspect pipe for defects before being lowered into trench.
- .5 Slope piping so it can be completely drained.
- .6 Provide cast brass dielectric type adapters/unions at connections between ferrous and copper pipe or equipment.

3.04 INSTALLATION OF SHUT-OFF AND CHECK VALVES

- .1 Refer to Part 3 of Section 20 05 00 – Common Work Results for Mechanical.
- .2 For shut off valves installed on solder joint copper piping up to and including 75 mm (3") diameter, provide ball type valves, and for flanged joints copper or stainless steel piping larger than 75 mm (3") diameter provide butterfly type valves.

3.05 INSTALLATION OF DRAIN VALVES

- .1 Provide a drain valve at the bottom of domestic water piping risers, at other piping low points, and wherever else shown.
- .2 Locate drain valves so they are easily accessible.

3.06 INSTALLATION OF DOMESTIC HOT WATER PIPING BALANCING VALVES

- .1 Provide balancing valves in domestic hot water recirculation piping where shown or required.
 - .1 for pipe 25 mm (3/4") dia. and less ground – equal to Victaulic Series 76X
 - .2 for pipe greater than 25 mm (3/4") dia. – equal to Victaulic TA Series 78BL
- .2 Locate each valve so it is easily accessible.

3.07 INSTALLATION OF PARTITION STOPS

- .1 Provide partition stops in domestic water piping to each group of suite washroom plumbing fixtures. Locate partition stops in piping near floor level in inconspicuous but accessible locations. Confirm exact locations prior to roughing-in.

3.08 INSTALLATION OF PRESSURE REDUCING VALVES

- .1 Provide domestic water pressure reducing valves. Install so each valve is readily accessible. Whenever possible, provide pressure reducing valves factory pre-set to required pressures.
- .2 Check and test operation, and adjust as required.

3.09 INSTALLATION OF DOMESTIC HOT WATER THERMOSTATIC MIXING VALVES

- .1 Provide a domestic hot water thermostatic mixing valve assembly and wall mount.
- .2 Adjust each valve to design requirements and check and test operation. Set maximum temperature limit stops.
- .3 Identify each valve and its water temperature delivery setting with an engraved nameplate.

3.10 INSTALLATION OF WATER METER

- .1 Provide domestic water service meter. Secure meter in place on a concrete housekeeping pad and connect with piping, including required valve by-pass.
- .2 Installation of water meter must comply with local municipal requirement.

3.11 INSTALLATION OF HOSE BIBBS

- .1 Provide hose bibbs.
- .2 Unless otherwise shown, specified, or required, mount hose bibbs approximately 1 m (3') above floor. Confirm exact locations prior to roughing-in.

3.12 INSTALLATION OF EXTERIOR NON-FREEZE WALL HYDRANTS

- .1 Provide non-freeze wall hydrants.
- .2 Install hydrants level and plumb such that hose outlets are approximately 600 mm (2') above grade level. Confirm exact locations prior to roughing-in.
- .3 Provide a shut-off valve inside building to each exterior non-freeze wall hydrant.

3.13 INSTALLATION OF EXTERIOR NON-FREEZE GROUND HYDRANTS

- .1 Provide non-freeze ground hydrants. Confirm exact locations prior to roughing-in.
- .2 Ensure length of piping to outlet box suits depth of underground piping, and underground piping elbow and valve housing is set in an envelope of clean sharp, 100% Proctor density compacted sand. Provide a length of small bore copper tubing from valve drain port into sand envelope.
- .3 Provide a shut-off valve inside building to each ground hydrant.

3.14 INSTALLATION OF NON-FREEZE ROOF HYDRANT

- .1 Provide non-freeze roof hydrants. Confirm exact locations prior to roughing-in.
- .2 Coordinate installation with trades providing roof opening and roofing work to ensure a water-tight roof penetration.
- .3 Provide 3.2 mm (1/8") diameter drain piping from inlet connection assembly inside building to a funnel floor drain or other suitable indirect connection location.

3.15 INSTALLATION OF TRAP SEAL PRIMERS

- .1 Provide required accessible trap seal primers to automatically maintain a water seal in floor drain traps, whether shown on drawings or not.
- .2 Water closet flush valves may be used for priming washroom floor drain traps if flush tube is properly tapped and primer tubing exposed in washroom is chrome plated.

- .3 Provide trap primer valves to prime single or multiple (1 to 6) traps. Install trap primer valves in domestic cold water piping to frequently used plumbing fixtures. Where from 2 to 6 traps are to be primed from same primer valve, provide appropriate supply and distribution tube assemblies. Ensure primer valves are accessible.
- .4 Provide 115 volt, electronic, surface wall mounting trap primer assemblies for multiple (4 to 30) traps. Include for a 115 volt 15 ampere panel breaker and wiring in conduit from closest panelboards to primer assembly, all to wiring standards of Electrical Division. Adjust primer water flow and timing to suit number of traps served.
- .5 Ensure trap primer piping is secured to floor drain primer tapplings and not terminated through the tapping in the throat of the drain.

3.16 INSTALLATION OF SHOCK ABSORBERS

- .1 Provide accessible shock absorbers in domestic water piping.
- .2 Ensure size of each shock absorber is properly selected to suit size of domestic water pipe and equipment pipe is connected to.

3.17 INSTALLATION OF WATER HAMMER ARRESTORS

- .1 Provide accessible water hammer arrestors in domestic water piping in locations as follows:
 - .1 in headers at groups of plumbing fixtures;
 - .2 at top of risers;
 - .3 at ends of long horizontal runs of piping;
 - .4 in piping connecting solenoid valves or equipment with integral solenoid valves;
 - .5 wherever else shown or required by Code.
- .2 Install each unit in a piping tee either horizontally or vertically in the path of potential water shock in accordance with manufacturer's instructions and details.

3.18 INSTALLATION OF BACKFLOW PREVENTERS

- .1 Provide a reduced pressure zone assembly backflow preventer on incoming DCW service and in each direct domestic water connection to equipment other than plumbing fixtures and fittings.
- .2 Provide a double check valve assembly backflow preventer on incoming DCW service. Provide a reduced pressure zone assembly backflow preventer in each direct domestic water connection to equipment other than plumbing fixtures and fittings.
- .3 Locate each backflow preventer on floor or wall between 765 mm and maximum 1.5 m (30" and 60") above floor such that it is easily accessible for maintenance and testing. Equip each backflow preventer with an air gap fitting and pipe the reduced pressure zone water outlet to drain.
- .4 Test operation of each backflow preventer in accordance with requirements of CAN/CSA B64 by personnel certified for such testing by governing authorities, and submit signed test results and a properly and clearly identified and marked inspection and test record card for each backflow preventer.

3.19 INSTALLATION OF EXPANSION COMPENSATORS, GUIDES, AND ANCHORS

- .1 Provide expansion compensators in domestic water piping.

- .2 Ensure pipe ends are properly aligned. Provide alignment guides on each side of expansion compensators, properly secured to building structure.
- .3 Provide anchors to secure domestic water piping to structure. Locate anchors generally where shown but with exact locations to suit piping as installed and requirements of reviewed anchor shop drawings.
- .4 When installation of anchors is complete, arrange, and pay for anchor design engineer to visit site to review anchor installation. Submit a letter from design engineer confirming each anchor is properly installed.

3.20 INSTALLATION OF LAVATORY SUPPLY FITTING TEMPERING VALVES

- .1 Provide thermostatic water tempering valves for hot water supply to public washroom lavatory supply fittings. Conceal valves and piping.
- .2 Provide a flush wall mount panel for each valve. Confirm exact location prior to roughing-in.
- .3 Install in accordance with manufacturer's instructions and set mixing valves to deliver 32°C (90°F) tempered water.

3.21 INSTALLATION OF AIR VENTS

- .1 Provide accessible air vents in domestic water piping to prevent air binding.
- .2 Extend copper indirect drain piping from top drain connection of each vent to nearest suitable drain.
- .3 Locate exact vent locations on as-built record drawings.

3.22 INSTALLATION OF DOMESTIC WATER THERMAL EXPANSION TANK

- .1 Provide domestic water thermal expansion tanks.
- .2 Unless otherwise specified, mount at least 450 mm (18") from cold water inlet to domestic water heater.
- .3 Adjust pre-charge to match incoming water pressure after installation.
- .4 Install in accordance with manufacturer's instructions and as per local governing Codes and Regulations.

3.23 FLUSHING AND DISINFECTING PIPING

- .1 Flush and disinfect all new and/or reworked domestic water piping after leakage testing is complete.
- .2 Isolate new piping from existing piping prior to flushing and disinfecting procedures.
- .3 Flush piping until all foreign materials have been removed and flushed water is clear. Provide connections and pumps as required. Open and close valves, faucets, hose outlets, and service connections to ensure thorough flushing.
- .4 When flushing is complete, disinfect the piping with a solution of chlorine in accordance with AWWA C601.
- .5 When disinfecting is complete, submit water samples to a certified laboratory for purity testing and, when testing indicates pure water in accordance with governing standards, submit a copy of test results and fill the systems.

End of Section

1 General

1.01 SUBMITTALS

- .1 Submit shop drawings/product data sheets for all equipment and associated hardware specified in this Section.

1.02 CLOSEOUT SUBMITTALS

- .1 Submit manufacturer/supplier installation certification letters as specified in Part 3 of this Section.
- .2 Submit, prior to Substantial Performance of the Work, start-up or test data specified in Part 3 of this Section.

2 Products

2.01 DOMESTIC HOT WATER RECIRCULATING PUMPS

- .1 All bronze construction centrifugal pumps in accordance with drawing schedule and complete with:
 - .1 lead free cast bronze casing with flanged pipe connections;
 - .2 alloy steel shaft with integral thrust collar, copper shaft sleeve, and oil lubricated bronze sleeve bearings;
 - .3 balanced lead free cast bronze impeller;
 - .4 motor conforming to requirements of Section 20 05 00 – Common Work Results for Mechanical, connected to motor by means of a 4-spring coupling with guard;
 - .5 mechanical seal.
- .2 Manufactures:
 - .1 S.A. Armstrong Ltd.;
 - .2 ITT Bell & Gossett;
 - .3 Grundfos Canada Inc.;
 - .4 Patterson Pump Company.
- .3 Domestic Hot Water Recirculating Pumps Automatic Controls
 - .1 Equal to ITT Bell & Gossett Model TC-1 115 volt, programmable, Automatic Timer Kit to control circulating pump on and off at pre-set minimum 15 minute intervals, and equipped with ON (continuous run), OFF (at all times), and TIMER (run at programmed times) modes.
 - .2 Equal to ITT Bell & Gossett AQS Series 115 volt Aquastat to automatically control pump on and off in response to domestic water temperature and equipped with a stainless steel pipe clip, bimetal sensing element, and insulated #18 AWG 450 mm (18") wire leads.

3 Execution

3.01 INSTALLATION OF DOMESTIC HOT WATER RECIRCULATING PUMPS

- .1 Provide horizontal in-line domestic hot water circulating pumps.

- .2 Install pumps in place in vertical piping approximately 1.2 m (4') above floor in accordance with pump manufacturer's instructions.
- .3 For equipment/system start-up requirements, refer to Section 20 05 00 – Common Work Results for Mechanical.
- .4 Include for 2 hours of on-site training for 2 groups of 6 people. Training is to be a full review of all components including but not limited to a full operation and maintenance demonstration, with abnormal events.

3.02 INSTALLATION OF DOMESTIC HOT WATER RECIRCULATING PUMPS CONTROLS

- .1 Provide a programmable timer and an aquastat to automatically control pump on and off in response to pre-set times and domestic water temperatures. Install in accordance with manufacturer's instructions. Programme both devices in accordance with Consultant's instructions.

End of Section

1 General

1.01 SUBMITTALS

- .1 Submit shop drawings/product data sheets for all products specified in this Section except pipe and fittings.

1.02 CLOSEOUT SUBMITTALS

- .1 Submit a copy of plumbing inspection certificate prior to application for Substantial Performance of the Work.
- .2 Submit letters from product manufacturers/suppliers to certify correct installation of products as specified in Part 3 of this section.
- .3 Record Drawings: Indicate inverts of new below grade sanitary and storm piping on as-builts drawings.

2 Products

2.01 PIPE, FITTINGS, AND JOINTS

- .1 PVC Sewer
 - .1 DR35 rigid, green PVC hub and spigot pattern sewer pipe and fittings to CAN/CSA B182.2, with gasket joints assembled with pipe lubricant.
 - .2 DR35 rigid, PVC sewer pipe and fittings, with solvent weld joints, all certified to CSA B182.1 and colour-coded as per local governing codes, regulations and standards.
- .2 PVC - DWV
 - .1 For Low Buildings: Equal to IPEX System 15 drain, waste and vent pipe and fittings to CAN/CSA B181.2, complete with a flame spread rating not more than 25 when tested to CAN/ULC S102.2, with solvent weld joints or MJ Grey mechanical joint couplings, and, for fire barrier penetration, approved firestop conforming to CAN/ULC S115.
 - .2 For High Buildings and Plenums: Equal to IPEX System XFR drain, waste and vent pipe and fittings to CAN/CSA B181.2, complete with a flame spread rating not more than 25 and a smoke developed classification not more than 50 when tested to CAN/ULC S102.2, with solvent weld joints or MJ Grey mechanical joint couplings, and, for fire barrier penetration, approved firestop conforming to CAN/ULC S115.
- .3 Copper - Solder Joint
 - .1 Type DWV hard temper to ASTM B306, with forged copper solder type drainage fittings and 50% lead - 50% tin solder joints.
- .4 Cast Iron
 - .1 Class 4000 cast iron pipe, fittings, and mechanical coupling joints to CAN/CSA B70.
- .5 Copper-Victaulic Coupling Joint
 - .1 Type DWV hard temper to ASTM B306, with factory or site rolled grooved ends (with grooving rolls designed for copper) and Victaulic "Copper Connection" wrought copper or cast bronze fittings and Style 606 gasket type couplings.
- .6 Galvanized Steel - Victaulic Coupling Joint

- .1 Schedule 40 mild steel, galvanized, ASTM A53, factory or site rolled grooved, complete with Victaulic galvanized ductile iron grooved end fittings and, unless otherwise specified, Victaulic Style 77 hot dip galvanized mechanical joint couplings with Grade M gaskets.
- .7 PVC Weeper Piping
 - .1 150 mm (6") dia. corrugated perforated PVC pipe with an integral geodesic sock, supplied in coils.

2.02 SHUT-OFF AND CHECK VALVES

- .1 Shut-off Valves
 - .1 Class 600, 4140 kPa (600 psi) WOG rated full port ball valves, each complete with a forged brass body, blowout-proof stem, chrome plated solid brass ball, solder or screwed ends as required, and removable lever handle.
 - .2 Manufacturers:
 - .1 Toyo Valve Co. Fig. 5049A or Fig. 5044A;
 - .2 Milwaukee Valve Co. #BA-155 or #BA -125;
 - .3 Kitz Corporation Code 58 or Code 59;
 - .4 Victaulic Co. of Canada Ltd. Series 722;
 - .5 Apollo Valves # 77-100 or # 77-200;
 - .6 Watts Industries (Canada) Inc. #FBVS-3C.
- .2 Check Valves
 - .1 Class 125, bronze, 1725 kPa (250 psi) WOG rated vertical lift check valve with solder or screwed ends as required, and, for horizontal piping, Class 125, bronze 1380 kPa (200 psi) WOG rated swing check valves with solder or screwed ends.
 - .2 Manufacturers:
 - .1 Toyo Valve Co. Fig. 231 or Fig. 236 or Fig. 237;
 - .2 Milwaukee Valve Co. #1510 or #510;
 - .3 Kitz Corporation Code 36 or Code 22 or Code 23.

2.03 VENT STACK COVERS

- .1 Equal to Lexcor Model "Flash-Tite" seamless, spun aluminum, insulated vent stack covers with caps and a factory applied asphalt primer coating on top and bottom of flange.
- .2 Each vent stack cover is to be complete with a vandal-proof cap.

2.04 CLEANOUTS

- .1 Horizontal Piping
 - .1 TY pipe fitting with an extra heavy brass plug screwed into the fitting.
- .2 Vertical Piping

- .1 Bronze or copper cleanout tees in copper piping, each complete with a bronze ferrule, and, for cast iron piping, "BARRETT" type cast iron cleanout tees, each gas and water-tight and complete with a bolted cover.
- .3 Urinal(s)
 - .1 Wall access cleanout assemblies, each complete with a tapered plug, threaded brass insert, urethane rubber seal, and polished stainless steel access cover with vandal-proof stainless steel securing screw.
 - .2 Manufacturers:
 - .1 Watts Industries (Canada) Ltd. #CO-590-RD.
 - .2 Jay R. Smith #SQ4-1819;
 - .3 Zurn #ZSS-1666-1;
 - .4 Mifab #C1440-RD;

2.05 FLOOR CLEANOUT TERMINATIONS

- .1 Factory finished cast iron terminations, each adjustable and complete with a cast iron body with neoprene sleeve, solid, gasketed, polished nickel-bronze scoriated top access cover to suit floor finish, a seal plug, and captive, vandal-proof, stainless steel securing hardware.
- .2 Manufacturers:
 - .1 Watts Industries (Canada) Ltd. # CO-200-R-1.
 - .2 Jay R. Smith #4020-F-C Series;
 - .3 Zurn # ZN-1602-SP Series;
 - .4 Mifab # C1100-XR-1 or #C1000-R-3;
- .3 Cleanout terminations in areas with a tile or sheet vinyl floor finish are to be as above but with a square top in lieu of a round top.

2.06 FLOOR DRAINS, FUNNEL FLOOR DRAINS, AND HUB DRAINS

- .1 Unless otherwise specified or indicated, floor drains are to be vandal-proof drains in accordance with drawing symbol list, each complete with a cast iron body and a trap seal primer connection. Cast iron components are to be factory finished with latex based paint coating.
- .2 Floor drains in areas with a tile or sheet vinyl floor finish are to be as above but with a square grate in lieu of a round grate.
- .3 Manufacturers:
 - .1 Watts Industries (Canada) Ltd.;
 - .2 Jay R. Smith Manufacturing Co.;
 - .3 Zurn Industries Ltd.;
 - .4 Mifab Inc.

2.07 ROOF DRAINS

- .1 Unless otherwise specified or indicated, roof drains are to be cast iron body drains with aluminium domes, in accordance with the drawing symbol list. Cast iron components are to be factory finished with a latex based paint coating.
- .2 Manufacturers:
 - .1 Watts Industries (Canada) Ltd.;
 - .2 Jay R. Smith Manufacturing Co.;
 - .3 Zurn Industries Ltd.;
 - .4 Mifab Inc.

2.08 DRAINAGE TRENCH FRAMES AND GRATING

- .1 Welded, hot dipped galvanized, 45 mm x 45 mm x 6.4 mm (1- $\frac{3}{4}$ " x 1- $\frac{3}{4}$ " x $\frac{1}{4}$ ") carbon steel angle frame, 300 mm (12") wide, with anchor straps and lengths as required, and baked epoxy coated cast iron slotted grating in 600 mm (24") long sections.
- .2 Manufacturers:
 - .1 Watts Industries (Canada) Ltd. #TD-910-B1-4;
 - .2 Jay R. Smith #2971VP.
 - .3 Zurn # Z796VP;

2.09 TRENCH DRAINS

- .1 Modular, pre-sloped, polyester fibreglass construction interlocking sections of drainage channel with overlapping joints, drain pipe connection outlets as required, end caps and covers to suit the application, integral anchor tabs for grate anchoring and trench levelling, heavy-duty coated steel angle top frames, and heavy-duty coated cast iron slotted grate supplied in 600 mm (24") long sections.
- .2 Manufacturers:
 - .1 Watts Industries (Canada) Inc. "Dead Level" Series;
 - .2 Jay. R. Smith #9810 Series.
 - .3 Zurn "Flow-Thru" System;
 - .4 ACO Systems Ltd. "ACODrain";

2.10 INTERIOR CATCH BASIN FRAMES AND COVERS

- .1 Heavy-duty, 508 mm (13") square, baked epoxy coated cast iron, non-removable, hinged slotted grate with coated steel frame with concrete anchors.
- .2 Manufacturers:
 - .1 Watts Industries (Canada) Ltd. #FD-410;
 - .2 Jay R. Smith #8915FC;
 - .3 Zurn #Z-799-1;

- .4 Mifab #F1570.

2.11 BACKWATER VALVES

- .1 Heat bonded powder epoxy coated cast iron in-line type, each complete with a bolted and gasketed cover, bronze flapper, stainless steel extension, and stainless steel hardware.
- .2 Manufacturers:
 - .1 Watts Industries (Canada) Inc. BV-230-R Series;
 - .2 Jay R. Smith #7022-CAN.
 - .3 Zurn #Z-1095-15-MJ;

2.12 EXTERIOR CATCH BASINS

- .1 Pre-cast reinforced concrete catch basins manufactured to ASTM C478 and Municipal standards, each sized and arranged to suit drainage pipe size and arrangement, and complete with:
 - .1 cast iron frame and cover to Municipal standards;
 - .2 required masonry work to raise top of catch basins flush with finished grade or pavement surfaces.
- .2 Masonry work is to consist of cement mortar and clay or shale bricks to ASTM C32 Grade M5, or Oaks Precast Industries "MODULOC" pre-cast interlocking concrete members and accessories.

2.13 EXTERIOR MANHOLES

- .1 Pre-cast reinforced concrete manholes manufactured to ASTM C478 and Municipal standards, each sized and arranged to suit drainage pipe size and arrangement, and complete with:
 - .1 poured-in-place or pre-cast concrete base;
 - .2 cast-in-place "Safety" type aluminum steps on 300 mm (12") centres, each step coated with 2 coats of static asphalt paint;
 - .3 unperforated cast iron cover with lifting holes and a matching frame;
 - .4 as required by manhole depth and safety regulations, cast-in-place hinged aluminum safety grating with SG 1 1 R-T6 aluminum alloy bearing bars, aluminum grate to CAN/CSA S157, and self-locking type stainless steel hinges and fasteners with galvanized steel safety chain and snap hook;
 - .5 required masonry work to raise top of manholes flush with finished grade.
- .2 Masonry work is to consist of cement mortar and clay or shale bricks to ASTM C32 grade M5, or Oaks Precast Industries "MODULOC" pre-cast interlocking concrete members and accessories.

2.14 GREASE INTERCEPTORS

- .1 Grease intercepting and recovery unit of #11 gauge type 304 stainless steel construction with sensor controlled grease draw-off solenoid valve, automatic shut-down with audible/visual alarm if maximum grease capacity is exceeded, integral heating element with thermostat, gasketed stainless steel cover, stainless steel solids interceptor, and remote surface wall mounting indicator panel with status indicating lights, audible alarm, 115/24 volt control transformer and NEMA 2 enclosure.
- .2 Manufacturers:

- .1 Watts Industries (Canada) Inc. WD-E Series;
- .2 Jay R. Smith #8000-ELECT series or #8400-ELECT series.
- .3 Zurn #Z1172-UN series;

2.15 OIL INTERCEPTORS

- .1 Epoxy coated steel construction automatic oil interceptor with removable baffles, deep seal trap with cleanout, sediment bucket, aluminum frame and cover, and remote wall mounting indicating panel with status indicating lights, audible alarm, 115/24 volt control transformer, and NEMA 2 surface wall mounting enclosure.
- .2 Manufacturers:
 - .1 Watts Industries (Canada) Inc. OI-SS / HI 7873 Series;
 - .2 Jay R. Smith 8500-SC-ELECT-CAN Series.
 - .3 Zurn #Z1198 series;

3 Execution

3.01 DEMOLITION

- .1 Refer to demolition requirements specified in Section 20 05 05 – Selective Demolition for Mechanical.

3.02 UNDERGROUND MUNICIPAL SERVICE CONNECTION

- .1 Make required arrangements with Municipality for installation of drain service piping mains from Municipal main to property line.
- .2 Pay charges levied by Municipality for service connection work.
- .3 Municipal charges for underground street service connection work will be paid out of a prime cost allowance. Submit original copies of invoices issued by Municipality for street service connection work.

3.03 DRAIN AND VENT PIPING INSTALLATION REQUIREMENTS

- .1 Provide required drainage and vent piping. Pipe, unless otherwise specified, as follows:
 - .1 for underground pipe inside building and to points 1.5 m (5') outside building lines – rigid PVC sewer pipe, minimum 75 mm (3") dia.;
 - .2 for pipe inside building and aboveground in sizes less than or equal to 65 mm (2-½") dia. – type DWV copper;
 - .3 for pipe inside building and aboveground in sizes greater than or equal to 75 mm (3") dia. – Class 4000 cast iron;
 - .4 for pipe inside building and aboveground in lieu of type DWV copper and cast iron, at your option and where permitted by governing Codes and Regulations – rigid PVC DWV;
 - .5 for drainage pump discharge pipe connections from pump to and including shut-off and check valve connections – Type "DWV" copper with Victaulic "Copper Connection" fittings and couplings, or Schedule 40 galvanized steel with Victaulic fittings and couplings.

- .2 Unless otherwise specified, slope horizontal drainage piping aboveground in sizes to and including 75 mm (3") dia. 25 mm (1") in 1.2 m (4'), and pipe 100 mm (4") dia. and larger 25 mm (1") in 2.4 m (8').
- .3 Install and slope underground drainage piping to inverts or slopes indicated on drawings to facilitate straight and true gradients between points shown. Verify available slopes before installing pipes.
- .4 Unless otherwise specified, slope horizontal branches of vent piping down to fixture or pipe to which they connect with a minimum pitch of 25 mm (1") in 1.2 m (4').
- .5 Extend vent stacks up through roof generally where shown but with exact locations to suit site conditions and in any case a minimum of 3 m (10') from fresh air intakes. Terminate vent stacks a minimum of 330 mm (13") above roof (including roof parapets) in vent stack covers. Where not shown on drawings, route vent piping from source to building exterior as required in order to satisfy local governing codes and authority. Coordinate vent routing with other building services and ensure there is no architectural impact.
- .6 Provide cast brass dielectric unions at connections between copper pipe and ferrous pipe or equipment.

3.04 INSTALLATION OF SHUT-OFF AND CHECK VALVES

- .1 Provide a shut-off valve and a check valve in discharge piping of each drainage pump.
- .2 Locate valves so they are easily accessible without the use of ladders or other such devices.

3.05 SUPPLY OF VENT STACK COVERS

- .1 Supply a properly sized vent stack cover for each vent stack penetrating roof.
- .2 Hand vent stack covers to roofing trade at site for installation and flashing into roof construction as part of roofing work. Coordinate installation to ensure proper locations. Provide waterproofing caps over vent stacks.

3.06 INSTALLATION OF CLEANOUTS

- .1 Provide cleanouts in drainage piping in locations as follows:
 - .1 in building drain or drains as close as possible to inner face of outside wall, and, if a building trap is installed, locate cleanout on downstream side of building trap;
 - .2 at or as close as practicable to the foot of each drainage stack;
 - .3 at maximum 15 m (50') intervals in horizontal pipe 100 mm (4") dia. and smaller;
 - .4 at maximum 30 m (100') intervals in horizontal pipe larger than 100 mm (4") dia.;
 - .5 in the wall at each new urinal or bank of urinals in a washroom;
 - .6 wherever else shown on drawings.
- .2 Cleanouts are to be same diameter as pipe in piping to 100 mm (4") dia., and not less than 100 mm (4") dia. in piping larger than 100 mm (4") dia.
- .3 Where cleanouts in vertical piping are concealed behind walls or partitions, install cleanouts near floor and so cover is within 25 mm (1") of the finished face of the wall or partition.

3.07 INSTALLATION OF FLOOR CLEANOUT TERMINATIONS

- .1 Where cleanouts occur in horizontal inaccessible underground piping, extend cleanout TY fitting up to floor, and provide a cleanout termination set flush with finished floor.

- .2 In waterproof floors, ensure each cleanout termination is equipped with a flashing clamp device. Cleanout terminations are to suit floor finish.
- .3 Where cleanout terminations occur in finished areas, confirm locations prior to rough-in and arrange piping to suit.
- .4 Ensure cleanout termination covers in tiled floor are square in lieu of round.

3.08 INSTALLATION OF FLOOR DRAINS, FUNNEL FLOOR DRAINS AND HUB DRAINS

- .1 Provide floor drains, funnel floor drains and hub drains.
- .2 Coordinate location of floor drains, funnel floor drains and hub drains with equipment provided by Mechanical Division and Owner's supplied equipment. Install in accordance with manufacturer's instructions.
- .3 Equip each drain with a trap.
- .4 In equipment rooms and similar areas, exactly locate floor drains to suit location of mechanical equipment and equipment indirect drainage piping. In washrooms, exactly locate floor drains to avoid interference with toilet partitions.
- .5 Confirm exact location of drains prior to roughing in. Where floor drains occur in washrooms coordinate locations with toilet partition installations.
- .6 Temporarily plug and cover floor drains during construction procedures. Remove plugs and covers during final clean-up work and when requested, demonstrate free and clear operation of each drain. Replace any damaged grates, and refinish any areas of the drain where cast iron finish has been damaged or removed, including rusted areas.

3.09 INSTALLATION OF ROOF DRAINS

- .1 Supply roof drains and place roof drain bodies in position for flashing into roof construction as part of roofing work. Connect with piping and provide accessories.
- .2 Protect roof drains from damage and entrance of debris until roofing work is complete, and refinish any areas where cast iron factory finish has been damaged or removed, including rusted areas.

3.10 INSTALLATION OF DRAINAGE TRENCH FRAMES AND GRATING

- .1 Supply frame and grating sections for drainage trench. Provide piping connections, traps, etc., as required.
- .2 Hand frames to concrete trade forming and pouring trenches. Ensure frames are properly and accurately installed.
- .3 Be present during concrete pour to ensure frames are not dislodged or damaged and remain straight and true. Immediately report any problems.
- .4 Install grates and secure in place. Temporarily cover grates during construction procedures. Clean trenches when work is complete.

3.11 INSTALLATION OF TRENCH DRAINS

- .1 Provide pre-sloped sections of drainage channel and install so top frames are level and plumb in relation to floor finishes. Provide accessories, traps, etc., as required.
- .2 Be present during concrete pour to ensure trench drainage is not dislodged or damaged and remains straight and true. Immediately report any problems.

- .3 Install grating and secure in place.
- .4 Temporarily cover trench drainage openings during construction procedures. Clean trenches when work is complete.

3.12 INSTALLATION OF INTERIOR CATCH BASIN FRAMES AND COVERS

- .1 Supply frames and hinged grates for interior catch basins and provide sump inlet and outlet piping and accessories.
- .2 Hand frames to concrete trade pouring concrete sump, and coordinate installation of sump piping with the formwork installation.
- .3 Install grates and secure in place. Clean sumps when work is complete.

3.13 INSTALLATION OF BACKWATER VALVES

- .1 Provide backwater valves in drainage piping and connect with piping.
- .2 Set backwater valve assembly such that cover is flush with finished floor. Provide an extension piece if required due to depth of piping.

3.14 INSTALLATION OF EXTERIOR MANHOLES

- .1 Provide pre-cast concrete manholes. Properly bed each unit and set to required invert.
- .2 Provide a reinforced pre-cast concrete base slab and bottom section for each manhole, or provide a poured-in-place concrete base. Ensure each manhole is sized to suit pipe size and arrangement. Conform to Municipal installation standards.
- .3 Provide masonry work required to raise top of each assembly flush with finished grade level.
- .4 When work is substantially complete, clean out each manhole.

3.15 INSTALLATION OF EXTERIOR CATCH BASINS

- .1 Provide pre-cast concrete catch basins. Properly bed each unit and set to required invert.
- .2 Ensure each catch basin is sized to suit pipe size and arrangement. Conform to Municipal installation standards.
- .3 Provide masonry work required to raise top of each assembly flush with finished grade level.
- .4 When work is substantially complete, clean out each catch basin.

3.16 INSTALLATION OF DRAINAGE INTERCEPTOR

- .1 Provide an interceptor in drainage piping.
- .2 Ensure unit is easily accessible for maintenance. Confirm exact location prior to roughing-in.
- .3 Wall mount control panel and provide required 24 volt control wiring in conduit from control panel to interceptor.
- .4 For equipment/system start-up requirements, refer to Section 20 05 00 – Common Work Results for Mechanical.
- .5 For equipment/system manufacturer certification requirements, refer to Section 20 05 00 – Common Work Results for Mechanical. Submit a copy of the letter prior to Substantial Performance of the Work.

- .6 Include for 2 hours of on-site training for 2 groups of 6 people. Training is to be a full review of all components including but not limited to a full operation and maintenance demonstration, with abnormal events.

End of Section

1 General

1.01 SUBMITTALS

- .1 Submit shop drawings/product data sheets for all equipment and associated hardware specified in this Section.
- .2 Submit with delivery of heater(s) a copy of the factory inspection and test report for each heater, and include a copy of each report with O&M Manual project close-out data.

1.02 CLOSEOUT SUBMITTALS

- .1 Submit manufacturer/supplier installation certification letters as specified in Part 3 of this Section.
- .2 Submit, prior to Substantial Performance of the Work, start-up or test data specified in Part 3 of this Section.

2 Products

2.01 ELECTRIC DOMESTIC HOT WATER TANK AND HEATER

- .1 CSA certified electric domestic hot water tank and heater with model number and performance as specified on drawings, and complete with:
 - .1 1035 kPa (150 psi) rated (working pressure) steel tank, glass lined, insulated (except for control panel area) with injected minimum R-16 foam insulation, covered with an enamelled steel jacket, and equipped with 40 mm (1-½") dia. NPS brass nipple water inlet and outlet connections, a drain valve, and sacrificial anode rods;
 - .2 removable multiple immersion heating elements, each consisting of a wire filament in a sealed stainless steel sheath;
 - .3 ASME rated temperature and pressure relief valve;
 - .4 factory pre-wired power and control panel.
- .2 Equip enamelled steel ventilated control panel with removable glass fibre insulation to cover bare area of tank, a hinged door, multiple knockouts, a ground screw, and following:
 - .1 terminal block for power wiring connections;
 - .2 magnetic contactors for heating elements;
 - .3 adjustable immersion thermostat;
 - .4 manual reset immersed high temperature limit control for each element;
 - .5 fuse block with fuses;
 - .6 element diagnostic panel with LED's for each element to monitor on-off operation of each element;
- .3 Manufacturers
 - .1 A.O. Smith Water Products Co.;
 - .2 John Wood (GWS Water Heating Co.);
 - .3 Rheem Canada Ltd.;

- .4 Bradford White Canada Inc.

3 Execution

3.01 ELECTRIC DOMESTIC HOT WATER TANK AND HEATER

- .1 Drainage Coordination
 - .1 Coordinate drain requirements of plumbing equipment provided by Mechanical Division and or Owner with location of drains specified in Section 22 13 00.
- .2 Installation
 - .1 Provide an electric domestic hot water tank and heater.
 - .2 Secure heater in place, level and plumb, on a concrete housekeeping pad, and:
 - .1 pipe temperature/pressure relief valve outlet to drain;
 - .2 pipe drain valve outlet to drain;
 - .3 coordinate installation with electrical trade who will connect heater with power wiring.
 - .3 Set thermostat to produce 48.8°C (120°F) hot water.
- .3 System Startup
 - .1 For equipment/system start-up requirements, refer to Section 20 05 00 – Common Work Results for Mechanical.
 - .2 For equipment/system manufacturer certification requirements, refer to Section 20 05 00 – Common Work Results for Mechanical. Submit a copy of the letter prior to Substantial Performance of the Work.
- .4 Training
 - .1 Include for 2 hours of on-site training for 2 groups of 6 people. Training is to be a full review of all components including but not limited to a full operation and maintenance demonstration, with abnormal events.

3.02 ELECTRIC DOMESTIC HOT WATER BOOSTER HEATER

- .1 Drainage Coordination
 - .1 Coordinate drain requirements of plumbing equipment provided by Mechanical Division and or Owner with location of drains specified in Section 22 13 00.
- .2 Installation
 - .1 Provide an electric domestic hot water booster heater.
 - .2 Secure heater in place, level and plumb, and:
 - .1 pipe temperature/pressure relief valve outlet to drain;
 - .2 pipe drain valve outlet to drain;
 - .3 coordinate installation with electrical trade who will connect heater with power wiring;

- .4 set thermostat to produce 82°C (180°F) hot water.
- .3 System Startup
 - .1 For equipment/system start-up requirements, refer to Section 20 05 00 – Common Work Results for Mechanical.
 - .2 For equipment/system manufacturer certification requirements, refer to Section 20 05 00 – Common Work Results for Mechanical. Submit a copy of the letter prior to Substantial Performance of the Work.
- .4 Training
 - .1 Include for 2 hours of on-site training for 2 groups of 6 people. Training is to be a full review of all components including but not limited to a full operation and maintenance demonstration, with abnormal events.

End of Section

1 General

1.01 SUBMITTALS

- .1 Submit product data sheets (fixture cuts) for all plumbing fixtures and fittings.
- .2 Submit fixture manufacturer's standard colour charts for all fixtures where colours are available but a particular colour is not specified.

2 Products

2.01 GENERAL RE: PLUMBING FIXTURES AND FITTINGS

- .1 Fixtures and fittings, where applicable, are to be in accordance with requirements of CAN/CSA B45 Series, General Requirements for Plumbing Fixtures, including supplements, ASME A112.1.18.1/CSA B125.1, Plumbing Supply Fittings, and CSA B125.3, Plumbing Fittings.
- .2 Barrier-free fixtures and fittings are to be in accordance with governing Code requirements.
- .3 Unless otherwise specified, vitreous china, porcelain enamelled, and acrylic finished fixtures are to be white.
- .4 Unless otherwise specified, fittings and piping exposed to view are to be chrome plated and polished.
- .5 Fittings located in areas other than private washrooms are to be vandal-proof.
- .6 Fixture carriers are to be suitable in all respects for the fixture they support and construction in which they are located.
- .7 Floor flanges for floor mounted water closets are to be cast iron or brass, secured to floor to prevent movement and complete with a wax seal and brass or stainless steel bolts, nuts, and washers. Plastic floor flanges will not be acceptable.
- .8 Proper seal to mate with fixture carrier flange and produce a water-tight installation.
- .9 Exposed traps for fixtures not equipped with integral traps, such as lavatories, are to be adjustable chrome plated cast brass "P" traps with cleanouts, minimum #17 gauge chrome plated tubular extensions, and chrome plated escutcheons, all to suit fixture type and drain connection.
- .10 Concealed traps for fixtures not equipped with integral traps, such as counter sinks, are to be adjustable cast brass with cleanout plugs, all to suit fixture type and drain connection.
- .11 Exposed supplies for fixtures which do not have supply trim/fittings with integral stops, i.e. lavatories, are to be solid chrome plated brass angle vales with screwdriver stops for public areas, wheel handle stops for private areas, flexible stainless steel risers, and stainless steel or chrome plated steel escutcheons, all arranged and sized to suit fixture.
- .12 Water piping as specified, complete with ball type shut-off valves as specified with water piping, or Dahl Bros. Canada Ltd. ¼ turn Mini Ball Valves.

2.02 PLUMBING FIXTURES AND FITTINGS

- .1 Plumbing fixtures and fittings are to be in accordance with the following:
 - .2 WC-1 – Toilet - Wall Hung
 - .1 Toilet – American Standard 3351101.020 Toilet - AFWALL® MILLENNIUM™ FloWise®, Toilet, Wall-hung with wall outlet, Toilet operates in the range of 4.2 to 6.0 LPF (1.1 - 1.6 GPF), White finish Vitreous China, EverClean® antimicrobial surface, Elongated bowl, Concealed trap way

- design, Direct-fed siphon jet flush action, 38 mm (1-1/2") top spud, Flush valve by others, 254 x 305 mm (10" x 12") water surface area, Fully-glazed 54 mm (2-1/8") trap way, Static load rating of 454 kg (1000 lb), this product is not recommended for bariatric use, Condensation channel, Toilet seat not included, 356 mm (14") wide, 660 mm (26") from finished wall, Compliances: ASME A112.19.2 compliant, CSA B45.1 compliant.
- .2 Seat – Centoco 500STSCCFE-001 Seat - FAST-N-LOCK, for elongated bowl, Open front, Heavy-duty, For commercial applications, Polypropylene, Toilet seat, Less seat cover, Plastic commercial check hinges, and Stainless steel hinge pin, Specified in White finish, FAST-N-LOCK mounting system takes the guess work out when tightening the hardware. The specially designed fasteners in click" when the appropriate torque is reached. The bolt and nut material shall be stainless steel, Dimensions:25 mm (1") high, 473 mm (18-5/8") long, 371 mm (14-5/8") wide.
- .3 Flush Valve – Sloan SL-ROYAL 111-1.28-ESS Flush Valve - ROYAL® Automatic no-touch Exposed Water closet flushometer, High Efficiency 4.8 LPF (1.28 GPF), 38 mm (1-1/2") spud coupling For top spud toilet, Hardwired, constructed from Semi-red brass, Polished chrome finish, Chloramine resistant PERMEX® synthetic rubber diaphragm, OPTIMA® EL-1500 self-adaptive infrared sensor, Sensor located on die cast sensor plate with no visible fasteners (for 2-gang electrical box), Courtesy Flush® electrical override button, Flush tube for 292 mm (11-1/2") rough-in, Adjustable tailpiece, 25 mm (1") I.P.S. screwdriver Bak-Chek® angle control stop with free spinning vandal-resistant stop cap, Dual-filtered fixed bypass, Sweat solder adapter kit with cover tube, High back pressure vacuum breaker, 25 mm (1") supply pipe, Cast wall flange with set screw, Non-hold-open, no external volume adjustment, fixed volume accuracy is controlled by CID™ technology, 24 VAC input/output, With indicator light, Requires transformers 0345154 or 0345999, 103 - 552 kPa (15 - 80 PSI) operating water pressure, Compliances: cUPC compliant.
- .4 Power Kit – Sloan SL-EL-154 Faucet and Flush Valve Power Kit - For flush valve.
- .5 Carrier – Watts ISCA-101-L/R-M11 Carrier - Closet Carrier, Industry Standard single Horizontal adjustable Closet Carrier, Adjustable for standard and wheelchair height, 102 mm (4") no hub waste, 51 mm (2") no hub vent connections, patented compression seal faceplate assembly, epoxy coated cast iron, with incremental measurements embossed onto legs to easily adjust height of carrier to most commonly used fixture requirements, epoxy coated cast iron foot support, neoprene bowl gasket, epoxy coated cast iron, integral test cap, chrome cap nuts, Plated hardware, Adjustable ABS nipple, Tiling frame, Codes and Compliances: Carrier complies with requirements of ASME A112.6.1M up to a 500 lb (227 kg) static load.
- .1 (Back to back installation) Watts ISCA-101-D Carrier - Horizontal, Closet Carrier, Industry Standard Back-to-Back Horizontal adjustable Closet Carrier, 500 lb (227 kg), Adjustable for standard and wheelchair height, 102 mm (4") no hub waste, 51 mm (2") no hub vent connections, patented compression seal faceplate assembly, epoxy coated cast iron, with incremental measurements embossed onto legs to easily adjust height of carrier to most commonly used fixture requirements, epoxy coated cast iron foot support, neoprene bowl gasket, epoxy coated cast iron, integral test cap, chrome cap nuts, Plated hardware, Adjustable ABS nipple, Codes and Compliances: Carrier complies with requirements of ASME A112.6.1M up to a 500 lb (227 kg) static load.
- .6 Coupling – Champion MI-XHUB Coupling - Shielded Transition coupling, Unsized pipe, Four clamps for 2" to 4" pipe size, Six clamps for 5" to 15" pipe size, Type 304 stainless steel clamps, Type 304 AISI stainless steel Eyelets, Neoprene gasket gasket, Type 300 stainless steel shield painted red for easy identification, Type 305 stainless steel screw, 3/8" hex head screws, Type 304 AISI stainless steel screw housing, Codes and Compliances:, ASTM C-1540; ASTM standard 1460-2012, Comply to the FM 1680-1989 standard (except for markings), CAN/ULC S102.2-10.
- .3 WC-2 – Toilet – Floor Mounted – Barrier Free
- .1 Toilet – Zurn Z5665-BWL1 - EcoVantage High Efficiency Toilet System. Vitreous China, 1.1 gpf [4.2 Lpf] high efficiency, ADA Height, floor mounted, bottom outlet toilet with siphon jet flushing

- action and elongated front rim with 1-1/2" [39mm] top spud. This bowl is designed to perform to industry standards with as little as 1.1 gallons per flush. Complies with ASME A112.19.2 / CSA B45.1. ADA Compliant.
- .2 Seat – Centoco 500STSCCFE-001 Seat - FAST-N-LOCK, for elongated bowl, Open front, Heavy-duty, For commercial applications, Polypropylene, Toilet seat, Less seat cover, Plastic commercial check hinges, and Stainless steel hinge pin, Specified in White finish, FAST-N-LOCK mounting system takes the guess work out when tightening the hardware. The specially designed fasteners in click" when the appropriate torque is reached. The bolt and nut material shall be stainless steel, Dimensions:25 mm (1") high, 473 mm (18-5/8") long, 371 mm (14-5/8") wide.
 - .3 Manual Flush Valve – Flush Valve – Zurn Z6000AV-2 - Exposed, quiet diaphragm-type, chrome plated flushometer valve with a polished exterior. Complete with Zurn's AquaVantage® TPE, chloramine resistant, dual seal diaphragm with a clog resistant, triple filtered by-pass. The valve is ADA compliant with a non-hold open and no leak handle feature. Internal seals are made of chloramine resistant materials. 610mm valve height. 1.1 gpf gallons per flush.
 - .4 Backrest – Franke Commercial CM-16104-WM Backrest - wall mounting, back rest, solid core plastic laminate panel back, Antique white, 305 mm (12") wide, 102 mm (4") high, 137 mm (5-3/8"), 18-gauge stainless steel bar with #4 gloss with flanges and covers, concealed snap flanges and mounting hardware included, provide adequate backing in wall for support and comply to local codes for barrier free requirements.
- .4 L-1 – Children's Seamless One Piece Lavatory - Two Wash Places
- .1 Basin – 'Bradley' #ELX2, Wall Mounted, seamless one-piece lavatory, 2 wash places, integral semi-circular continuous bowls, deck, and ledge containing concealed, vandal-resistant spray head. Unit includes waste and supply connections to wall with stop, strainer, and check valves, and stainless steel support frame, concealed by high impact polymer pedestal enclosure, 26" Junior Height Mounting option. ADA/ABA, ANSI A117.1, and TAS compliant. IPC/cUPC certified by IAPMO. Overall Unit Size: 55" x 18-7/8" x 21-5/8".
 - .2 Faucet – 'Bradley' #IR-DCG, Independent water stream former with flow rate of 0.5 gpm (1.9 Lpm) at operating range of 20 to 80 psi, battery operated, Infrared sensing module and solenoid with automatic shut-off, pushbutton air valve metering with adjustable timing. 4" centerset and centershank faucet drilling available for faucets by others
 - .3 Basin – American Standard 0955001EC.020 0059020EC.020 Basin - MURRO, Wall-hung Lavatory, Vitreous China, EverClean® antimicrobial surface, White finish, Single hole center set, Rear overflow, Faucet ledge with recessed self-draining deck, For concealed arm or wall support, Vitreous China shroud/knee contact guard with EverClean (0059020EC), Soap dispenser, When installed with a below deck electronics faucet which has the control box, the accessories will not fit under the shroud and will need to be installed outside the shroud, Overall Dimensions: 545 mm (21-7/16") long, 540 mm (21-1/4") wide, 152 mm (6") high, Bowl Dimensions: 343 mm (13-1/2") long, 394mm (15-1/2") wide, 127 mm (5") deep.
 - .4 Faucet – Sloan EFX-200-CP-0.5GPM-MLM-IR-HLP-FCT Faucet - BASYS®, Counter mounted, Automatic no-touch, Hardwired less plug adapter, Lavatory faucet, Polished chrome finish, Single hole center set, Metal, Flexible supply hoses with 10 mm (3/8") compression connections, 1.9 LPM (0.5 GPM) maximum flowrate, Multi-laminar spray outlet, Fixed spout, 153 mm (6") spout reach, 254 mm (10") high, Double infrared sensors with automatic setting feature, Solenoid housed in removable carrier that includes supply strainer, Above deck individual diagnostic indicators for battery life, solenoid condition, and power-up mode, Mixing valve ordered separately, Sloan transformer recommended, Vandal-resistant spray insert, key housed inside faucet body, Integral above deck water supply shut off, Line purge mode.
 - .5 Power Kit – Sloan SL-EL-154 Faucet and Flush Valve Power Kit - For flush valve.

- .6 Mixing Valve – Lawler TMM-1070-87500 Mixing Valve - The point of use mechanical mixing valve with thermostatic limit stop, MECHANICAL MIXING VALVE, lead free brass body construction, The temperature adjusting dial is located on the cold inlet. Turning the dial clockwise will lower the outlet temperature, turning the dial counterclockwise will raise it. The valve cannot be adjusted above its shut-off temperature of 120F, 1.8 LPM (0.5 GPM) tempered flowrate @ 5 PSI pressure drop, Compression Fitting, 84 mm (3-5/16") high, ASSE 1070 approved ASSE lead free Certified for ASSE 1070 applications, 3/8" MNPT (9.5 mm) inlet, 3/8" MNPT (9.5 mm) outlet, Integral rubber duck-bill backflow checks, High temperature limit stop, 125 PSI max supply pressure, Automatically shuts down flow of water when temperature reaches 120 °F, 5 PSI Minimum Operating pressure, 140 °F max, 118 °F ±3 °F, Protects against scalding and chilling, 8 LPM (2.1 GPM) flowrate @ 45 PSI
 - .7 Fixture Drain – McGuire 155A Fixture Drain - Straight drain, cast brass, Chrome-plated finish, Open grid PO plug, 7/32" (5.5 mm) Ø holes size, 17-gauge 32 mm (1-1/4") Ø tailpiece diameter, 17-gauge 152 mm (6") long, Brass locknut, Heavy rubber basin washer Fiber friction washer, ASME A112.18.2 CSA B125.2, CSA compliant.
 - .8 Supply – McGuire LFBV170 Supply - Lead Free, with Chrome-plated finish, Convertible quarter-turn supply, Lavatory, 13 mm (1/2") copper sweat x 10 mm (3/8") outer Ø brass ball valve connection, one deep bell flange, Convertible loose key handle, extension is 127 mm (5") length, 304 mm (12") copper flexible risers.
 - .9 P-Trap – McGuire 8872C P-Trap - Heavy cast brass, Adjustable p-trap, 292 mm (11-1/2") distance, with cleanout plug, Steel shallow flange, Neoprene gasket, Slip nuts, 17-gauge seamless tubular wall bend, ASME A112.18.2 CSA B125.2, CSA compliant.
 - .10 Carrier – Watts WCA-411-CA-481 Carrier - WCA-411/WCA-411-WC, Lavatory carrier, Single floor-mounted lavatory carrier with concealed arms, for concealed arm carrier, adjustable arms, epoxy coated cast iron, integral welded feet, upper tie rod, Heavy gauge steel offset uprights, basin locking device, Plated hardware, levelling screws, Wall mounted steel support plate with plated hardware.
- .5 L-2 – Barrier Free Wall Hung Lavatory
- .1 Basin – ‘American Standard Murro’ #0954.004EC.020, Vitreous china, Wall-hung, White, three hole, 102mm (4") center, rear overflow, recessed self draining faucet ledge, Everclean anti-microbial surface, 32mm (1-1/4") waste assembly, bowl dimensions; 394mm (15-1/2") wide x 343mm (13-1/2") front to back x 127mm (5") deep, nominal dimensions; 540mm (21-1/4") wide x 520mm (20-1/2") front to back x 165mm (6-1/2") high, with 0059.020EC vitreous china, semi-pedestal P-trap cover, for concealed arm or wall support.
 - .2 Faucet – ‘Moen Commercial’ #8215F15, Two Handle Lavatory Faucet, chrome plated finish, 102mm (4") centerset, 12mm (1/2") IPS connections, 1.5 gpm (5.7 L/min) flow rate, vandal resistant aerator. 102mm (4") wrist blade handle with hot and cold colour indicators, vandal resistant torx head screws, brass shell, 1/4 turn operation, ceramic disc cartridge.
 - .3 Carrier – ‘Watts’ - #WCA-411, Floor Mounted Lavatory Carrier, adjustable epoxy coated cast iron, concealed arms.
 - .4 Mixing Valve – #570-86820, Point of Use Thermostatic Water Mixing Valve, nickel plated bronze body, temperature adjusting spindle, 10mm (3/8") inlet and outlet FNPT connections, integral checks, set valve temperature at 35°C (95°F) and 46°C (114.8°F).
 - .5 Supplies – #LFH165LKNS3, chrome plated finish, polished brass, heavy duty angle stops, 10mm (3/8") I.P.S. inlet x 76mm (3") long rigid horizontal nipples, V.P. loose keys, escutcheon and flexible copper risers.

- .6 Drain – #155A, Open Grid Drain, cast brass one piece top, 17 GA (1.5mm) tubular 32mm (1-1/4") tailpiece.
- .7 P-Trap - #8872C, chrome plated finish, heavy cast brass adjustable body, with slip nut, 32mm (1-1/4") size, with cleanout, shallow wall flange and seamless tubular wall bend.
- .6 EW-1 – Eye Wash Station Stainless Steel Bowl
 - .1 Emergency Equipment – Guardian G1814-G3600LF-T Emergency Equipment - Wall-hung, Eye wash, constructed from Type 304 brushed stainless steel finish, Thermostatic mixing valve blends hot and cold water, 283 mm (11-1/8") Ø bowl size, Corrosion resistant powder coated finish, Two GS-Plus spray heads with flip top dust cover each, 13 mm (1/2") Ø IPS Chrome plated brass stay open ball valve, 13 mm (1/2") Ø NPT female inlet supply inlet, Chrome plated brass tailpiece and trap with 1-1/2" (38 mm) IPS waste connection, 32 mm (1-1/4") Ø NPT female outlet, Codes and Compliances:, ANSI compliant.
- .7 MS-1 – Floor Mounted, Mop Service Sinks
 - .1 Sink – Stern Williams SB-900-T-35-T-40-BP Sink - Single compartment sink, Mop service sinks, with overall dimension 610 mm (24") long, 610 mm (24") wide, 305 mm (12") high, constructed from Precast terrazzo, Bowl dimensions are 546 mm (21-1/2") long, 546 mm (21-1/2") wide, 254 mm (10") deep, Pearl grey marble chips and white Portland cement, 76 mm (3") pipe size, cast integrally and provides for a caulked lead connection not less than 25 mm (1") deep to a 76 mm (3") pipe, flat stainless steel strainer, Without tiling flange, With stainless steel cap, Hose and wall hook, Mop hanger, Splash catcher.
 - .2 Faucet – American Standard 8354112.002 Faucet - Wall-hung, Manual, Two handles, Mop sink faucet, Polished chrome finish, 152 - 254 mm (6" - 10") adjustable center set, Brass construction, Integral check valve, Ceramic disc cartridge, no flow restrictor, 37.8 LPM (10 GPM) @20 PSI, Threaded hose end, Cast brass spout with bucket hook, 248 mm (9-3/4") spout reach, Top brace, Vandal-resistant lever handles, 13 mm (1/2") female inlet.
 - .3 Mixing Valve – Lawler TMM-1070-87500 Mixing Valve - The point of use mechanical mixing valve with thermostatic limit stop, MECHANICAL MIXING VALVE, lead free brass body construction, The temperature adjusting dial is located on the cold inlet. Turning the dial clockwise will lower the outlet temperature, turning the dial counterclockwise will raise it. The valve cannot be adjusted above its shut-off temperature of 120F, 1.8 LPM (0.5 GPM) tempered flowrate @ 5 PSI pressure drop, Compression Fitting, 84 mm (3-5/16") high, ASSE 1070 approved ASSE lead free Certified for ASSE 1070 applications, 3/8" MNPT (9.5 mm) inlet, 3/8" MNPT (9.5 mm) outlet, Integral rubber duck-bill backflow checks, High temperature limit stop, 125 PSI max supply pressure, Automatically shuts down flow of water when temperature reaches 120 °F, 5 PSI Minimum Operating pressure, 140 °F max, 118 °F ±3 °F, Protects against scalding and chilling, 8 LPM (2.1 GPM) flowrate @ 45 PSI
- .8 S-1 – Counter Mounted, Drop-In, Commercial Sinks
 - .1 Sink – Franke Commercial LBS4010P-1-3 Sink - Single compartment sink, 203 mm (8") center set, Commercial sinks, with overall dimension 562 mm (22-1/8") long, 478 mm (18-13/16") wide, 254 mm (10") high, constructed from 18 gauge Type 304 Stainless steel, Bowl dimensions are 508 mm (20") long, 356 mm (14") wide, 254 mm (10") deep, Polished to #4 satin finish, Factory installed EZ TORQUE™ fasteners, Factory applied rim seal, Center back waste location, 38 mm (1-1/2") (DN38) brass tailpiece, standpipe with guard, 89 mm (3-1/2") crumb cup strainer, Undercoated to reduce condensation and resonance, Codes and Compliances: ASME A112.19.3 compliant, CSA B45.4 compliant.
 - .2 Faucet – Chicago Faucets 786-GN8FCABCP Faucet - Counter mounted, Manual, Two handles, Sink faucet, Chrome-plated finish, 203 mm (8") center set, Lead Free ANSI/NSF 61 and ANSI/NSF 372 compliant, ECAST® brass construction, -377-XTAB quatern compression

- cartridge, 5.7 LPM (1.5 GPM) maximum flowrate, -FC 5.7 LPM (1.5 GPM) laminar flow control insert in spout inlet, plain end outlet, Gooseneck spout, 203 mm (8") spout reach, -317-PR vandal-resistant 102 mm (4") metal wrist blade handles with red & blue index, Grid drain included, 13 mm (1/2") NPSM supply inlet for 10 mm (3/8") or 13 mm (1/2") flexible riser.
- .3 Mixing Valve – Lawler TMM-1070-87500 Mixing Valve - The point of use mechanical mixing valve with thermostatic limit stop, MECHANICAL MIXING VALVE, lead free brass body construction, The temperature adjusting dial is located on the cold inlet. Turning the dial clockwise will lower the outlet temperature, turning the dial counterclockwise will raise it. The valve cannot be adjusted above its shut-off temperature of 120F, 1.8 LPM (0.5 GPM) tempered flowrate @ 5 PSI pressure drop, Compression Fitting, 84 mm (3-5/16") high, ASSE 1070 approved ASSE lead free Certified for ASSE 1070 applications, 3/8" MNPT (9.5 mm) inlet, 3/8" MNPT (9.5 mm) outlet, Integral rubber duck-bill backflow checks, High temperature limit stop, 125 PSI max supply pressure, Automatically shuts down flow of water when temperature reaches 120 °F, 5 PSI Minimum Operating pressure, 140 °F max, 118 °F ±3 °F, Protects against scalding and chilling, 8 LPM (2.1 GPM) flowrate @ 45 PSI.
 - .4 Supply – McGuire LFCK170 Supply - ICV DEFENDER, Lead Free, with Chrome-plated finish, Integral check supply kit w/5" sweat extension, Faucet, Sweat to compression connection, 1/2" Sweat w/5" Sweat extension x 3/8" O.D connection, Deep bell wall flange, Wheel handle, Full turn brass stem, 305 mm (12") chrome-plated risers, Purple EPDM peroxide cured washers, Codes and compliances: NSF/ANSI 61 & 372, UPC.
 - .5 P-Trap – McGuire 8912CB P-Trap - Heavy cast brass, Adjustable p-trap, 292 mm (11-1/2") length, with cleanout plug, Steel box flange, Neoprene gasket, Seamless tubular brass bend, Slip nuts.
- .9 S-2 – Double Compartment, Counter Mounted, Drop-In, Commercial Sinks
- .1 Sink – Franke Commercial LBT6407CB-1 Sink - Triple compartment self rimming topmount sink with faucet ledge. 20 gauge (0.9 mm), type 302 (CNS 18/8) stainless steel. Exposed surfaces are #4 satin finished. Undercoated to reduce condensation and resonance. Complete with waste fittings, factory applied rim seal, and factory installed EZ TORQUE™ fasteners. Certified to ASME A112.19.3-2008 / CSA B45.4-08. Centre back waste location. Includes 3 1/2" (89 mm) crumb cup strainer with 1 1/2" (DN38) brass tailpiece. Model Options: LBT6407CB-1-1, 1 faucet hole, 1 1/2" (89 mm) diameter. LBT6407CB-1-3, 3 faucet holes, 8" centreset, 1 1/2" diameter. 20 9/16 x 46 3/8" (522 x 1178 mm) Overall. 16 x 14 x 7" (406 x 356 x 178 mm) Bowl.
 - .2 Faucet – American Standard 7074300.075 Faucet - COLONY®, Counter mounted, Manual, Single handle, Sink faucet, Stainless steel finish, 203 mm (8") center set, Installed with included 244 mm (9-5/8") deck plate, Lead Free ANSI/NSF 61 and ANSI/NSF 372 compliant, Metal, Integral check valve, 610 mm (24") flexible colour-coded braided stainless steel supply hoses with 10 mm (3/8") compression connections, Ceramic disc cartridges, 5.7 LPM (1.5 GPM) maximum flowrate, Pressure compensating spray outlet, Pull-down spray with adjustable spray pattern and pause feature, Brass spout, Pull down, 227 mm (8-15/16") spout reach, 375 mm (14-3/4") high, Lever handle.
 - .3 Mixing Valve Lawler TMM-1070-87500 Mixing Valve - The point of use mechanical mixing valve with thermostatic limit stop, MECHANICAL MIXING VALVE, lead free brass body construction, The temperature adjusting dial is located on the cold inlet. Turning the dial clockwise will lower the outlet temperature, turning the dial counterclockwise will raise it. The valve cannot be adjusted above its shut-off temperature of 120F, 1.8 LPM (0.5 GPM) tempered flowrate @ 5 PSI pressure drop, Compression Fitting, 84 mm (3-5/16") high, ASSE 1070 approved ASSE lead free Certified for ASSE 1070 applications, 3/8" MNPT (9.5 mm) inlet, 3/8" MNPT (9.5 mm) outlet, Integral rubber duck-bill backflow checks, High temperature limit stop, 125 PSI max supply pressure, Automatically shuts down flow of water when temperature reaches 120 °F, 5 PSI Minimum Operating pressure, 140 °F max, 118 °F ±3 °F, Protects against scalding and chilling, 8 LPM (2.1 GPM) flowrate @ 45 PSI.

- .4 Supply – McGuire LFCK170 Supply - ICV DEFENDER, Lead Free, with Chrome-plated finish, Integral check supply kit w/5" sweat extension, Faucet, Sweat to compression connection, 1/2" Sweat w/5" Sweat extension x 3/8" O.D connection, Deep bell wall flange, Wheel handle, Full turn brass stem, 305 mm (12") chrome-plated risers, Purple EPDM peroxide cured washers, Codes and compliances: NSF/ANSI 61 & 372, UPC.
- .5 P-Trap – McGuire 8912CB P-Trap - Heavy cast brass, Adjustable p-trap, 292 mm (11-1/2") length, With cleanout plug, Steel box flange, Neoprene gasket, Seamless tubular brass bend, Slip nuts.
- .10 S-3 – Counter Mounted, Drop-In, Commercial Sinks
 - .1 Sink – Franke Commercial LBS4010P-1-1 Sink - Single compartment sink, Single hole center set, Commercial sinks, with overall dimension 562 mm (22-1/8") long, 478 mm (18-13/16") wide, 254 mm (10") high, constructed from 18 gauge Type 304 Stainless steel, Bowl dimensions are 508 mm (20") long, 356 mm (14") wide, 254 mm (10") deep, Polished to #4 satin finish, Factory installed EZ TORQUE™ fasteners, Factory applied rim seal, Center back waste location, 38 mm (1-1/2") (DN38) brass tailpiece, standpipe with guard, 89 mm (3-1/2") crumb cup strainer, Undercoated to reduce condensation and resonance, Codes and Compliances: ASME A112.19.3 compliant, CSA B45.4 compliant.
 - .2 Faucet – American Standard 7074300.002 Faucet - COLONY®, Counter mounted, Manual, Single handle, Sink faucet, Polished chrome finish, Single hole center set, Lead Free ANSI/NSF 61 and ANSI/NSF 372 compliant, Metal, Integral check valve, 610 mm (24") flexible colour-coded braided stainless steel supply hoses with 10 mm (3/8") compression connections, Ceramic disc cartridges, 5.7 LPM (1.5 GPM) maximum flowrate, Pressure compensating spray outlet, Pull-down spray with adjustable spray pattern and pause feature, Brass spout, Pull down, 227 mm (8-15/16") spout reach, 375 mm (14-3/4") high, Lever handle.
 - .3 Mixing Valve – Lawler TMM-1070-87500 Mixing Valve - The point of use mechanical mixing valve with thermostatic limit stop, MECHANICAL MIXING VALVE, lead free brass body construction, The temperature adjusting dial is located on the cold inlet. Turning the dial clockwise will lower the outlet temperature, turning the dial counterclockwise will raise it. The valve cannot be adjusted above its shut-off temperature of 120F, 1.8 LPM (0.5 GPM) tempered flowrate @ 5 PSI pressure drop, Compression Fitting, 84 mm (3-5/16") high, ASSE 1070 approved ASSE lead free Certified for ASSE 1070 applications, 3/8" MNPT (9.5 mm) inlet, 3/8" MNPT (9.5 mm) outlet, Integral rubber duck-bill backflow checks, High temperature limit stop, 125 PSI max supply pressure, Automatically shuts down flow of water when temperature reaches 120 °F, 5 PSI Minimum Operating pressure, 140 °F max, 118 °F ±3 °F, Protects against scalding and chilling, 8 LPM (2.1 GPM) flowrate @ 45 PSI.
 - .4 Supply – McGuire LFCK170 Supply - ICV DEFENDER, Lead Free, with Chrome-plated finish, Integral check supply kit w/5" sweat extension, Faucet, Sweat to compression connection, 1/2" Sweat w/5" Sweat extension x 3/8" O.D connection, Deep bell wall flange, Wheel handle, Full turn brass stem, 305 mm (12") chrome-plated risers, Purple EPDM peroxide cured washers, Codes and compliances: NSF/ANSI 61 & 372, UPC.
 - .5 P-Trap – McGuire 8912CB P-Trap - Heavy cast brass, Adjustable p-trap, 292 mm (11-1/2") length, with cleanout plug, Steel box flange, Neoprene gasket, Seamless tubular brass bend, Slip nuts.
- .11 S-4 – Counter Mounted, Drop-In, Commercial Sinks
 - .1 Sink – Franke Commercial LBS4010P-1-3 Sink - Single compartment sink, 203 mm (8") center set, Commercial sinks, with overall dimension 562 mm (22-1/8") long, 478 mm (18-13/16") wide, 254 mm (10") high, constructed from 18 gauge Type 304 Stainless steel, Bowl dimensions are 508 mm (20") long, 356 mm (14") wide, 254 mm (10") deep, Polished to #4 satin finish, Factory installed EZ TORQUE™ fasteners, Factory applied rim seal, Center back waste location, 38 mm

- (1-1/2") (DN38) brass tailpiece, standpipe with guard, 89 mm (3-1/2") crumb cup strainer, Undercoated to reduce condensation and resonance, Codes and Compliances: ASME A112.19.3 compliant, CSA B45.4 compliant.
- .2 Faucet – American Standard 7074300.040 Faucet - COLONY® PRO, Counter mounted, Manual, Single handle, Sink faucet, Polished chrome finish, Single hole center set, Lead Free ANSI/NSF 61 and ANSI/NSF 372 compliant, Metal, Integral check valve, 610 mm (24") flexible colour-coded braided stainless steel supply hoses with 10 mm (3/8") compression connections, Ceramic disc cartridges, 5.7 LPM (1.5 GPM) maximum flowrate, Pressure compensating spray outlet, Pull-down spray with adjustable spray pattern and pause feature, Brass spout, Pull down, 227 mm (8-15/16") spout reach, 375 mm (14-3/4") high, Lever handle.
 - .3 Mixing Valve – Lawler TMM-1070-87500 Mixing Valve - The point of use mechanical mixing valve with thermostatic limit stop, MECHANICAL MIXING VALVE, lead free brass body construction, The temperature adjusting dial is located on the cold inlet. Turning the dial clockwise will lower the outlet temperature, turning the dial counterclockwise will raise it. The valve cannot be adjusted above its shut-off temperature of 120F, 1.8 LPM (0.5 GPM) tempered flowrate @ 5 PSI pressure drop, Compression Fitting, 84 mm (3-5/16") high, ASSE 1070 approved ASSE lead free Certified for ASSE 1070 applications, 3/8" MNPT (9.5 mm) inlet, 3/8" MNPT (9.5 mm) outlet, Integral rubber duck-bill backflow checks, High temperature limit stop, 125 PSI max supply pressure, Automatically shuts down flow of water when temperature reaches 120 °F, 5 PSI Minimum Operating pressure, 140 °F max, 118 °F ±3 °F, Protects against scalding and chilling, 8 LPM (2.1 GPM) flowrate @ 45 PSI
 - .4 Supply – McGuire LFCK170 Supply - ICV DEFENDER, Lead Free, with Chrome-plated finish, Integral check supply kit w/5" sweat extension, Faucet, Sweat to compression connection, 1/2" Sweat w/5" Sweat extension x 3/8" O.D connection, Deep bell wall flange, Wheel handle, Full turn brass stem, 305 mm (12") chrome-plated risers, Purple EPDM peroxide cured washers, Codes and compliances: NSF/ANSI 61 & 372, UPC.
 - .5 P-Trap – McGuire 8912CB P-Trap - Heavy cast brass, Adjustable p-trap, 292 mm (11-1/2") length, with cleanout plug, Steel box flange, Neoprene gasket, Seamless tubular brass bend, Slip nuts.

.12

2.03 MANUFACTURERS

- .1 Subject to compliance with requirements, manufacturers that may be incorporated into the Work include, but are not limited to, following:
 - .1 Flush Valves:
 - .1 Sloan;
 - .2 Delta Commercial;
 - .3 Zurn Industries;
 - .4 Moen Commercial.
 - .2 Plumbing Brass:
 - .1 Sloan;
 - .2 Acorn Engineering;
 - .3 American Standard;

- .4 Delta Commercial;
- .5 Chicago Faucet;
- .6 Moen Commercial.
- .3 Stainless Steel Sinks:
 - .1 Franke Commercial;
 - .2 Novanni Commercial;
 - .3 Aristaline;
 - .4 Arch Metal Ind.
- .4 Mop Sinks:
 - .1 Stern Williams;
 - .2 Acorn Engineering;
 - .3 Zurn Industries.
- .5 Emergency Eye Wash and Emergency Showers:
 - .1 Haws;
 - .2 Speakman;
 - .3 Bradley.
- .6 Drain Fittings, Angle Supplies, and Traps:
 - .1 McGuire;
 - .2 American Standard;
 - .3 Delta Commercial;
 - .4 Zurn Industries.
- .7 Fixture Carriers:
 - .1 Watts Industries;
 - .2 Jay R. Smith;
 - .3 Zurn Industries.
- .8 Hose Bibbs:
 - .1 Jay R. Smith;
 - .2 Zurn Industries.
- .9 Water Closets, Lavatories, and Urinal:
 - .1 American Standard;
 - .2 Zurn Industries;

- .3 Kohler.
- .10 Thermostatic Mixing Valves:
 - .1 Lawler;
 - .2 Delta Commercial;
 - .3 Leonard.
- .11 Shower and Associated Trim:
 - .1 American Standard;
 - .2 Delta Commercial;
 - .3 Zurn Industries;
 - .4 Moen Commercial.
- .12 Toilet Seats:
 - .1 Olsonite;
 - .2 Centoco;
 - .3 Bemis Commercial.
- .13 Electronic “No Touch” Flush Valves:
 - .1 Sloan;
 - .2 Delta Commercial;
 - .3 Zurn Industries;
 - .4 Moen Commercial.
- .14 Electronic “No Touch” Faucets:
 - .1 Sloan;
 - .2 Delta Commercial;
 - .3 Zurn Industries;
 - .4 Moen Commercial.

2.04 CAULKING

- .1 General Electric Series SCS-1200 Silicone Construction Sealant or Dow Corning 780 silicone rubber sealant with primers as recommended by sealant manufacturer. Caulking colour(s) for coloured fixtures other than white, if any, will be selected by the Consultant from sealant manufacturer’s standard colour range.

3 Execution

3.01 DEMOLITION

- .1 Refer to demolition requirements specified in Section 20 05 05 – Selective Demolition for Mechanical.

3.02 INSTALLATION OF PLUMBING FIXTURES AND FITTINGS

- .1 Provide required plumbing fixtures and fittings.
- .2 Where new fixtures and fittings are to be connected to existing piping, include for required piping revisions.
- .3 Connect plumbing fixtures and fittings with piping sized in accordance with drawing schedule. Refer to manufacturer's published connection (rough-in) requirements. Where manufacturer requires piping connection larger than shown below, provide piping accordingly:

<u>Fixture and/or Fitting</u>	<u>Drain Size mm (IN)</u>	<u>Vent Size mm (in)</u>	<u>DHW Size mm (in)</u>	<u>DCW Size mm (in)</u>	<u>Temp Water Size mm (in)</u>
Water Closets Flush Valve Type	100 (4)	38 (1-½)	-----	25 (1)	-----
Urinals	75 (3)	38 (1-½)	-----	25 (1)	-----
Lavatories	32 (1-¼)	32 (1-¼)	12 (½)	12 (½)	-----
Lavatories (Electronic Faucet)	32 (1-¼)	32 (1-¼)	12 (½)	12 (½)	12 (½)
Counter Sinks	38 (1-½)	32 (1-¼)	12 (½)	12 (½)	-----
Shower Valves and Heads	-----	-----	12 (½)	12 (½)	12 (½)
Shower Stalls	50 (2)	38 (1-½)	12 (½)	12 (½)	12 (½)
Prefab. Mop Sinks with Drain	75 (3)	38 (1-½)	20 (¾)	20 (¾)	-----
Emergency Eye Wash	-----	-----	-----	-----	12 (½)
Emergency Shower	-----	-----	-----	-----	25 (1)

- .4 Confirm exact location of plumbing fixtures and trim prior to roughing-in. Refer to architectural plan and elevation drawings.
- .5 When installation is complete, check, and test operation of each fixture and fitting. Adjust or repair as required.
- .6 For barrier-free fixtures, comply with mounting height and other requirements of governing Code(s).
- .7 For barrier-free water closets utilizing manual flush controls, controls to be installed so that it is operable from the transfer side of the fixture.
- .8 Supply templates for counter mounted fixtures and trim and hand to trades who will cut the counter. Ensure openings in counter are properly located.
- .9 Locate control panels for electronic faucets under lavatories and recessed into wall. Coordinate panel installations with electrical trade who will provide 115 volt power wiring to panels. Install flexible conduit (supplied with box) and extend cord from faucet through the flexible conduit to control box. Connect hot and cold water piping to mixing valve in each box, and tempered water piping from each mixing valve to faucet. Set mixing valve maximum temperature limit stops to 43°C (110°F) after domestic water systems (hot and cold) are complete. Ensure each programmable controller is properly programmed and water off after deactivation is set for 3 seconds.
- .10 For electronic flush valves, locate transformer in ceiling space above electronic units to be served. Coordinate locations with electrical trade who will provide 120 volt line supply to transformers. Provide low voltage wiring from transformers to each electronic flush valve terminal point. Electrical line supply and low voltage wiring is to be concealed and access to transformer must be provided for servicing.
- .11 Protect baths from damage during construction and finishing work. Unless otherwise specified, pack concealed voids under baths with batt type glass fibre insulation as baths are installed.

- .12 Protect shower bases from damage during construction and finishing work.
- .13 Confirm exact mixing valve and shower head locations prior to roughing-in.
- .14 Install refrigerated drinking fountains in accordance with manufacturer's instructions. Plug into a wall receptacle provided as part of electrical work. Coordinate receptacle installation with electrical trade on site.
- .15 For emergency showers, install so bottom of shower head is approximately 2 m (82") above floor, and approximately 400 mm (16") out from the wall. Wall mount mixing valve approximately 1.5 m (5') above floor and adjacent shower head. Set valve temperature limit stop to 35°C (95°F). Ensure valve is open and exposed piping is chrome plated or stainless steel.
- .16 Install eye wash fixtures in accordance with manufacturer's instructions. Ensure exposed piping is painted.
- .17 Wall mount mixing valves for emergency fixtures approximately 1.5 m (5') above floor and secure in place. Check and confirm valve operation and temperature of tempered water supply. Provide cabinets. Identify each cabinet and hand 3 identified cabinet keys to Consultant prior to Substantial Performance of the Work.
- .18 Set mop service basins on floor over drain piping and connect to roughed-in service. Install wall supply trim and any accessories specified.

3.03 CAULKING AT PLUMBING FIXTURES AND FITTINGS

- .1 Caulk around plumbing fixtures and fittings where they contact walls, floors, and any other building surface.
- .2 Clean areas/surfaces to be caulked and prime in accordance with sealant manufacturer's instructions. Where damage to a building surface may occur, mask surface to prevent damage and ensure a clean exact edge to the caulking bead.
- .3 Apply caulking using a gun with proper size and shape of nozzle and force sealant into joints to ensure good surface contact and a smooth and even finished bead of sealant.
- .4 If joints have been masked sealant may be tooled in a continuous stroke to obtain complete void filling. Remove masking tape immediately after tooling and before sealant begins to skin.

3.04 DISHWASHER CONNECTIONS

- .1 Provide roughed-in water and drain connections for Owner supplied dishwasher consisting of:
 - .1 15 mm (½") dia. domestic hot water connection with a Dahl "Mini-Ball" valve with hose end and water hammer arrestor;
 - .2 40 mm (1-½") dia. DWV copper drain connection with "P" trap and cleanout plug.

3.05 CLOTHES WASHER CONNECTIONS

- .1 Provide roughed-in water and drain connections for Owner supplied clothes washer consisting of:
 - .1 15 mm (½") dia. piping connection for both hot and cold water, each terminated in a Dahl "Mini-Ball" Valve with hose end and water hammer arrestor;

- .2 50 mm (2") dia. standing waste with a height to suit the washer drain and complete with a "P" trap.

End of Section

1 General

1.01 SUBMITTALS

- .1 Submit shop drawings/product data for all products specified in Part 2 of this section except for pipe, fittings, and unions. Indicate performance criteria, conformance to appropriate reference standards, and limitations.

1.02 REFERENCES

- .1 CSA B149.1:20, Natural Gas and Propane Installation Code.
- .2 TSSA FS-255-21, Gaseous Fuels Code Adoption Document Amendment: Ontario requirements effective May 1, 2021.

1.03 QUALITY ASSURANCE

- .1 All gas system work is to be in accordance with requirements of CSA B149.1, Natural Gas and Propane Installation Code, as amended by local Gas Codes.
- .2 All gas system work is to be performed only by licensed gas pipe fitters (holding Gas Technician 1 Certificate) authorized under the TSSA Act.
- .3 Apply for, on TSSA forms, approval of the gas system design by the TSSA prior to work beginning at the site and prior to ordering any equipment. Submit the completed TSSA Form and copies of shop drawings/product data sheets as required to the TSSA and obtain an approval certificate. Pay all costs for the TSSA review and approval process. If the TSSA requires revisions to the system and the revisions result in an extra cost, a Notice of Change will be issued by the Consultant for the revision.

2 Products

2.01 PIPE, FITTINGS, AND JOINTS

- .1 Uncoated Black Steel - Screwed Joints: Schedule 40 mild black carbon steel, ASTM A53, Grade B, complete with malleable cast iron screwed fittings to ANSI B2.1, and screwed joints.
- .2 Uncoated Black Steel - Welded Joints: Schedule 40 mild black carbon steel, ASTM A53, Grade B, mill or site bevelled, complete with factory made forged steel butt welding fittings and welded joints.
- .3 Copper-Uncoated: Type "G" seamless copper tubing to ASTM B837, hard temper with wrought copper capillary brazed joint type fittings to ASTM B.61, and brazed joints made with "Sil-Fos" or "Sil-Fos 5" brazing alloy, or, soft temper with flared brass fittings of a single 45° flare type, forged or with a machined long nut and copper to copper threaded connectors, and, where required, flared brass copper to NPS adapters.
- .4 Flexible Stainless Steel: Flexible, CSA certified, 860 kPa (125 psi) rated, gas-tight, convoluted stainless steel tubing factory jacketed with a bright yellow PVC coating which is continuously identified. The tubing is to be supplied in coils and is to be complete with factory attached stainless steel end fittings, and adapter unions, protective plates, and steel clamps.
 - .1 Manufacturers:
 - .1 Tru-Flex Metal Hose LLC. "Pro-Flex";
 - .2 Titeflex Corp. "Gastite";
 - .3 Omega Flex Canada "TracPipe".

2.02 PIPING UNIONS

- .1 Screwed Piping: Malleable iron, ground joint, bronze or brass to iron or bronze to bronze seat screwed unions and union elbows with a minimum pressure rating of 1725 kPa (250 psi) steam at 260°C (500°F).
- .2 Flanged Piping: Forged carbon steel slip-on type raised faced welding flange unions to ASTM A105, 150 lb. Class for steel pipe, and slip-on type 150 lb. Class bronze flanges for copper pipe.
- .3 Copper to Steel: Equal to Kamco Products "Copper Stopper".

2.03 SHUT-OFF VALVES

- .1 Ball Type: CSA certified, minimum 3100 kPa (450 psi) WOG rated, 1/4 turn, full port non-lubricated brass ball valves, each complete with a Teflon PTFE seat, chrome plated solid ball, removable lever handle, and screwed ends.
 - .1 Manufacturers:
 - .1 Neo Valves Inc. #425;
 - .2 Kitz Corp. Code 58;
 - .3 Toyo Valve Co. Fig. 5044A.
 - .2 Plug or Ball Type: CSA certified, plain face flanged, Class 125, 1380 kPa (200 psi) rated, 1/4 turn, cast iron lubricated plug valves, each wrench operated and complete with cylindrical plug with lubricant grooves, lubricant screw, and lubricant receptacle, or full port carbon steel ball valves with flanged ends.
 - .1 Manufacturers:
 - .1 Neo Valves Inc. #1AS40114 plug valve;
 - .2 Newman Hattersley #171M plug valve;
 - .3 Kitz Corp. Code No. 150 SCTAM-FS-CGA ball valve.

3 Execution

3.01 DEMOLITION

- .1 Do all required gas system demolition work. Refer to demolition requirements specified in Section 20 05 05 – Selective Demolition for Mechanical.

3.02 NATURAL GAS PIPING INSTALLATION REQUIREMENTS

- .1 Provide all required natural gas distribution piping and connect gas fired or operated equipment, and provide all required vent piping to atmosphere, including vent piping from pressure regulators. Do all piping work in accordance with requirements of CAN/CSA-B149.1, Natural Gas and Propane Installation Code, as amended by local Gas Codes.
- .2 Piping is to be as follows:
 - .1 for underground piping, coated Schedule 40 black steel, coated soft copper, or polyethylene;
 - .2 for above ground piping, uncoated Schedule 40 black steel, hard temper or soft copper, or, if permitted, flexible stainless steel.
- .3 Install flexible stainless steel pipe in strict accordance with the pipe manufacturer's printed instructions.

- .4 Slope gas piping in the direction of flow to low points.
- .5 Ensure that supports for roof mounted piping are sized (height) to accommodate the roof slope and the required piping slope, and to permit the installation of low point dirt pockets.
- .6 Provide full pipe diameter 150 mm (6") long drip pockets at the bottom of all vertical risers, at all piping low points, and wherever else shown and/or required.
- .7 Identify all natural gas piping above ground with two coats of safety yellow enamel applied over primer and coil type vinyl identification makers with arrows. SMS Ltd. or equal can be used for identification markers.
- .8 For all underground gas piping, provide continuous 75 mm (3") wide yellow PVC warning tape with "CAUTION - GAS LINE BURIED BELOW" wording at 750 mm (30") intervals located above the pipe approximately 250 mm (10") below grade.
- .9 Include for mounting only of a solenoid valve in the gas piping to kitchen cooking equipment.

3.03 INSTALLATION OF SHUT-OFF VALVES

- .1 Provide CSA approved ball type or lubricated plug type shut-off valves to isolate equipment, and wherever else shown.
- .2 Ensure that valves are located for easy accessibility and maintenance.

End of Section

1 General

1.01 SUBMITTALS

- .1 Submit shop drawings/product data sheets for all products specified in this section except piping and unions.
- .2 Submit motor product data sheets and certified performance curves with all pump shop drawings.

1.02 CLOSEOUT SUBMITTALS

- .1 Submit with delivery of each unit a copy of factory inspection and test report, and include a copy of each report with O&M Manual project close-out data.
- .2 Submit a site inspection and start-up report from manufacturer's representative as specified in Part 3 of this section.
- .3 Prior to Substantial Performance of the Work, submit a spare seal flush line filter for each pump equipped with a seal flush line.
- .4 Shop drawings for piping anchors must be prepared and stamped by a professional Structural Engineer registered in the jurisdiction of the work. Refer to requirements for Contractor retained engineers specified in Section 20 05 10 - Mechanical Work General Instructions.
- .5 Submit a letter from pipe anchor design engineer to stating engineer has visited site to examine installation of pipe anchors and pipe anchor installation is in accordance with reviewed anchor shop drawing.

1.03 QUALITY ASSURANCE

- .1 Pump motors are to comply with requirements of Section 20 05 00 – Common Work Results for Mechanical.

2 Products

2.01 PIPE, FITTINGS, AND JOINTS

- .1 Black Steel - Screwed Joint
 - .1 Mild black carbon steel, Grade B, ASTM A53, complete with Class 125 cast iron threaded fittings to ANSI/ASME B16.4, and screwed joints.
- .2 Black Steel - Welded Joint
 - .1 Mild black carbon steel, Grade B, ASTM A53, mill or site bevelled, complete with factory made seamless carbon steel butt welding fittings to ASTM A234, Grade WPB, with long sweep pattern elbows unless otherwise specified, and welded joints.
- .3 Soft Copper Pipe
 - .1 Type "L" seamless soft copper to ASTM B77.
- .4 Hard Copper - Solder Joint
 - .1 Type "L" hard drawn seamless copper to ASTM B88, complete with wrought copper fittings to ANSI B16.22, and 95% tin / 5% Antimony solder joints.
- .5 Hard Copper - Pressure Coupled Joint

- .1 Type "L" hard drawn seamless copper to ASTM B88, complete with Viega "ProPress with Smart Connect feature" system copper fittings with EDPM seals, and pressure type crimped joints made by use of manufacturer recommended tool.

2.02 PIPING UNIONS

- .1 Screwed Piping
 - .1 Malleable iron, ground joint, bronze or brass to iron or bronze to bronze seat screwed unions and union elbows with a minimum pressure rating of 1725 kPa (250 psi) steam at 260°C (500°F).
- .2 Flanged Piping
 - .1 Forged carbon steel slip-on type raised faced welding flange unions to ASTM A105, 150 lb. Class for steel pipe, and slip-on type 150 lb. Class bronze flanges for copper pipe.

2.03 SHUT-OFF VALVES

- .1 Ball Type
 - .1 Class 600, 4140 kPa (600 psi) WOG rated full port ball valves, each complete with a forged brass or bronze body and cap, blowout-proof stem, solid forged brass chrome plated ball, "Teflon" or "PTFE" seat, threaded ends, and removable lever handle.
 - .2 Manufacturers:
 - .1 Toyo Valve Co. Fig. 5044A;
 - .2 Watts Industries (Canada) Inc. #FBV-3;
 - .3 Kitz Corp. Code 58;
 - .4 Victaulic Co. of Canada Ltd. Series 722;
 - .5 Apollo Valve #77-100.
- .2 Butterfly Type
 - .1 Cast ductile iron, lug body style, 1200 kPa (175 psi) rated butterfly valve, each complete with a neck to permit 50 mm (2") of insulation above the flange, a field replaceable EPDM seat, ductile iron disc, stainless steel shaft with EPDM seal, a lever handle for valves to and including 150 mm (6") diameter, a handwheel and gear type operator for valves larger than 150 mm (6") diameter, and each suitable for bubble-tight dead end service with valve closed and either side of connecting piping removed.
 - .2 Manufacturers:
 - .1 DeZurik of Canada Ltd., Figure No. 632;
 - .2 Victaulic Co. of Canada Ltd. Vic-300 MasterSeal or AGS Vic-300;
 - .3 Apollo Valve 143 Series;
 - .4 Watts Industries (Canada) Inc. #BF-03;
 - .5 Kitz Corp. 6112 Series;
 - .6 Toyo Valve Co. 918DESL/G2.

2.04 SWING CHECK VALVES

- .1 Bronze - Screwed
 - .1 Class 125, 1380 kPa (200 psi) WOG rated horizontal swing check valves, each complete with a "Y" pattern bronze body, hinged brass disc, easy access screw-in cap, and screwed ends.
 - .2 Manufacturers:
 - .1 Toyo Valve Co. Fig. 236;
 - .2 Nibco #T-433;
 - .3 Kitz Corp. Code No. 22.
 - .2 Cast Iron - Screwed and Flanged
 - .1 Cast iron, bronze trim, 1380 kPa (200 psi) rated swing check valves, each complete with a bronze disc and seat, malleable iron hinge, bolted cover, and screwed or flanged ends as required.
 - .2 Manufacturers:
 - .1 Toyo Valve Co. Fig. 435A;
 - .2 Watts Industries (Canada) Inc. #F-511;
 - .3 Kitz Corp. Code No. 78.

2.05 VERTICAL LIFT CHECK VALVES

- .1 Class 150, 1380 kPa (200 psi) WOG rated bronze vertical lift check valves, each complete with screwed ends and a bronze disc.
- .2 Manufacturers:
 - .1 Toyo Valve Co. Fig. 231;
 - .2 Watts Industries (Canada) Inc. #600;
 - .3 Kitz Corp. Code No. 36.

2.06 WAFER CHECK VALVES

- .1 Threaded lug body type, full bore, ANSI Series 150, 1965 kPa (285 psi) rated at 38°C (100°F), non-slam wafer check valves, each complete with a carbon steel body, stainless steel discs, a shaft, springs, disc stop and thrust bearings constructed of type 316 stainless steel, and seat materials to suit the application. The inside diameter of the valve must equal the inside diameter of the connecting pipe.
- .2 Manufacturers:
 - .1 Gulf Valve Co. "WAFER CHECK";
 - .2 Watts Industries (Canada) Inc. Series ICV-125;
 - .3 The Metraflex Co. Style CVXX.

2.07 DRAIN VALVES

- .1 Minimum 2070 kPa (300 psi) WOG rated, 20 mm ($\frac{3}{4}$ ") diameter straight pattern bronze ball valves, each complete with a threaded outlet suitable for coupling connection of 20 mm ($\frac{3}{4}$ ") diameter hose, and a cap and chain.
- .2 Manufacturers:
 - .1 Toyo Valve Co. Ltd. Fig. 5046;
 - .2 Watts Industries (Canada) Inc. #B-6000-CC;
 - .3 Kitz Corp. Code No. 68AC;
 - .4 Apollo Valves #78-104-01.

2.08 CIRCUIT BALANCING VALVES

- .1 Screwed or flanged as required, globe style, non-ferrous circuit balancing valves designed to facilitate precise flow measurement, precision flow balancing, and positive shut-off, complete with capped and valved drain connection, and valved ports for connection to a differential pressure meter.
- .2 Manufacturers:
 - .1 Equal to Victaulic Co. of Canada Ltd. (Tour & Anderson) Series 787 screwed, Series 788 flanged, and Series 78K "Koil Kit" valves.

2.09 RADIATOR SHUT-OFF AND BALANCING VALVES

- .1 Heavy pattern, straight, 1750 kPa (250 psi) rated at 120°C (250°F) bronze radiator valves, each complete with composition disc, spring loaded packing, and union. Equip inlet valves with a handle for shut-off. Equip outlet valves with a lockshield for shut-off and balancing.
- .2 Manufacturers:
 - .1 Dahl Brothers Canada Ltd. #11042 and #13013;
 - .2 Spirax Sarco Ltd. Type R.

2.10 PRESSURE RELIEF VALVES

- .1 ASME tested, rated, and certified, bronze or cast iron bronze fitted, 1725 kPa (250 psi) rated pressure relief valves, each capable of relieving full output of equipment it is associated with, and each factory set at 415 kPa (60 psi) unless otherwise specified.
- .2 Manufacturers:
 - .1 ITT Bell & Gossett 3301/4100, or 790/1170;
 - .2 Dresser Industries "CONSOLIDATED";
 - .3 Spirax Sarco Ltd. SVI Series;
 - .4 McDonnell & Miller Models 250 and 260;
 - .5 Conbraco 10-600 Series;
 - .6 Watts Industries (Canada) Inc. 174A or 740.

2.11 AIR VENTS

- .1 Manual Air Vents
 - .1 Equal to Conbraco 27 Series, 3.2 mm (1/8") diameter with a key handle.
- .2 Automatic Air Vents
 - .1 Float actuated air vents, each complete with a semi-steel body and cap, a stainless steel float assembly and seat, and a neoprene head.
 - .2 Manufacturers:
 - .1 Spirax Sarco Ltd., Type 13 W for system working pressures to 1035 kPa (150 psi), 13 WH for system working pressures greater than 1035 kPa (150 psi);
 - .2 Armstrong International Inc. No. 1-AV.

2.12 STRAINERS

- .1 Cast iron wye shaped strainers, minimum 890 kPa (125 psi) rated and complete with a removable type 304 stainless steel screen with perforations sized to suit the application, and, for strainers 50 mm (2") diameter and larger, a blowdown pipe connection tapping.
- .2 Manufacturers:
 - .1 Spirax Sarco Ltd. Type IF-125 screwed or Type AF-250 flanged;
 - .2 Toyo Valve Co. Ltd. Fig. 380A screwed or Fig. 381 flanged;
 - .3 Victaulic Co. of Canada Style 732 or W732 "Vic-Strainer";
 - .4 Armstrong International Inc. A1 Series;
 - .5 Watts Industries (Canada) Inc. #77SCI;
 - .6 Mueller Steam Specialty Products Model 11M screwed or Model 758 flanged.

2.13 PIPING EXPANSION JOINTS

- .1 Steel Piping Mains:
 - .1 Controlled flexing, flanged expansion joints, 2070 kPa (300 psi) rated, with corrugated stainless steel bellows with closely matched neck rings and reinforcing or control rings, and selected for operating pressure plus 25% safety factor.
 - .2 Manufacturers:
 - .1 Senior Flexonics Ltd. Series CSF "High-Corr";
 - .2 Victaulic Co. of Canada Ltd. Style 155 with Style 07 or 107 "Zero-Flex" couplings on each side of assembly and a full length steel "V" shaped support trough with hangers;
 - .3 The Metraflex Co. Model MC.
- .2 Steel or Copper Branch/Runout Piping:
 - .1 Externally pressurized, 1380 kPa (200 psi) rated expansion joints with a stainless steel bellows and shroud, welding or threaded steel nipple ends for steel piping, and copper sweat nipple ends for copper piping.

- .2 Manufacturers:
 - .1 Senior Flexonics Ltd. Series "H";
 - .2 The Metraflex Co. Model "HP".

2.14 PIPING ALIGNMENT GUIDES

- .1 Prime coat painted black carbon steel pipe alignment guides sized and fabricated to suit pipe size and pipe insulation thickness.
- .2 Manufacturers:
 - .1 Senior Flexonics Ltd. Series PGT;
 - .2 E. Myatt & Co. Ltd. Fig. 1267;
 - .3 Empire Tool & Mfg. Inc. Fig 256;
 - .4 The Metraflex Co. Style IV.

2.15 PIPE ANCHORS

- .1 Welded structural black steel anchors of a design, size, and type to securely anchor pipe at point shown. Each anchor is to withstand 150% of axial thrust, and, as specified in Part 1 of this section, is to be designed and detailed by a Professional Structural Engineer.

3 Execution

3.01 DEMOLITION

- .1 Perform required hydronic piping system demolition/revision work. Refer to demolition requirements specified in Section 20 05 05 – Selective Demolition for Mechanical.

3.02 PIPING INSTALLATION REQUIREMENTS

- .1 Provide required hydronic piping. Pipe, unless otherwise specified, is to be:
 - .1 for pipe sizes up to and including 50 mm (2") diameter, Schedule 40 black steel, screwed, or type "L" hard copper with solder joints or pressure coupled joints;
 - .2 for pipe 65 mm (2-½") to 300 mm (12") dia. and larger, Standard weight black steel pipe, 10 mm (0.375") thickness, with welding fittings and welded joints;
 - .3 for short branch connections, 25mm(1") pipe diameter size and less, to heating equipment where structural obstructions occur and site bending of pipe is advantageous, a single length of type "L" soft copper.
- .2 Slope horizontal piping mains to provide a minimum continuous up-grade of 25 mm (1") in 6 m (20') to high points. Slope branch supply and return piping connections to equipment a minimum of 25 mm (1") in 1.2 m (4'). Leave sufficient room at high points for installation and maintenance of air vents.
- .3 Install automatic control valves, piping wells and similar piping and/or equipment mounted control components required for automatic temperature control systems supplied as part of the control work. Refer to drawing control diagrams and details.
- .4 Connect equipment provided as part of the work of other sections with piping as indicated and/or required. Refer to pipe connection details on drawings.

- .5 Provide screwed unions, removable mechanical joint couplings, or weld-on or solder-on flanges in piping at all connections to valves, strainers and similar piping system components which may need maintenance or repair, at equipment connections, in runs of piping exceeding 9 m (30') at 4.5 m (15') regular intervals to permit removal of sections of piping, and wherever else indicated on drawings.
- .6 Provide shut-off valves in piping connections to equipment, to isolate piping risers, to isolate other sections of systems as shown, and wherever else indicated on drawings. Valves in piping to and including 50 mm (2") dia. are to be ball type. All other shut-off valves are to be ball or butterfly type unless otherwise specified. Locate valves so they are easily accessible. Wherever possible, install valves at uniform height. Provide chain operators for valves which are inaccessible for operation from floor level.
- .7 Provide a check valve in discharge piping of every pump, and elsewhere in piping where shown on drawings. Where check valves are required in vertical piping, ensure they are suitable in all respects for the application. Check valves for vertical in-line and/or base mounted circulating pumps are integral with the discharge accessory.
- .8 Provide a drain valve at base of each piping riser, in drain connections to equipment, in low points of horizontal piping, and wherever else shown and/or specified.
- .9 Provide circuit balancing valves in piping generally where shown on drawings but with exact locations in accordance with instructions of personnel doing system flow balancing work. Confirm locations prior to installation.

3.03 INSTALLATION OF PRESSURE RELIEF VALVES

- .1 Provide factory set pressure relief valves. Pipe discharge of each water piping relief valve to drain unless otherwise shown or specified.
- .2 Pipe discharge of each glycol solution piping relief valve back to system expansion tank or return piping.
- .3 Confirm relief valve settings.

3.04 INSTALLATION OF AIR VENTS

- .1 Provide an air vent in piping mains at all high points, at equipment connections, and wherever else shown and/or specified. Equip each air vent with a ball type shut-off valve. Install vents in 100 mm (4") dia. and larger piping and all vents in mechanical rooms in accordance with drawing detail.
- .2 Provide 9 mm (3/8") dia. copper drain piping from each automatic air vent to nearest suitable drain and terminate so discharge is visible. Identify drain piping.

3.05 INSTALLATION OF STRAINERS

- .1 Provide strainers in piping. Locate strainers so baskets are easily accessible and removable. Clean strainer baskets during and after piping system flushing and cleaning is complete, and before water quantity balancing commences.

3.06 INSTALLATION OF EXPANSION COMPENSATORS

- .1 Provide expansion compensation in piping.
- .2 Generally, locate expansion compensation where shown, but with exact locations to suit piping as installed.
- .3 Provide double pipe alignment guides in horizontal piping at each side of expansion compensation facilities to permit movement in axial direction only. Secure guides to building structure only.
- .4 Provide a pipe guide at each side of expansion joints in vertical risers.

3.07 INSTALLATION OF PIPING ANCHORS

- .1 Provide anchors to secure piping to structure. Locate anchors generally where shown but with exact locations to suit piping as installed and requirements of reviewed anchor shop drawings.
- .2 When installation of anchors is complete, arrange, and pay for anchor design engineer to visit site to review anchor installation. Submit a signed letter with engineer's stamp from design engineer confirming each anchor is properly installed.

3.08 FLUSHING AND CLEANING PIPING

- .1 Flush and clean new piping in accordance with requirements specified in Section 23 25 00 - HVAC Water Treatment.

3.09 TESTING, ADJUSTING AND BALANCING

- .1 When work is complete and equipment is operating as intended, test, adjust and balance water flows in accordance with requirements specified in Section 20 05 93 - Testing, Adjusting, and Balancing for Mechanical Systems, and Section 20 08 00 – Commissioning of Mechanical Systems.

End of Section

1 General

1.01 SUBMITTALS

- .1 Submit shop drawings/product data sheets for all products specified in Part 2 of this section except for pipe and fittings.
- .2 Submit, in shop drawing form, a schematic piping diagram for each refrigerant piping system indicating pipe sizes, slopes, valves, traps, and piping specialties. Piping schematics must be reviewed, approved, and signed by refrigeration equipment manufacturers prior to being submitted to Consultant for review.

1.02 CLOSEOUT SUBMITTALS

- .1 Submit letters from equipment suppliers certifying proper installation and start-up of piping systems and equipment as specified in Part 3 of this section.

1.03 QUALITY ASSURANCE

- .1 Refrigerant piping systems are to be in accordance with CSA B52, Mechanical Refrigeration Code, and any applicable local Codes and Regulations.
- .2 Refrigerant piping installing contractor is to be certified by Technical Standards and Safety Authority (TSSA). Installing contractor is to install refrigerant piping in accordance with manufacturer's installation instructions and in accordance with local codes. Contractor is responsible for all regulatory approvals, if required. Upon completion of installation, documentation of refrigerant amount, test certificates and verification documentation, etc., is to be provided in a binder, in accordance with requirements of local authorities having jurisdiction.
- .3 Refrigerant piping and direct expansion refrigeration equipment must be installed by or under direct on site supervision of a licensed journeyman refrigeration mechanic.

2 Products

2.01 PIPE, FITTINGS, AND JOINTS

- .1 Type ACR hard drawn seamless copper refrigerant tubing to ASTM B280, factory degreased, dehydrated and capped or nitrogen filled and capped, complete with factory washed and bagged wrought copper soldering fittings to ASME B16.22, and brazed joints made with high melting point silver brazing alloy conforming to AWS Classification BcuP-5.

2.02 PIPING LINE SETS

- .1 Equal to Great Lakes Copper Inc. "EZ-Roll" soft annealed copper to ASTM B280, suitable for use with refrigerant involved, factory cleaned and capped, and with sizes and lengths as required.

2.03 GENERAL RE: VALVES AND PIPING SPECIALTIES

- .1 Refrigerant valves and piping specialties specified below are to factory cleaned, degreased, and supplied to site with capped ends.

2.04 SHUT-OFF VALVES

- .1 Ball Valves
 - .1 ¼ turn, CSA certified forged brass ball valves, each suitable for a maximum working pressure of 3445 kPa (500 psi) and complete with carbon filled Teflon ball seals, 2 O-ring stem seals, a gasketed seal cap, a flow direction arrow cast into body, a ball position indicator on stem, and extended copper tube connections to permit brazing the valve into line without disassembling valve.

- .2 Manufacturers:
 - .1 Mueller Industries Inc.;
 - .2 Sporlan Valve Co.;
 - .3 Superior Refrigeration Products/Sherwood.
- .2 Diaphragm Valves
 - .1 Forged brass, frost-proof, Type 1 Series, CSA certified packless diaphragm valves, each suitable for a 3445 kPa (500 psi) working pressure and complete with an O-ring to prevent moisture from entering diaphragm chamber, one phosphor bronze and 2 stainless steel diaphragms, and extended copper tube brazing connections.
 - .2 Manufacturers:
 - .1 Mueller Industries Inc.;
 - .2 Sporlan Valve Co.;
 - .3 Superior Refrigeration Products/Sherwood.

2.05 CHECK VALVES

- .1 Straight through type for valves 6.4 mm to 16 mm (¼" to 5/8") diameter, globe type for valves 22 mm (7/8") diameter and larger, each complete with extended tubing for brazing connections, and as follows:
 - .1 straight through type check valves complete with a machined brass gasketed body, phosphor bronze spring, and neoprene seat;
 - .2 globe type check valves complete with a cast bronze body, forged brass cap, phosphor bronze spring, Teflon seat disc, and neoprene O-ring seal.
- .2 Manufacturers:
 - .1 Mueller Industries Inc.;
 - .2 Sporlan Valve Co.;
 - .3 Superior Refrigeration Products/Sherwood.

2.06 PIPING TRAPS

- .1 Mueller Industries Inc. Style No. WE-554P brazing end copper "P" traps.
- .2 Manufacturers:
 - .1 Mueller Industries Inc.;
 - .2 Sporlan Valve Co.;
 - .3 Superior Refrigeration Products/Sherwood.

2.07 PRESSURE VESSEL RELIEF VALVES

- .1 Factory set pressure relief valves, straight through or angle type as required, each constructed in accordance with requirements of ANSI B9.1 and the ASME Code for Unfired Pressure Vessels, and each complete with a brass body, neoprene seat disc, and lead seal and locking wire.

- .2 Manufacturers:
 - .1 Mueller Industries Inc.;
 - .2 Sporlan Valve Co.;
 - .3 Superior Refrigeration Products/Sherwood.

2.08 REFRIGERANT LIQUID MOISTURE INDICATORS

- .1 Forged brass, triple sealed, CSA certified liquid moisture indicators, each suitable for a maximum working pressure of 3445 kPa (500 psi) and complete with a liquid indicator which shows "FULL" when system is fully charged with refrigerant and remains blank when there is a restriction or shortage of refrigerant in liquid line, a moisture indicator which changes colour from blue to pink when moisture is present in system, a plastic dust cover, and extended copper tube brazing connections.
- .2 Manufacturers:
 - .1 Mueller Industries Inc.;
 - .2 Sporlan Valve Co.;
 - .3 Superior Refrigeration Products/Sherwood.

2.09 LIQUID LINE FILTER-DRIER

- .1 Mueller Industries Inc. "Drymaster" CSA certified filter-driers, each suitable for a maximum 3445 kPa (500 psi) working pressure and complete with a combination of desiccants in a fluted briquette for drying, and a fluted briquette type filter.
- .2 Manufacturers:
 - .1 Mueller Industries Inc.;
 - .2 Sporlan Valve Co.;
 - .3 Superior Refrigeration Products/Sherwood.

2.10 FLEXIBLE PIPING CONNECTIONS

- .1 Senior Flexonics Canada "VIBRA-SORBERS" phosphor bronze construction, factory cleaned, dried, and sealed flexible piping connections with copper tube brazing ends.
- .2 Manufacturers:
 - .1 Senior Flexonics Canada;
 - .2 The Metraflex Co.

2.11 THERMOSTATIC EXPANSION VALVES

- .1 Factory tested, balanced port design thermostatic expansion valves, with exact selection to suit the application and refrigerant used, each complete within a replaceable stainless steel diaphragm and welded element construction thermostatic element charged with hydraulic fluid, and removable inlet strainer.
- .2 Manufacturers:
 - .1 Mueller Industries Inc.;

- .2 Sporlan Valve Co.;
- .3 Superior Refrigeration Products/Sherwood.

3 Execution

3.01 DEMOLITION

- .1 Perform required refrigerant piping system demolition work. Refer to demolition requirements specified in Section 20 05 05 – Selective Demolition for Mechanical.

3.02 INSTALLATION OF REFRIGERANT PIPING, VALVES AND SPECIALTIES

- .1 Provide required refrigerant piping. Piping is to be type ACR copper with wrought copper fittings. Install piping in accordance with requirements of reviewed refrigerant piping schematics referred to in Part 1 of this section.
- .2 Make refrigerant piping joints using a light coat of approved brazing flux applied to both pipe and fitting. Do not use acid flux. During brazing process, ensure pipe and fittings are kept full of nitrogen or carbon dioxide to prevent scale formation inside pipe and fitting.
- .3 Where shown or specified, use soft copper refrigerant piping line sets.
- .4 Provide shut-off valves to isolate each piece of equipment if shut-off valves are not supplied integral with equipment. Provide ball or diaphragm type shut-off valves inside building. Provide diaphragm shut-off valves outside building.
- .5 Provide a refrigerant charging valve for each system if such a valve is not supplied integral with equipment.
- .6 Provide refrigerant piping accessories shown and/or required and install in accordance with manufacturer's recommendations.
- .7 Provide required refrigerant.
- .8 Provide flexible connections at piping connections to roof mounted condensing units. Install in accordance with manufacturer's instructions.
- .9 Provide expansion valves where shown and/or required, each matched to coil and installed in accordance with manufacturer's instructions.

End of Section

1 General

1.01 SUBMITTALS

- .1 Submit shop drawings/product data sheets for all products specified in this section except shop fabricated ductwork and fittings.
- .2 Include capacity, throw and terminal velocity, noise criteria, and pressure drops with grille and diffuser shop drawing/product data sheet submission.
- .3 With shop drawing/product data sheet submission, supply evidence that fire rated duct manufacturer is ULC listed to size requirements shows on drawings.
- .4 Submit duct leakage test data prior to ductwork being covered from view.
- .5 Submit manufacturer's colour chart(s) for all items for which a finish colour is to be selected.

1.02 CLOSEOUT SUBMITTALS

- .1 Submit proper installation certification from fire rated duct manufacturer as specified in Part 3 of this section.
- .2 Submit a site inspection and start-up report from fan filter diffuser manufacturer's representative as specified in Part 3 of this section.

1.03 MAINTENANCE MATERIAL SUBMITTALS

- .1 Supply and hand to Owner at Substantial Performance of the Work, a minimum of 10 identified (with tags) grille/diffuser volume control damper adjustment keys.

1.04 COORDINATION

- .1 Supply reviewed copies of ventilator/curb assembly shop drawings or product data sheets to trade who will cut roof openings for ventilators, and ensure openings are properly sized and located.

1.05 QUALITY ASSURANCE

- .1 Grilles and diffusers are to be tested and performance certified to ANSI/ASHRAE 70, Method of Testing the Performance of Air Outlets and Air Inlets.

2 Products

2.01 GALVANIZED STEEL DUCTWORK

- .1 Galvanized steel sheet is to be hot dipped in accordance with requirements of ASTM A653. G60 galvanizing for bare uncovered duct to be finish painted. G90 for all other galvanizing.
- .2 Rectangular
 - .1 Lock forming grade hot dip galvanized steel, ASTM A653, shop fabricated, minimum #26 gauge.
- .3 Round
 - .1 Factory machine fabricated, spiral, mechanically locked flat seam, single wall duct, fittings and couplings.
- .4 Flat Oval
 - .1 Factory machine fabricated, single wall, 4-ply spiral lock seam duct, fittings and couplings.

2.02 FLEXIBLE METALLIC DUCTWORK

- .1 Bare
 - .1 Spirally wound, semi-rigid, self-supporting corrugated aluminum duct with continuous triple lock seams, SMACNA Form "M-UN", CAN/ULC-S110 listed and labelled as a Class 1 Air Duct, constructed of dead soft aluminum strip, and supplied in 3 m (10') lengths.
- .2 Insulated
 - .1 Spirally wound, semi-rigid, self-supporting corrugated aluminum duct with continuous triple lock seams, SMACNA Form "M-I", CAN/ULC-S110 listed and labelled as a Class 1 Air Duct, constructed of dead soft aluminum strip, supplied in 3 m (10') lengths and factory covered with 40 mm (1-½") thick, 12 kg/m³ (0.75 lb/ft³) density fibreglass insulation with a vinyl jacket meeting 25/50 flame spread and smoke developed requirements tested in accordance with CAN/ULC S102.

2.03 FLEXIBLE CONNECTION MATERIAL

- .1 Waterproof, indoor-outdoor type flexible connection material meeting requirements of NFPA 90A, consisting of woven glass fibre fabric coated on both sides with synthetic rubber.
- .2 Manufacturers:
 - .1 Duro Dyne Canada Inc. "DUROLON";
 - .2 Dyn Air Inc. "HYPALON".
- .3 Waterproof, flameproof, high temperature flexible connection material meeting requirements of NFPA 90A, consisting of a woven glass fibre fabric coated on both sides with silicone rubber.
- .4 Manufacturers:
 - .1 Duro-Dyne Canada Inc. "THERMAFAB";
 - .2 Dyn Air Inc. "SILICON HI-T".

2.04 METAL DUCT SYSTEM JOINT SEALANT

- .1 ULC listed and labelled, premium grade, grey colour, water base, non-flammable duct sealer, brush, or gun applied, with a CAN/ULC S102 tested maximum flame spread rating of 5 and smoke developed rating of 0.
- .2 Manufacturers:
 - .1 Johns Manville;
 - .2 Manson Insulation;
 - .3 Knauf Insulation.

2.05 ACOUSTIC LINING

- .1 Minimum 25 mm (1") thick acoustic lining material meeting 25/50 flame spread and smoke developed ratings tested in accordance with CAN/ULC S102, meeting NFPA 90A, ASTM C1071, and ASTM G21 requirements, not supporting microbial growth, flexible for round ducts, board type for rectangular ducts, consisting of a bonded fiberglass mat coated on inside (airside) face with a black fire-resistant coating.
- .2 Manufacturers:

- .1 Johns Manville;
- .2 Manson Insulation;
- .3 Knauf Insulation.

2.06 CASING AND PLENUM MATERIAL AND ACCESSORIES

- .1 Unless otherwise specified, casing and plenum material is to be same as connecting duct material.
- .2 Accessories such as access doors and drain pans are to be constructed of same material as casing and plenum and are to be in accordance with Chapter 6 of SMACNA HVAC Duct Construction Standards Metal and Flexible.

2.07 ACOUSTIC PLENUM PANELS

- .1 Vibro-Acoustics Ltd. type "AP", 100 mm (4") thick panels with acoustic media meeting NFPA 90A requirements sandwiched between minimum #24 gauge galvanized sheet steel, with airside face perforated, access doors where shown, and with acoustic performance as follows:

Octave Bands, (Hz)	125	250	500	1000	2000	4000
Transmission Loss	21	28	39	50	53	56
Absorption Coefficient	0.7	0.9	.99	.99	0.9	0.9

- .2 Acoustic plenum media factory encapsulated in sealed DuPont "Tedlar" polyvinyl fluoride film to ensure no media enters the airstream.
- .3 Manufacturers:
 - .1 Vibro-Acoustics Ltd.;
 - .2 Kinetics Noise Control Inc.;
 - .3 Carrier Corp. – Racan;
 - .4 Haakon Industries;
 - .5 Price Industries Inc.

2.08 PLENUM ACCESS DOORS

- .1 Factory fabricated, double wall insulated access doors, sized as indicated on drawings, and constructed of same material as connecting ductwork in accordance with ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible to suit operating pressure of the system.

2.09 ROUND TO RECTANGULAR DUCT CONNECTIONS

- .1 Equal to Flexmaster Canada Ltd. galvanized steel, flared, flanged or notched "Spin-On" round duct take-off collars with locking dampers in accordance with ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible.

2.10 SPLITTER DAMPERS

- .1 Minimum #20 gauge damper blade constructed of same material as duct, reinforced as required to suit blade size, system velocity, and to prevent "chatter", and complete with operating hardware equal to DynAir Inc. #Q-50 "DYN-A-QUAD S-S" quadrant regulator with RW-50 backup washers to prevent leakage, long square bearing pin, and slide pin.

2.11 AIR TURNING VANES

- .1 For square elbows, multiple-radius turning vanes interconnected with bars, adequately reinforced to suit pressure and velocity of system, constructed of same material as duct they are associated with, and in accordance with ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible.
- .2 For short branch ducts at grille and diffuser connections, air extractor type each equipped with a matching bottom operated 90° opposed blade volume control damper, constructed of same material as duct it is associated with and in accordance with requirements and details in ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible.

2.12 MANUAL BALANCING (VOLUME) DAMPERS

- .1 Flanged and drilled, single or parallel blade (depending on damper size) manual balancing dampers, each constructed of same material as connecting ductwork unless otherwise specified, each designed to maintain internal free area of connecting duct, and each complete with:
 - .1 hexagonal or square shaft extension through frame;
 - .2 non-stick, non-corrosive synthetic bearings for rectangular dampers, flange stainless steel bearings for round dampers;
 - .3 blade stops for single blade dampers, designed to prevent blade from moving more than 90°;
 - .4 linkage for multiple blade dampers;
 - .5 locking hand quadrant damper operator with, for insulated ducts 50 mm (2") standoff mounting.
- .2 Rectangular Dampers: Nailor Industries Inc. 1800 Series, maximum size 1.2 m x 1.2 m (4' x 4') for a single damper.
- .3 Round Dampers: Nailor Industries Inc. Model 1890, maximum 600 mm (24") diameter, equipped with a minimum 200 mm (8") deep frame, and blade stiffeners where required.
- .4 Multiple Rectangular Damper Section Assembly: Rectangular assembly supplied with the dampers or site constructed, of same material as damper and designed for tight and secure mounting of individual dampers.
- .5 Manufacturers:
 - .1 Nailor Industries Inc.;
 - .2 T.A. Morrison & Co. Inc. "TAMCO";
 - .3 NCA Manufacturing Ltd.;
 - .4 Greenheck Fan Corp.;
 - .5 Ruskin Co.

2.13 BACKDRAFT DAMPERS

- .1 Nailor Industries Model 1370CB counterbalanced backdraft dampers, vertical or horizontal mounting, 50 mm (2") wide, sized as shown and complete with:
 - .1 extruded 6063-T5 aluminum frame, 2.3 mm (0.090") nominal wall thickness, with mitred corners;
 - .2 extruded 6063-T5 aluminum blades, 1.3 mm (0.050") nominal wall thickness on 92 mm (3-5/8") centres, and with extruded PVC blade seals;

- .3 corrosion-resistant synthetic bearings;
 - .4 adjustable plated steel counterweights mounted internally in the airstream;
 - .5 concealed blade linkage located out of the airstream.
- .2 Manufacturers:
- .1 Nailor Industries Inc.;
 - .2 T.A. Morrison & Co. Inc. "TAMCO";
 - .3 NCA Manufacturing Ltd.;
 - .4 Greenheck Fan Corp.;
 - .5 Ruskin Co.

2.14 FUSIBLE LINK DAMPERS

- .1 Curtain blade type, dynamic, galvanized steel (unless otherwise specified) fusible link dampers, ULC classified to CAN/ULC S112 and in accordance with NFPA 90A requirements, factory tested for closure under airflow, 1-1/2 hour or 3 hour rated as required, and complete with a constant force type 301 stainless steel closure spring, a blade lock assembly, a steel sleeve, retaining angles, and, unless otherwise specified, a 74°C (165°F) rated standard fusible link.
- .2 Fusible link dampers are to be Type "B" or Type "C" (as required) with folded curtain blade out of air stream except where damper size or location requires use of type "A" dampers with curtain blade in air stream.
- .3 Dampers in ductwork other than galvanized steel are to be as specified above but constructed of type 316 stainless steel.
- .4 Manufacturers:
 - .1 Nailor Industries Inc.;
 - .2 Greenheck Fan Corp.;
 - .3 NCA Manufacturing Ltd.;
 - .4 Ruskin Co.;
 - .5 Price Industries (E.H. Price).

2.15 COMBINATION FIRE/SMOKE DAMPERS

- .1 Nailor Industries Series 1221, ULC listed to CAN/ULC S112 and CAN/ULC S112.1, meeting requirements of NFPA 80, 90A, 92, 101 and 105, consisting of type A, B, or C fusible link fire dampers as required and a fail-safe, opposed blade, normally closed, motor operated smoke damper complete with factory installed and tested 120 V electric actuator.
- .2 ULC 1-1/2 hour fire rated and ULC Class I leakage rated for smoke, and equipped with a 74°C (165°F) ULC classified fusible link that will cause damper to close and lock independent of actuator when duct temperature reaches maximum temperature of damper assembly.
- .3 Supply damper with factory installed sleeves of minimum 400 mm (16") length, field verified by contractor dependent on wall thickness. Caulk sleeves to ULC requirements and constructed of 20 gauge for sizes up to 2.1 m (84") wide and 18 gauge for sizes greater than 2.1 m (84") wide.

- .4 Dampers in ductwork other than galvanized steel are to be as specified above but constructed of type 316 stainless steel.
- .5 Manufacturers:
 - .1 Nailor Industries Inc.;
 - .2 Greenheck Fan Corp.;
 - .3 NCA Manufacturing Ltd.;
 - .4 Ruskin Co.;
 - .5 Price Industries (E.H. Price).

2.16 SMOKE DAMPERS

- .1 Multi-blade type, fail-safe, dynamic, galvanized steel (unless otherwise specified) smoke dampers, ULC classified to CAN/ULC S112.1, ULC Class I leakage rated for smoke, meeting requirements of NFPA 90A, 92, 101 and 105, normally closed, low pressure drop design, dynamically tested, each complete with jamb and blade seals, linkage concealed in the frame, a steel sleeve to suit the opening, and an electric actuator to automatically close damper upon receiving an external signal, and to automatically open damper when system is reset.
- .2 Dampers in ductwork other than galvanized steel are to be as specified above but constructed of type 316 stainless steel.
- .3 Manufacturers:
 - .1 Nailor Industries Inc.;
 - .2 Greenheck Fan Corp.;
 - .3 NCA Manufacturing Ltd.;
 - .4 Ruskin Co.;
 - .5 Price Industries (E.H Price).

2.17 ROOF DUCT SUPPORTS

- .1 Equal to PHP Systems Design Model PHP-D adjustable duct support assemblies sized to suit duct size, each assembly complete with injection moulded recycled plastic and carbon black bases and tubular hot dip galvanized steel framing.

2.18 DUCT ACCESS DOORS

- .1 In accordance with ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible, with sizes suitable in all respects for purpose for which they are provided, and, unless otherwise specified, constructed of same material as duct they are associated with.

2.19 DUCTWORK DRAIN POINTS

- .1 Equal to Ductmate Canada Ltd. "Moisture Drain", 20 mm (¾") diameter moisture drains with galvanized sheet metal funnel, and chrome plated brass threaded drain, nut and cap.

2.20 INSTRUMENT TEST PORTS

- .1 Equal to Duro-Dyne of Canada Ltd. #IP1 or #IP2 (to suit insulation thickness where applicable) gasketed, leakproof instrument test ports for round or rectangular ducts as required, each complete with a neoprene expansion plug and a plug securing chain.

2.21 WIRE MESH (BIRDSCREEN)

- .1 Heavy-gauge galvanized steel or aluminum mesh, 12 mm x 12 mm (½" x ½") secured in a rigid galvanized steel or aluminum framework, sized as indicated on drawings, and constructed so as to be removable.

2.22 LOUVRES

- .1 Price Industries Inc. DE439 or DE635, 100 mm (4") or 150 mm (6") deep (to suit wall thickness) factory assembled stationary, drainable, louvres sized as indicated on drawings, each AMCA water penetration and air performance certified, constructed of welded, extruded, alloy 6063-T5 aluminum with drainable blades, mounting and securing hardware to suit the application, and 12 mm (½") mesh aluminum birdscreen in an aluminum frame.
- .2 Acoustical Louvres: Price Industries Inc. Model QA1245 300 mm (12") deep, welded, extruded alloy 3003-H14 aluminum, storm-proof, stationary, drainable acoustical louvers, AMCA water penetration and air performance certified, with high density mineral wool acoustic media secured to blades and protected by perforated aluminum, sound ratings in accordance with ASTM E90 and ASTM E413, and mounting and securing facilities as required.
- .3 Louvres are to be factory finished with a finish equal to PPG Industries "Duramar" fluoropolymer powder coating over primer with colour as selected from manufacturer's standard colour range.
- .4 Manufacturers:
 - .1 Price Industries Inc.;
 - .2 The Airolite Co. LLC;
 - .3 Construction Specialities;
 - .4 Nailor Industries Inc.;
 - .5 Kinetics Noise Control Inc.
 - .6 Greenheck Fan Corp.

2.23 LOUVRE BLANK-OFF PANELS

- .1 Insulated, framed, sandwich construction panels consisting of 40 mm (1-½") thick rigid insulation (meeting NFPA 90A requirements) between minimum #20 gauge galvanized sheet steel with exterior face of panels finished to match finish of exterior wall louvres.

2.24 BRICK AND BLOCK VENTS

- .1 Equal to Price Industries Inc. vents constructed of 6063-T5 alloy extruded aluminum, sized as shown, complete with stainless steel fasteners, aluminum rod vertical supports on minimum 300 mm (12") centres, #2 mesh fixed aluminum screen, and all required accessories to suit the application.
- .2 Vent(s) to be factory finished with a finish equal to a baked "Kynar 500-XL" colour coat and a clear coat over cleaned and primed metal with colour as selected from manufacturer's standard colour range.

2.25 FIRE STOP FLAPS AND THERMAL BLANKET MATERIAL

- .1 Rectangular or round, ULC listed and labelled, blade type galvanized steel fire stop flaps in accordance with CAN/ULC S112, Standard Methods of Fire Test of Fire-Damper Assemblies and CAN/ULC S112.2, Standard Method of Fire Test of Ceiling Firestop Flap Assemblies, each complete with #22 gauge G60 galvanized steel blade(s) and frame, a 74°C (165°F) fusible link, and, for dampers 300 mm (12") and larger, ceramic fibre insulation on both sides of the blades.
- .2 Ceramic fibre material in accordance with 25/50 flame spread/smoke developed ratings when tested to CAN/ULC S102 and of a thickness to suit required fire rating.

2.26 GRILLES AND DIFFUSERS

- .1 Grilles and diffusers of type, size, capacity, finish, and arrangement as shown on drawings and in accordance with drawing schedule, each equipped with all required mounting and connection accessories to suit mounting location and application.
- .2 Manufacturers:
 - .1 Price Industries Inc.;
 - .2 Anemostat;
 - .3 Krueger Division of Air System Components Inc.;
 - .4 Titus;
 - .5 Nailor Industries Inc.;
 - .6 Tuttle & Bailey.

2.27 FAN FILTER DIFFUSERS

- .1 Factory assembled and leakage tested, suspended ceiling mount, modular assemblies, each ULC and CSA or ETL certified and labelled, consisting of a fan-motor and HEPA filter enclosed in a metal plenum, designed for unidirectional vertical flow of filtered air over a cleanroom space. Sound performance of each is not to exceed 50 dBA measured 765 mm (30") from filter face at 0.5 m/s (90 FPM). Units are to be in accordance with the Institute of Environmental Services and Technology Recommended Practices IEST RP CCOO1, HEPA and ULPA Filters, and IEST RP CCOO2, Unidirectional-Flow, Clean-Air Devices. Each unit is to be equipped with:
 - .1 plenum and face frame: airtight low profile design, constructed of type 304 stainless steel with aluminum interior parts including an extruded aluminum filter frame with air by-pass seal, an inlet duct connection collar, sound insulation meeting 25/50 flame spread/smoke developed ratings when tested to CAN/ULC S102, a static pressure port, eyebolts at each corner;
 - .2 fan and motor: removable, consisting of a blower wheel encased in a strategically shaped enclosure a direct connected to a vibration isolated 1/3 HP ECM brushless DC motor with permanent built-in inverter programmed for constant volume airflow and equipped with a 2.4 m (8') length of power cord with plug;
 - .3 filter: HEPA ultra low penetration air (ULPA) filters, 99.9995% efficient on 0.12 µm micron particles, latched into fan plenum and protected by a perforated screen attached with quarter-turn thumb-wheel fasteners, and room side replaceable;
 - .4 diffuser face: perforated, laminar flow face constructed of aluminum with quarter-turn fasteners for removal and access to fan-motor and filter;

- .5 mounting gasket: roll type gasket material supplied with units for site installation on T-bar ceiling members;
- .6 factory secured seismic restraint connection hardware.

2.28 ROUND LOW SILHOUETTE ROOF MOUNTED VENTILATORS

- .1 Spun aluminium, round, gravity roof mounting hoods in accordance with drawing schedule, each complete with:
 - .1 wind band with a rolled bead, and curb cap with one-piece, spun, deep venturi inlet, and pre-punched holes for mounting;
 - .2 galvanized steel bird screen;
 - .3 minimum 300 mm (12") high welded aluminium, insulated roof mounting curb with damper tray;
 - .4 aluminium backdraft damper supplied loose, for site installation in roof curb damper tray;
 - .5 non-corrosive motorized damper supplied loose for site installation in roof curb damper tray, equal to T. A. Morrison TAMCO Series 9000 insulated damper with linkage, end switch, and a Belimo or equal motor with voltage to suit control voltage requirements;
 - .6 factory secured seismic restraint connection hardware.
- .2 Manufacturers:
 - .1 Greenheck Fan Corp.;
 - .2 PennBarry;
 - .3 Twin City Fan and Blower.

2.29 LOUVRED PENTHOUSE TYPE VENTILATORS

- .1 Low silhouette, rectangular, roof mounting louvred penthouse type hoods in accordance with drawing schedule, each constructed of aluminium, supplied in knock-down form for site assembly, and each complete with:
 - .1 extruded aluminium, welded storm-proof louver blades with mitred corners and stainless steel securing screws;
 - .2 removable cover for internal access, lined with glass fibre insulation material and equipped with stainless steel fasteners;
 - .3 12 mm x 12 mm (½" x ½") aluminium mesh birdscreen;
 - .4 welded aluminium, minimum 300 mm (12") high insulated roof mounting curb with damper tray and curb seal;
 - .5 aluminium backdraft damper supplied loose, for site installation in roof curb damper tray;
 - .6 non-corrosive motorized damper supplied loose for site installation in roof curb damper tray, equal to T. A. Morrison TAMCO Series 9000 insulated damper with linkage, end switch, and a Belimo or equal motor with voltage to suit site control voltage requirements;
 - .7 factory secured seismic restraint connection hardware.
- .2 Manufacturers:

- .1 Greenheck Fan Corp.;
- .2 Twin City Fan and Blower;
- .3 PennBarry.

2.30 HOODED TYPE VENTILATORS

- .1 Low silhouette, rectangular, roof mounting hooded penthouse type ventilators in accordance with drawing schedule, each constructed of aluminium, supplied in knock-down form for site assembly, and each complete with:
 - .1 full 360° perimeter hood opening;
 - .2 12 mm x 12 mm (½" x ½") aluminium mesh bird screen;
 - .3 welded aluminium, minimum 300 mm (12") high insulated roof mounting curb with damper tray and curb seal;
 - .4 aluminium backdraft damper supplied loose for site installation in roof curb damper tray;
 - .5 non-corrosive motorized damper supplied loose for site installation in roof curb damper tray, equal to T. A. Morrison TAMCO Series 9000 insulated damper with linkage, end switch, and a Belimo or equal motor with voltage to suit site control voltage requirements;
 - .6 factory secured seismic restraint connection hardware.
- .2 Manufacturers:
 - .1 Greenheck Fan Corp.;
 - .2 Twin City Fan and Blower;
 - .3 PennBarry.

3 Execution

3.01 CLEANLINESS REQUIREMENTS FOR HANDLING AND INSTALLATION OF DUCTWORK

- .1 Handle and install ductwork in accordance with CSA Z317.2, Special Requirements for Heating, Ventilation, and Air-Conditioning (HVAC) Systems in Healthcare Facilities and SMACNA's Duct Cleanliness for New Construction Guidelines at the Advanced Level.
- .2 Handle and install ductwork in accordance with SMACNA's Duct Cleanliness for New Construction Guidelines at the Advanced Level.

3.02 FABRICATION AND INSTALLATION OF GALVANIZED STEEL DUCTWORK

- .1 Provide required ductwork, rectangular, round and/or flat oval. Where rectangular ductwork is shown, round or flat oval ductwork of equivalent cross-sectional area is acceptable.
- .2 It is to be understood that all duct dimensions shown on drawings are clear internal dimensions.
- .3 Unless otherwise specified, construct and install ductwork in accordance with ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible to suit duct pressure class designation of minimum 500 Pa (2" w.c.) positive or negative as applicable, a minimum velocity of 10 m/s (2000 fpm), and so ductwork does not "drum". Flat surfaces of rectangular ductwork are to be cross-broken. Duct system sealing is to meet ANSI/SMACNA Seal Class A requirements.

- .4 Variable air volume ductwork from supply fans to boxes is as above but rectangular duct take-offs are double side straight taper type with a take-off length equal to 0.5 times the branch duct width but minimum 150 mm (6") length, and double taper side is to have an included angle of minimum 60°.
- .5 Confirm routing of all ductwork at site and site measure ductwork prior to fabrication. Duct dimensions may be revised to suit site routing and building element requirements, if dimension revisions are reviewed with and approved by Consultant. Duct routing and/or dimension revisions to suit conditions at site are not grounds for a claim for an extra cost.
- .6 Refer to structural drawings. Where ductwork is to be run within or through open web steel joists, ductwork shown on mechanical drawings is schematic only and is to be altered as required to suit steel joist configuration, spacing, panel points, and cross-bridging at no additional cost.
- .7 Wherever ductwork is required at locations where sprayed fireproofing is applied to building construction, install ductwork only after fireproofing work is complete and do not compromise fire rating of sprayed fireproofing.
- .8 Install (but do not connect) duct system mounted automatic control components supplied as part of the automatic control work.
- .9 Where indicated, provide duct connections to fan powered heat transfer equipment with integral coils.
- .10 Flange connect ductwork to hot water reheat coils in accordance with requirements of ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible. Coils will be suspended independent of connecting ductwork as part of the heat transfer work.
- .11 Support horizontal rectangular ducts inside building in accordance with ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible, but use trapeze hangers with, unless otherwise specified, galvanized steel channels, and galvanized steel hanger rods for exposed ducts and concealed ducts wider than 500 mm (20"). Support hardware constructed of same material as duct for metal duct, and, unless otherwise specified, type 316 stainless steel for non-metal duct. Supports for "heavy" duct such as cementitious core duct is to be suitable in all respects for the application and approved by Consultant.
- .12 Support round and flat oval ducts inside building in accordance with ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible, but, unless otherwise specified, for both uninsulated and insulated ducts exposed in finished areas, use bands and secure at top of duct to a hanger rod, all similar to Ductmate Canada Ltd. type "BA". If duct is insulated, size strap to suit diameter of insulated duct. Unless otherwise specified, duct support hardware for metal duct is constructed of same material as duct, and for non-metal duct, type 316 stainless steel.
- .13 Where flanged duct joints are used, do not locate joints in wall or slab openings, or immediately at wall or slab openings. Do not use flanged joints for exposed uninsulated ducts in finished areas.
- .14 Where watertight horizontal ductwork is required, construct ducts without bottom longitudinal seams. Solder or weld joints of bottom and side sheets. Seal all other joints with duct sealer. Slope horizontal duct to hoods, risers, or drain points. Provide drain points. Provide watertight ductwork for:
 - .1 ductwork outside building or otherwise exposed to the elements;
 - .2 dishwasher exhaust;
 - .3 shower exhaust ducts from grilles to duct main or riser;
 - .4 minimum of 3 m (10') upstream and downstream of duct mounted humidifiers or humidifier manifolds;
 - .5 fresh air intakes;

- .6 wherever else shown.
- .15 Leakage Testing:
 - .1 Ductwork leakage is not to exceed following:
 - .1 ductwork to 2" W.C. Class, 1% of total air quantity handled by respective fans;
 - .2 ductwork exceeding 2" W.C. Class, 2% of total air quantity handled by respective fans.
 - .2 Leakage testing is to be performed by the Testing, Adjusting and Balancing (TAB) agency in accordance with SMACNA HVAC Air Duct Leakage Test Manual and is to be witnessed by Consultant.
 - .3 Be responsible for following:
 - .1 preparing duct systems for leakage testing prior to installation of external insulation including capping duct runouts and provision of final tap-in for test equipment;
 - .2 schedule testing with TAB agency in advance, be present for all testing and ensure notice is given to Consultant so they may witness testing;
 - .3 resealing and/or replacement of defective ductwork;
 - .4 bearing all costs associated with retesting ductwork which has failed to pass leakage testing.
- .16 Seal all ductwork in accordance with SMACNA Seal Class "A", except for round duct with self-sealing gasketed fittings and couplings which does not require site applied sealant. Apply sealants by brush or gun to cleaned metal surfaces. Where bare ductwork is exposed apply neat uniform lines of sealant. Randomly brushed, sloppy looking sealant applications will be rejected and must be repaired or replaced with a neat application of sealant.
- .17 Apply sealants by brush or gun to cleaned metal surfaces. Where bare ductwork is exposed apply neat uniform lines of sealant. Randomly brushed, sloppy looking sealant applications will be rejected and must be repaired or replaced with a neat application of sealant.
- .18 Clean exterior exposed (uninsulated) ducts and coat with a heavy full coverage of Bakor #410-02 black metal paint.
- .19 Where dissimilar metal ducts are to be connected, isolate ducts by means of flexible duct connection material.
- .20 Round exposed ductwork in Gymnasium is to be 2 metal gauges heavier than standard metal gauge for same size duct, and duct hangers are to be pairs of 9.5 mm ($\frac{3}{8}$ ") diameter hanger rods secured to 40 mm (1- $\frac{1}{2}$ ") wide #12 gauge galvanized steel split clamps around full circumference of duct at maximum 1.8 m (72") centres. Provide double nuts and lock washers on each hanger rod above and below each clamp.
- .21 Equip ducts with a dimension of 600 mm (24") and larger and located in mechanical equipment rooms of any kind with hanger rods equipped with double deflection neoprene rod isolation hangers properly sized for associated load. Also refer to Section 20 05 48.16 - Seismic Controls for Mechanical Systems.
- .22 In addition to SMACNA duct construction standards specified above, ductwork is to be constructed and installed to meet seismic requirements of British Columbia Building Code and ANSI/SMACNA The Seismic Restraint Manual: Guidelines for Mechanical Systems.

3.03 INSTALLATION OF FLEXIBLE DUCTWORK

- .1 Provide maximum 3 m (10') long lengths of flexible ductwork for connections between galvanized steel duct mains and branches, and necks of ceiling grilles and diffusers. Do not install flexible ductwork through walls, even if shown on drawings.
- .2 At rectangular galvanized steel duct, accurately cut holes and provide flanged or "Spin-in" round flexible duct connection collars. Seal joints with duct sealer.
- .3 Install flexible ducts as straight as possible and support in accordance with requirements of ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible, and secure at each end with nylon or stainless steel gear type clamps, and seal joints. Provide long radius duct bends where they are required.
- .4 Do not penetrate fire barriers with flexible duct.

3.04 INSTALLATION OF ACOUSTIC LINING

- .1 Provide acoustic lining in ductwork in locations as follows:
 - .1 wherever shown and/or specified on drawings;
 - .2 supply ductwork downstream of air terminal boxes for a distance of 2.4 m (8') measured along duct and outward from box in all directions;
 - .3 all transfer air ducts.
- .2 Install lining in accordance with requirements of ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible, however, for all installations regardless of velocity, at leading and trailing edges of duct liner sections, provide galvanized steel nosing channel in accordance with detail entitled Flexible Duct Liner Installation found in the ANSI/SMACNA manual referred to above.

3.05 INSTALLATION OF CASINGS AND PLENUMS

- .1 Provide required shop or site fabricated casings and plenums. Unless otherwise specified or shown, construct casings and plenums of same material as connecting duct system.
- .2 Construct and install casings and plenums in accordance with Chapter 6 of ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible to suit systems' pressure classification. Ensure plenums and casings secured to building structure are gasketed air-tight and equipped with angle reinforcing.
- .3 Provide drain pans with accessible trapped drains for fresh air intake plenums, and wherever else shown.
- .4 In addition to SMACNA duct construction standards specified above, casings and plenums are to be constructed and installed to meet seismic requirements of British Columbia Building Code and ANSI/SMACNA - The Seismic Restraint Manual: Guidelines for Mechanical Systems.

3.06 INSTALLATION OF ACOUSTIC PANELS

- .1 Provide acoustic panels for plenums. Integrate acoustic plenums with standard casings and plenums. Install acoustic panels in strict accordance with manufacturer's instructions. Seal panels with acoustic caulking where pipes, ducts or conduit penetrate and make air and watertight.
- .2 Provide floor to ceiling high acoustic plenums where shown, each complete with required framing, including framing for access doors and other openings, each structurally designed to resist excessive deflection or bowing, constructed to be air-tight when subjected to a pressure differential of 2.48 kPa (0.36 psi), and designed so any one panel can be removed without dismantling entire plenum.

- .3 Provide acoustic type access doors where shown, and provide acoustic caulking at all locations where acoustic plenums abutt building walls or slabs, and at all points where pipe, ducts or conduit penetrate acoustic panels.
- .4 In addition to SMACNA duct construction standards specified above, acoustic plenums are to be constructed and installed to meet seismic requirements of British Columbia Building Code and ANSI/SMACNA, The Seismic Restraint Manual: Guidelines for Mechanical Systems.

3.07 INSTALLATION OF CASING AND PLENUM ACCESS DOORS

- .1 Provide access doors into all site or shop fabricated casings and plenums requiring access, and wherever shown.
- .2 Construct access doors to open in or out to suit positive and negative pressures of system.
- .3 Provide pitot tube openings in access doors where required for system air quantity balancing purposes.
- .4 Provide suitably sized, engraved, red-white laminated Lamacoid warning nameplates on access doors into casings and plenums where equipment is located, i.e. fans.

3.08 INSTALLATION OF ROUND TO RECTANGULAR DUCT CONNECTIONS

- .1 Cut round holes in rectangular ducts and provide round to rectangular lock-in fittings with dampers for connection of flexible round ductwork.

3.09 INSTALLATION OF SPLITTER DAMPERS

- .1 Provide splitter dampers in supply ductwork at branch duct connections off supply air mains, and wherever else shown and/or specified on drawings. Install splitter dampers so they cannot vibrate and rattle and so damper operation mechanisms are in an easily accessible and operable location. Ensure operators for dampers in insulated ducts are equipped with stand-off mounting brackets.

3.10 INSTALLATION OF TURNING VANES

- .1 Provide turning vanes in ductwork elbows where shown on drawings and wherever else required where, due to site installation routing and duct elbow radius, turning vanes are recommended in accordance with ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible.
- .2 Provide volume extractor type turning vanes in short branch supply duct connections off mains to grilles and diffusers where shown and/or specified.

3.11 INSTALLATION OF MANUAL BALANCING (VOLUME) DAMPERS

- .1 Provide manual balancing dampers as required to provide a fully balanced system, including but not limited to in all open end ductwork, in all duct mains, and wherever else shown and/or specified.
- .2 Install dampers so operating mechanism is accessible and positioned for easy operation, and so dampers cannot move or rattle. Ensure operating mechanisms for dampers in insulated ducts are complete with stand-off mounting brackets.
- .3 Where a duct for which a balancing damper is required has dimensions larger than dimensions of maximum size volume damper available, provide multiple dampers bolted together in a properly sized assembly, or bolted to a heavy-gauge black structural steel angle or channel framework which is properly sized. Seal to prevent air by-pass, and provide connecting linkage.
- .4 Confirm exact damper locations with personnel doing air quantity balancing testing work and install dampers to suit. Include for providing 5 additional dampers at no additional cost.

3.12 INSTALLATION OF BACKDRAFT DAMPERS

- .1 Provide backdraft dampers.
- .2 Install and secure dampers so they cannot move or rattle.

3.13 INSTALLATION OF FUSIBLE LINK DAMPERS

- .1 Provide fusible link dampers. Ensure damper rating (1-½ or 3 hr.) is suitable for fire barrier it is associated with.
- .2 Install dampers with retaining angles on all 4 sides of sleeve on both sides of damper and connect with ductwork in accordance with damper manufacturer's instructions and details, and Code requirements.
- .3 Provide expansion clearance between damper or damper sleeve and opening in which damper is required. Ensure openings are properly sized and located, and all voids between damper sleeve and opening are properly sealed to maintain rating of fire barrier.
- .4 Where size of fire barrier opening requires use of a sectionalized fire damper assembly, provide multiple fusible link dampers (sized to CAN/ULC S112) bolted together in a properly sized assembly or bolted to a heavy-gauge black structural steel angle or channel framework.

3.14 INSTALLATION OF COMBINATION FIRE/SMOKE DAMPERS

- .1 Provide combination fire/smoke dampers. Install dampers with retaining angles on all 4 sides of each side of damper, and, where required, connect with ductwork, all in accordance with damper manufacturer's instructions and details, and Code requirements.
- .2 Coordinate damper installation with electrical work where electrical connections to damper actuators are specified.

3.15 INSTALLATION OF SMOKE DAMPERS

- .1 Provide smoke dampers. Install dampers with retaining angles on all 4 sides of sleeve on both sides of damper and connect with ductwork in accordance with damper manufacturer's instructions and details, and Code requirements.
- .2 Coordinate damper installation with electrical work where electrical connections to damper actuators are specified.
- .3 Where size of fire barrier opening requires use of a sectionalized fire damper assembly, provide multiple smoke dampers (sized to CAN/ULC S112) bolted together in a properly sized assembly or bolted to a heavy-gauge black structural steel angle or channel framework.

3.16 INSTALLATION OF FLEXIBLE CONNECTION MATERIAL

- .1 Provide a minimum of 100 mm (4") of flexible connection material where ducts, plenums, and/or easings connect to fans, and wherever else shown or specified.
- .2 Rigidly secure a minimum of 75 mm (3") of duct material (minimum #24 gauge) to each edge of flexible fabric and to fan, duct, plenum, etc., in accordance with ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible. Ensure connections to flexible fabric material are arranged and supported so as to not impose any external forces on the fabric.

3.17 INSTALLATION OF ROOF MOUNTED DUCT SUPPORTS

- .1 Supply supports for roof mounted ductwork.
- .2 Hand adjustable structural supports to roofing trade on roof for installation and flashing into roof construction as part of roofing work. Accurately mark exact locations and spacing of structural supports

and supervise installation. Provide properly sized hot dip galvanized structural steel angles between structural supports and secure in place on support studs. Support ductwork on the angles and provide galvanized steel banding to secure ducts to the angles.

- .3 Accurately mark location and spacing of roof support assemblies. At each plastic base location, carefully scrape away loose roof ballast (gravel) and all other debris and dirt. Prime existing membrane with a primer which is compatible with existing roofing components. Set bases in adhesive in accordance with manufacturer's installation instructions. Scrape loose ballast back around and on bases. Install framing, and install ductwork on the cross-members. Secure ductwork to cross-members with galvanized steel banding.

3.18 INSTALLATION OF DUCT ACCESS DOORS

- .1 Provide access doors in ductwork for access to all components which will or may need maintenance and/or repair, including reheat coils. Install in accordance with requirements of ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible.
- .2 Identify access doors provided for fusible link damper maintenance with "FLD" stencil painted or marker type red lettering and ensure doors are properly located for damper maintenance.
- .3 When requested, submit a sample of proposed duct access doors for review.
- .4 Where sectionalized fusible link dampers and/or balancing dampers are provided in large ducts, provide a plenum type access door to suit, and adequately reinforce ductwork to suit access door installed.

3.19 INSTALLATION OF INSTRUMENTS TEST PORTS

- .1 Provide instrument test ports in all main ducts at connections to fans, plenums or casings, in all larger branch duct connections to mains, and wherever else required for proper air quantity balancing and testing.
- .2 Locate test ports where recommended by personnel performing air quantity testing and balancing work.

3.20 INSTALLATION OF WIRE MESH (BIRDSCREEN)

- .1 Provide framed, removable wire mesh panels over openings in ducts and/or walls where shown and/or specified on drawings. Rigidly secure in place but ensure panels are removable.
- .2 Provide wire mesh panels for open-end return air ducts in ceiling spaces whether shown on drawings or not.

3.21 INSTALLATION OF LOUVRES

- .1 Provide louvres for wall openings.
- .2 Install louvre assemblies and secure in place in accordance with manufacturer's instructions and details.
- .3 Confirm exact louvre sizes and finish prior to ordering.

3.22 INSTALLATION OF LOUVRE BLANK-OFF PANELS

- .1 Provide blank-off panels for inactive portions of exterior wall louvres.
- .2 Secure panels in place with non-ferrous hardware so they cannot move or rattle, yet are easily removable.
- .3 Confirm exact finish of panels prior to fabrication.

3.23 INSTALLATION OF BRICK AND BLOCK VENTS

- .1 Supply brick or block vents for installation in exterior walls.
- .2 Hand assemblies to masonry trade for installation.
- .3 Accurately mark exact locations and coordinate installation.

3.24 INSTALLATION OF FIRE STOP FLAPS AND THERMAL BLANKETS

- .1 Provide fire stop flaps in duct connection necks of grilles and diffusers installed in ULC fire rated suspended ceiling systems where shown on drawings.
- .2 Provide thermal blanket material to completely cover grille and/or diffuser pans above suspended ULC fire rated ceilings. Cut, install, and secure in place in accordance with manufacturer's instructions and ULC requirements.

3.25 INSTALLATION OF GRILLES AND DIFFUSERS

- .1 Provide grilles and diffusers. Wherever possible, grilles and diffusers are to be product of same manufacturer.
- .2 Unless otherwise specified connect grilles and diffusers in accordance with requirements of SMACNA HVAC Duct Construction Standards Metal and Flexible.
- .3 Exactly locate grilles and diffusers to conform to final architectural reflected ceiling plans and detailed wall elevations, and to conform to final lighting arrangement, ceiling layout, ornamental and other wall treatment.
- .4 Equip supply diffusers having a basic 4-way or all round air pattern for operation in 1-, 2-, or 3-way pattern where indicated on drawings.
- .5 Attach troffer type diffusers associated with typical ceiling mounted fluorescent lighting fixtures to the fixtures on floor prior to fixture installation in ceiling. When fixtures are installed, connect diffuser boots with flexible ductwork.
- .6 Provide sheet metal plenums, constructed of same material as connecting duct, for linear grilles and/or diffusers where shown. Construct and install plenums in accordance with requirements of SMACNA HVAC Duct Construction Standards Metal and Flexible. Where individual sections of linear grilles or diffusers are not equipped with a volume control device, equip duct connection collar(s) with volume control device(s).
- .7 Where linear type diffusers/grilles are installed in suspended T-bar ceilings, clip diffusers/grilles in place using clip supplied by diffuser/grille manufacturer.
- .8 Confirm grille and diffuser finishes prior to ordering.

3.26 INSTALLATION OF FAN FILTER DIFFUSERS

- .1 Provide fan filter diffusers.
- .2 Exactly locate fan filter diffusers to conform to final architectural reflected ceiling plans, and to conform to final lighting arrangement and locations of ceiling equipment.
- .3 Install in strict accordance with manufacturer's instructions, including gasket tape on T-bar ceiling members at unit locations. Plug each unit into an adjacent ceiling receptacle.
- .4 Brace and secure each unit in accordance with requirements specified in Section 20 05 48.16 - Seismic Controls for Mechanical Systems.

- .5 For equipment/system manufacturer certification requirements, refer to Section 20 05 00 – Common Work Results for Mechanical.
- .6 For equipment/system start-up requirements, refer to Section 20 05 00 – Common Work Results for Mechanical.
- .7 Include for a 1/2 day on-site operation demonstration and training session. Training is to be a full review of all components including, but not limited to, a full operation and maintenance demonstration.

3.27 SUPPLY OF DOOR GRILLES

- .1 Supply door grilles as shown and scheduled.
- .2 Hand grilles to appropriate trade at site for installation.

3.28 INSTALLATION OF ROOF MOUNTED GRAVITY VENTILATORS

- .1 Provide roof mounted gravity ventilators.
- .2 Supply a roof mounting curb with each ventilator and hand curbs to roofing trade on roof for mounting and flashing into roof construction as part of the roofing work. Site assemble gravity ventilators as required, and secure in place on curbs.
- .3 Brace and secure each unit in accordance with requirements specified in Section 20 05 48.16 – Seismic Controls for Mechanical Systems.
- .4 Install dampers in curb damper tray and secure in place.

3.29 DUCT SYSTEM PROTECTION, CLEANING AND START-UP

- .1 Temporarily cover all open ends of ducts during construction.
- .2 Remove all dirt and foreign matter from entire duct systems and clean duct system terminals and interior of air handling units prior to operating fans.
- .3 Prior to starting any supply air handling system provide 50 mm (2") thick glass fibre construction filters at fan equipment in place of permanent filters.
- .4 Provide cheesecloth over duct system inlets and outlets and run system for 24 hours, after which remove cheesecloth and construction filters, and install new permanent filters.
- .5 Include all labour for a complete site walk-through with testing and balancing personnel following route of all duct systems to be tested, adjusted and balanced for the purpose of confirming proper position and attitude of dampers, location of pitot tube openings, and any other work affecting testing and balancing procedures. Perform corrective work required as a result of this walk-through.

End of Section

1 General

1.01 SUBMITTALS

- .1 Submit shop drawings/product data sheets for all products specified in this section.

1.02 MAINTENANCE MATERIAL SUBMITTALS

- .1 Prior to Substantial Performance of the Work, submit a set of spare filters in original identified packaging for each air handling unit requiring filters. Store filters on site where directed by Consultant or Owner.
- .2 Prior to Substantial Performance of the Work, submit a spare bottle of red manometer filter gauge oil, with instructions, to Owner for each manometer type gauge installed.

2 Products

2.01 GENERAL

- .1 Unless otherwise specified or noted, filters are to be synthetic and/or glass fibre disposable media type in accordance with drawing schedule(s).
- .2 Minimum Efficiency Reporting Values (MERV) ratings in accordance with ASHRAE Standard 52.2, Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Sizes.
- .3 Unless otherwise specified or noted, filters are to be UL/ULC Class 1 in accordance with UL Standard 900, Air Filter Units, ULC S111, Standard Method of Fire Tests for Air Filter Units, and CAN/CGSB 115.10, Disposable Air Filters for Removal of Particulate Matter from Ventilation Systems.
- .4 Manufacturers:
 - .1 AAF International;
 - .2 Camfil Farr Inc.;
 - .3 Modern Air Filter Corp.

2.02 CONSTRUCTION FILTERS

- .1 Roll type, disposable, MERV 7 to 9 woven glass fibre media, UL Class 2.

2.03 HEPA FILTERS

- .1 HEPA high capacity filters in accordance with drawing schedule and UL Standard 586, High-Efficiency, Particulate, Air Filter Units, 99.995% efficient on 0.12 µm particles, consisting of a continuous pleating of water-proof micro glass fibre media with pleats uniformly separated by aluminum separators, urethane sealant to encapsulate the filter pack in minimum #16 gauge galvanized steel frame with one-piece urethane gasket or neoprene dove-tailed gasket for positive leak-free filter-to-holding mechanism seal.

2.04 FILTER FRAMING AND RACKS

- .1 No. 16 gauge galvanized steel filter framing/racks, sized and arranged to suit filters and filter bank, easily accessible for filter service and replacement, and complete with slide-in tracks or lay-in flanges as required for filter placement, and all required gasketing and facilities to prevent air by-pass.

2.05 INCLINED MANOMETER AIR FILTER GAUGE

- .1 Dwyer Instruments Inc. Model 250.5-AF inclined tube differential pressure type filter gauge of solid acrylic construction, complete with vent valves for zeroing, built-in level vial, over-pressure safety traps,

adjustable mirror polished scale, and 2, 1.5 m (5') lengths of 6.4 mm (¼") dia. tubing, 2 static pressure tips, mounting hardware, and a spare bottle of red gauge oil and instructions.

2.06 DIAL TYPE AIR FILTER GAUGE

- .1 Dwyer Instruments Inc. Series 2000 "Magnehelic" differential dial type filter gauge, accurate to within ± 2% of full scale and complete with a die-cast aluminum housing and bezel, acrylic cover, over-pressure relief plug, a pair of 3.2 mm (1/8") dia. female NPT pressure taps at both the side and back of gauge, 2 pressure tap plugs, flexible vinyl tubing, a scale overlay or marker to indicate dirty filters, and all other required mounting and connection accessories.
- .2 Each filter gauge is to be complete with contacts suitable for connection into building automation system.

3 Execution

3.01 INSTALLATION OF CONSTRUCTION FILTERS

- .1 Provide roll type medium efficiency disposable media filter(s) across entire filter bank of each supply air handling unit, either at factory where fan is produced or at site as soon as fan is installed. Secure media in place so it will not be dislodged by fan operation. Replace roll media periodically if it becomes loaded and clogged.
- .2 For exhaust systems, secure filter media across exhaust air openings and ductwork to prevent construction dirt and dust from fouling the fan
- .3 Leave media in place until fan start-up, at which time remove and dispose of construction media.

3.02 INSTALLATION OF FILTERS

- .1 Provide required filter media when fan equipment is ready for start-up and performance testing. Provide any required filter framing/racks.
- .2 Prior to Substantial Performance of the Work, supply a complete spare set of filter media in original packaging and clearly identified as to the applicable system for each air handling system with filters. Store filters at site where directed by Owner.

3.03 INSTALLATION OF INCLINED MANOMETER FILTER GAUGES

- .1 Provide an inclined manometer filter gauge for air handling system filter banks.
- .2 Secure gauge to filter section casing and install differential pressure tubing and tips. Fill gauges with red oil and adjust as required.
- .3 Affix a red arrow to scale so it indicates point on scale where filters are clogged and require replacement.

3.04 INSTALLATION OF DIAL TYPE FILTER GAUGES

- .1 Provide dial type filter gauges for air handling system filter banks.
- .2 Secure gauge to filter section casing and install differential pressure tubing and accessories. Set gauges to suit fresh clean filter media and mark scales at point where filter media requires replacement.

End of Section

1 General

1.01 SUBMITTALS

- .1 Submit shop drawings/product data sheets for all products specified in this Section. Include motor data sheets and all required information.
- .2 Submit a site inspection and start-up report from manufacturer's representative as specified in Part 3 of this Section.

1.02 QUALITY ASSURANCE

- .1 Unit Ventilators are to be CSA or cETL listed and labelled, factory assembled and tested, shipped to site in one-piece, and are to be in accordance with requirements of following codes and regulations:
 - .1 CAN/CSA-C22.2 No. 236, Heating and Cooling Equipment;
 - .2 UL/ANSI 1995, Heating and Cooling Equipment;
 - .3 ANSI/AHRI Standard 350, Sound Performance Rating of Non-Ducted Indoor Air-Conditioning Equipment;
 - .4 ANSI/AHRI Standard 440, Performance Rating of Room Fan-Coils;
 - .5 Applicable Provincial Codes and Regulations.

2 Products

2.01 UNIT VENTILATORS

- .1 General Specification:
 - .1 The energy recovery ventilator shall be a vertical design with a small footprint. The unit shall be ducted or freeblow through a top acoustical plenum. The unit shall be provided with 100% economizer and 100% powered exhaust.
 - .2 The unit shall be fully assembled and tested prior to shipment. It shall comply with ASHRAE 90.1 – 2010 and 62.1 – 2010 and be constructed in accordance with UL 1995 / CSA C22.2 No. 236 Standard (Heating and Cooling Equipment). A label shall be affixed to the unit listing the product code under which it is registered.
- .2 Cabinet:
 - .1 The unit cabinet shall be 14ga, formed unibody construction for rigidity. The finish shall be a durable powder coat – textured finish, color as per the Architect's instruction. The cabinet shall be fully lined with 25mm (1") closed cell insulation. The return air grille shall be heavy duty steel. The unit shall have a draw through configuration. For easy maintenance, access to the internal components shall be through the front of the unit.
- .3 Hot Water Heating Coil:
 - .1 A hot water heating coil shall be installed inside of the unit. The coil shall have 1/2" OD copper tube with aluminum fins. The coil supply and return headers shall be copper pipe, stubbed out for sweat connection. The coil shall be factory pressure tested at not less than 350 p.s.i. A manual air vent and drain cock shall be factory installed. The coil capacity shall be as shown in the equipment schedule. A hot water coil mounted in a plenum that is field installed above the unit is not acceptable.

- .4 Direct Expansion (DX) Evaporator Cooling Coil:
 - .1 The DX evaporator coil shall be designed for R410A refrigerant, formed with 3/8" copper tube and mechanically bonded to aluminum fins. Field connections shall be brazed under nitrogen. The mechanical contractor shall properly charge the refrigeration system with R410A refrigerant after installation and ensure that the cooling system is operating correctly. The coil capacities shall be as shown in the equipment submittals.
- .5 Drain Pan:
 - .1 For all units with cooling coils an acrylic coated galvanized steel (optional stainless steel), double sloped drain pan shall be provided. The drain pan shall be insulated on the underside with 1/2" closed cell insulation. A "P" trap will be included below the drain pan.
- .6 Supply Air Fans/Motors:
 - .1 The internal supply fan assembly shall include two direct drive electronically commutated motors (ECM) and blowers (one blower for units <1200 c.f.m.) mounted on rubber isolation grommets. The ECM motors shall be programmed for high efficiency and low audible sound. The motors shall consist of a brushless, permanently lubricated ball bearing construction for maintenance free operation.
- .7 Filter:
 - .1 The filters shall have a MERV (minimum efficiency reporting value) rating of 13.
- .8 Access Panels:
 - .1 Internal components shall be easily accessible through front access panels which shall either be side hinged or removable. The hinge shall not protrude beyond the front surface of the unit and the hinged panel shall be securely closed with two fast lead captive fasteners. The removable access panel shall have four fast lead captive fasteners. The fast lead captive fasteners shall ensure a tight air seal for the access panels.
- .9 Line Voltage:
 - .1 All internal line voltage wiring shall be by the unit manufacturer with a single power connection point. A single suitably rated unfused service disconnect switch shall be factory installed within the unit.
 - .2 Neutral. A suitably rated remote circuit breaker shall be provided and installed by the electrical contractor.
- .10 Control Panel:
 - .1 A control panel (without the controller) shall be factory provided and installed. It shall be located at eye height (approximately 5.5 ft) behind the front access panel for easy maintenance and service and shall include a 24-volt transformer with the required contactors, relays and circuit protection.
- .11 Factory Installed Controls:
 - .1 Control items shall be furnished by the controls contractor for factory mounting and shall function as described in the controls specifications. Controls are to arrive at the factory well before scheduled production and are to be freight, duty and customs pre-paid by the controls contractor.

- .12 Outdoor / Return Air Mixing Dampers, ERV Dampers, Exhaust Dampers:
 - .1 The outdoor air (OA) and exhaust air (EA) dampers shall have airfoil section extruded aluminum blades with flexible seal blade tips and jamb seals. Leakage shall not exceed 4 c.f.m. per sq. ft. at 3" W.G. differential pressure as determined by a recognized testing laboratory. The return air damper shall modulate and balance the airflow through the unit. Flap dampers exposed to outside air are NOT acceptable.
 - .2 Energy Recovery Module: The ER module shall include an AHRI certified energy recovery enthalpy wheel with a desiccant coating for energy efficiency and dehumidification. Supply and exhaust fans shall provide up to a nominal 600 c.f.m. of fresh air. OA and EA disposable filters shall be removable from the front of the unit. Also included are a set of actuated aluminum dampers that close when the wheel is not active to ensure air leakage does not occur between the building exterior and interior of the cabinet.
- .13 Condensate Pump:
 - .1 A condensate pump shall be factory installed within the unit. The head capacity of the pump shall be a minimum of 15 ft.
- .14 Water Control Valve:
 - .1 Control valves are to be provided by controls contractor and factory mounted.
- .15 Piping Options
 - .1 Piping valves and accessories are to be provided as per details shown on drawings.
- .16 Rear Plenum & Exterior Wall Sleeve:
 - .1 Unit ventilators shall be provided with 200mm (8") deep plenum between unit and exterior louvre. Plenum to be provided with air flow separator to prevent mixing of fresh air intake and exhaust air. Plenum to be insulated as per section 20 07 00 – Mechanical Systems Insulation.
 - .2 The manufacturer shall provide a wall sleeve to suit the wall thickness, including an air flow separator to prevent mixing of the fresh air intake and exhaust air. Louvre to be provided by contractor and dimensions and location shall be coordinated with manufacturer.
- .17 Top Extension:
 - .1 The unit manufacturer shall provide a color matched top extension for the cabinet, size to suit the ceiling height.
- .18 Acceptable manufacturers are:
 - .1 Temspec;
 - .2 Change Air;
 - .3 Engineered Air.

3 Execution

3.01 INSTALLATION OF UNIT VENTILATORS

- .1 Provide unit ventilators.
- .2 Unless otherwise shown or specified, secure each vertical fan coil unit in place on floor, complete with vibration isolation pads supplied with fan coil units.

- .3 Brace and secure each unit in accordance with requirements specified in Section 20 05 48.16 - Seismic Controls for Mechanical Systems.
- .4 Provide shut-off valves and install a control valve in piping for each coil. Refer to drawing detail and piping schematic.
- .5 Refer to Section 20 05 00 – Common Work Results for Mechanical for equipment/system manufacturer certification requirements.
- .6 Refer to Section 20 05 00 – Common Work Results for Mechanical for equipment/system start-up requirements.
- .7 Include for a 1/2 day on-site operation demonstration and training session. Training is to be a full review of all components including but not limited to a full operation and maintenance demonstration, with abnormal events.

End of Section

1 General

1.01 RELATED REQUIREMENTS

- .1 Section 23 21 00 – Hydronic Piping and Pumps.

1.02 SUBMITTALS

- .1 Submit shop drawings/product data sheets for radiation units, including accessories, and any required control wiring schematics.

1.03 CLOSEOUT SUBMITTALS

- .1 Submit a site inspection and start-up report from manufacturer's representative as specified in Part 3 of this section.

2 Products

2.01 FIN-TUBE TYPE DIRECTION RADIATION

- .1 Hot water fin-tube type direct radiation units with capacities/lengths as indicated on the drawings. Heating capacities and element lengths indicated are based on 82.2°C (180°F) average entering water temperature at a velocity of 0.0762 m/s (0.25 ft/sec) with an 11.1°C (20°F) temperature drop through the element, and 21.1°C (70°F) entering air temperature.
- .2 Baseboard radiation complete with:
 - .1 heating elements: seamless copper tubes mechanically expanded into collars integral with continuous plate type aluminum fins;
 - .2 enclosure: one-piece #18 gauge cold rolled steel front louvred panel with a factory prime coat finish, #10 gauge galvanized steel support brackets, and all required enclosure accessories (including valve boxes) to suit mounting arrangements shown.
- .3 Convector radiators complete with:
 - .1 heating elements consisting of seamless copper tubes mechanically expanded into collars integral with continuous plate type aluminum fins and into machined openings in cast iron headers, and equipped with steel protective plates which extend full length on both sides of each element;
 - .2 enclosure, as indicated on drawings, consisting of minimum #20 gauge steel back and end panels, minimum #18 gauge steel, removable, reinforced front panels with integral formed grilles, minimum #18 gauge steel top panels, rounded exposed edges and corners, and element support clips or legs fastened to enclosure and adjustable for element pitch.
- .4 Wall-fin convectors complete with:
 - .1 steel heating elements consisting of minimum 32 mm (1-¼") IPS steel tubes mechanically expanded into and permanently bonded to 110 mm (4-½") square steel plate fins, and factory coated with a black finish;
 - .2 copper-aluminum elements consisting of minimum 32 mm (1-¼") IPS seamless copper tubing mechanically expanded into and permanently bonded to 110 mm (4-½") square plate type aluminum fins;
 - .3 enclosures, as indicated on drawings, each removable and constructed of #16 gauge cold rolled steel, factory cleaned, phosphatized and finished with primer, and equipped with stamped grilles,

- flush slip joint enclosure to enclosure joints where required, access doors for valve access, and any required enclosure trim such as column to column extension pieces, column enclosures, etc.;
- .4 continuous minimum #20 gauge steel top support wall guard strip prime coat painted as for enclosure and arranged to maintain the top back edge of enclosure 20 mm ($\frac{3}{4}$ ") from face of wall, enclosure supports with enclosure locks constructed and finished as for wall strip and designed to hook onto top strip, and steel element support cradles which attach to slots in wall guard strip;
 - .5 for radiation units as indicated, fully adjustable, plate type, knob operated control dampers located behind front grille and integral with front panel of enclosure.
- .5 Manufacturers:
- .1 Modine Manufacturing Co.;
 - .2 Rosemex Inc.;
 - .3 Slant/Fin Ltd.;
 - .4 Engineered Air.

3 Execution

3.01 INSTALLATION

- .1 Provide fin-tube type direct radiation units.
- .2 Secure enclosure brackets in place at maximum 900 mm (35") centres and install element supports or cradles. Slope elements to ensure proper water circulating and to eliminate air. Ensure enclosures are level and plumb. Provide required enclosure accessories.
- .3 Connect elements with piping. Provide radiator type valves in piping at each element or group of series connected elements, shut-off type in supply piping, balancing type in return piping. Unless otherwise noted or specified, locate valves and accessories inside enclosures or behind trim, and ensure valves are accessible.
- .4 Where 2 or more heating elements are connected in series, join elements with piping the full size of the element tubes or use piping sized to supply pipe size and connect elements with eccentric fittings.
- .5 Equip each element or group of series connected elements with a manual air vent installed in an accessible location.
- .6 Provide proper height, cleaned and prime coat painted, flanged steel pipe supports for free-standing radiation units. Size inside diameter of supports to suit diameter of heating piping which is to extend through the supports to the elements. Secure supports to floor over floor openings.

End of Section

1 General

1.01 SECTION INCLUDES

- .1 Hot water unit heaters and cabinet unit heaters.

1.02 RELATED REQUIREMENTS

- .1 Section 23 21 00 – Hydronic Piping and Pumps.

1.03 SUBMITTALS

- .1 Submit shop drawings/product data sheets for motorized heaters, including accessories.

1.04 CLOSEOUT SUBMITTALS

- .1 Submit a site start-up report from manufacturer's representative as specified in Part 3 of this section.
- .2 Training attendance records.

2 Products

2.01 UNIT HEATERS

- .1 CSA certified hot water unit heaters in accordance with drawing schedule, each complete with:
 - .1 for vertical unit casing, top and bottom heavy-gauge circular steel plates, top plate equipped with a depression for motor and an opening for motor cooling air as well as threaded hanger rod connections, bottom plate equipped with a die-formed fan venturi and a bolt-on adjustable air deflector, both plates bolted together with a circular heating coil in between;
 - .2 for horizontal unit casing, minimum #20 gauge die-formed steel front and back casing halves with formed ribs and rounded corners, both halves secured together top and bottom with screws and equipped with threaded hanger rod connections in the top, a formed fan venturi with bolt-on wire grid guard in the back, and a rectangular formed discharge opening with adjustable horizontal and vertical air deflectors in the front;
 - .3 factory applied casing finish, consisting of electrostatically applied baked powder epoxy on cleaned and primed casing surfaces;
 - .4 factory leak tested heating coil, consisting of minimum 16 mm (5/8") OD seamless copper tubing mechanically expanded into and permanently bonded to continuous plate type aluminum fins, and equipped with screwed steel supply and return piping connections and silver braced tube joints;
 - .5 continuous duty TEFC motor conforming to requirements specified in Section 20 05 00 – Common Work Results for Mechanical, direct connected to a balanced propeller type fan wheel with aluminum blades secured to a steel hub;
 - .6 seismic restraint connection hardware factory secured to each unit heater.
- .2 Manufacturers:
 - .1 Armstrong-Hunt Inc.;
 - .2 Engineered Air.
 - .3 Modine Manufacturing Co.;
 - .4 Rosemex Inc.;

.5 Sigma

2.02 CABINET UNIT HEATERS

- .1 CSA certified hot water cabinet unit heaters in accordance with drawing schedule, each complete with:
 - .1 cabinet, of welded fabrication, constructed from one-piece top and sides, and one-piece partition panels and backsheet, both die-formed from single sheets of minimum #18 gauge insulated furniture grade steel and complete with minimum 825 mm (32-1/2") space at each end for piping and wiring, stamped grilles where required, and, for surface floor and wall mounted cabinets, key lock access doors for access to valves and speed controls;
 - .2 #16 gauge removable front panel with tamperproof fasteners, stamped grille where required, and insulation applied to the inside face;
 - .3 for all exposed cabinet surfaces, a baked enamel prime coat finish applied to cleaned metal surfaces;
 - .4 factory leak tested heating coil, consisting of seamless copper tubing mechanically expanded into and permanently bonded to continuous plate type aluminum fins, and equipped with screwed steel supply and return piping connections and silver brazed tube joints;
 - .5 removable galvanized steel fan board with centrifugal forward curved, formed aluminum fan wheel(s) with galvanized steel housings, direct connected to a continuous duty, three-speed, permanent split capacitor motor conforming to requirements specified in Section 20 05 00 – Common Work Results for Mechanical;
 - .6 for cabinets where indicated, duct connection collars;
 - .7 permanent, cleanable aluminum mesh filter;
 - .8 seismic restraint connection hardware factory secured to each unit as required.
- .2 Manufacturers:
 - .1 Armstrong-Hunt Inc.;
 - .2 Engineered Air.
 - .3 Modine Manufacturing Co.;
 - .4 Rosemex Inc.;
 - .5 Sigma

3 Execution

3.01 INSTALLATION OF MOTORIZED HEATERS

- .1 Provide motorized heaters.
- .2 Secure unit heaters in place at proper height by means of hanger rods attached to structure. Ensure heaters are level and plumb. Confirm exact locations prior to roughing-in.
- .3 Carefully coordinate installation of cabinet heaters with trades constructing building surfaces in or on which heaters are located. Confirm exact locations prior to roughing-in.
- .4 Brace and secure each unit in accordance with requirements specified in Section 20 05 48.16 - Seismic Controls for Mechanical Systems.

- .5 Connect with piping in accordance with drawing detail.

3.02 SYSTEM STARTUP

- .1 For equipment/system start-up requirements, refer to Section 20 05 00 – Common Work Results for Mechanical.

3.03 CLOSEOUT ACTIVITIES

- .1 Include for a 4 hour on-site heater operation demonstration and training session. Training is to be a full review of all components including but not limited to construction details, operation, and maintenance.

End of Section

1 General

1.01 SUBMITTALS

- .1 Submit shop drawings/product data sheets for following:
 - .1 all control system components;
 - .2 identified schematic control diagrams with component identification, catalogue numbers, and sequence of operation for all systems;
 - .3 certified wiring diagrams for all systems.
- .2 Submit following samples for review:
 - .1 control damper section with linkage, operator, and certified flow and leakage data;
 - .2 wall mounting control system flow diagram as specified in Part 2 of this Section;
 - .3 each type of thermostat to be used, each identified as to intended use.

1.02 CLOSEOUT SUBMITTALS

- .1 Submit a site inspection and start-up report from manufacturer's representative as specified in Part 3 of this Section.
- .2 Submit written confirmation from control component manufacturer that site installation personnel are qualified and experienced in installation of components, and have parts and service availability on a 24/7 basis.

1.03 QUALITY ASSURANCE

- .1 Control systems are to be installed by control component manufacturer or by licensed personnel authorized by control component manufacturer. Submit written confirmation from control component manufacturer.
- .2 Control wiring work is to be performed by licensed journeyman electricians, or under direct daily supervision of journeyman electricians.

2 Products

2.01 AUTOMATIC CONTROL VALVES AND OPERATORS

- .1 Each control valve must be suitable in all respects for the application, including system pressure, and must have design output and flow rates with maximum pressure drops as follows:
 - .2 Two-Position: Line size or size using a pressure differential of 1 psi.
 - .3 Two-Way Modulating: 3 psid or twice the load pressure drop, whichever is more.
 - .4 Three-Way Modulating: Twice the load pressure drop, but not more than 5 psid.
- .5 Unless otherwise indicated, control valves for proportional operation are to have equal percentage characteristics, and control valves for open/shut 2-position operation are to have straight line flow characteristics. All valves are to have position indicators. Valves for outdoor applications must be suitable in all respects for the application.
- .6 Heating valves are to be normally open unless otherwise specified.

- .7 Cooling valves are to be normally closed unless otherwise specified.
- .8 Unless otherwise specified, control valves in hydronic piping systems are to conform to requirements specified in Section 23 21 00 – Hydronic Piping and Pumps.
- .9 Unless otherwise specified, valves in steam/condensate piping are to generally conform to requirements specified in Section 23 22 00 – Steam and Condensate Piping and Pumps, but must be equipped with stainless steel plugs and stems, removable screwed stainless steel seat rings, and spring loaded Teflon V-ring packing.
- .10 All control valve operators are to be spring return type for fail safe operation, sized to tightly shut the control valves against differentials imposed by system, equipped with position indicators, and suitable in all respects for environment in which they are located.
- .11 Electric valve operators are to be equal to Belimo "EF Series" enclosed reversible gear type operators that can accept modulating control signals as required. Each is to be 1-phase AC, 120 or 24 volt as required or indicated, overload protected, and complete with an enclosure to suit the mounting location.
- .12 Unless otherwise specified, pneumatic valve operators are to be renewable neoprene diaphragm piston type. Pneumatic operators used to sequence multiple valves must be equipped with a pilot positioner to ensure proper sequence of each valve and allow for an adjustable "dead band" between heating and cooling valves.

2.02 CONTROL DAMPERS AND OPERATORS

- .1 T. A. Morrison & Co. Inc. "TAMCO" 100 mm (4') deep, flanged, AMCA low leakage certified aluminium dampers. Dampers for modulating and mixing applications are to be parallel blade type. Dampers for open-shut service are to be opposed blade type. Maximum blade length is to be 1 m (4'). Dampers greater than 2 sections wide are to be complete with a jackshaft. Each damper is to be complete with:
 - .1 extruded 6063T5 aluminum frame and airfoil blades, each with an integral slot to receive a gasket;
 - .2 extruded TPE frame gaskets and extruded EPDM blade gaskets;
 - .3 slip-proof aluminium and corrosion resistant plated steel linkage of a metal thickness to prevent warping or bending during damper operation, concealed in frame, equipped with seal-sealing and self-lubricating bearings consisting of a Celcon inner bearing fixed on hexagonal blade pin and rotating in a polycarbonate outer bearing inserted in frame.
- .2 For standard damper(s), Series 1000 as above.
- .3 For insulated damper(s), Series 9000 as above but with all 4 sides of frame insulated with polystyrene, and blades thermally broken and insulated with expanded polyurethane foam.
- .4 For stainless steel dampers, as above but constructed of type 316 stainless steel and equipped with Teflon blade bearings.
- .5 Each damper motor is to be shaft mounted, spring return, fail safe in the normally open or normally closed position, sized to control damper against maximum pressure or dynamic closing pressure, whichever is greater, to suit sizes of dampers involved, and to provide sufficient force to maintain damper rated leakage characteristics. Each operator is to be complete with a damper position indicator, and external adjustable stops to limit length of stroke in either direction, and is to be mounted on a corrosion resistant adjustable bracket. Operating arms are to have double yoke linkages and double set screws for fastening to damper shaft. Operators for dampers to be connected to building fire alarm system or to freeze protection devices are to be equipped with additional relays to permit dampers to respond and go to required position in less than 15 seconds upon receipt of a signal. Operator enclosures are to be suitable in all respects for environment in which they are located.

- .6 Electric damper operators are to be equal to Belimo EF Series 24 volt or 120 volt AC spring return, direct coupled electric motor operators for either modulating or 2-position control as required. Each operator is to be overload protected and complete with an enclosure to suit the mounting location.
- .7 Pneumatic damper operators are to be replaceable elastomer diaphragm piston type, suitable in all respects for damper sequence.

2.03 LOCAL CONTROL PANELS

- .1 NEMA 1 (NEMA 2 in sprinklered areas) wall mounting, enamelled steel barriered enclosures sized to suit the application with 20% spare capacity, a perforated sub-panel, numbered terminal strips for all low and line voltage wiring, hinged door, and slotted flush latch.

2.04 CONTROL SYSTEM COMPONENTS

- .1 Components specified below are required for control of equipment and systems in accordance with drawing control diagrams and sequences of operation. Not all required components may be specified.
- .2 Sensor/transmitter input devices must be suitable in all respects for the application and mounting location. Devices are as follows:
 - .1 unless otherwise specified, temperature sensors are to be resistance type, either 2-wire 1000 ohm nickel RTD or 2-wire 1000 ohm platinum RTD with accuracy (includes errors associated with sensor, lead wire, and A to D conversion), equipped with type 316 stainless steel thermowells for pipe mounting applications, as follows:
 - .1 chilled water, room temperature, and duct temperature points, $\pm 1^{\circ}\text{C}$ ($\pm 0.5^{\circ}\text{F}$);
 - .2 all other points, $\pm 0.75^{\circ}\text{C}$ ($\pm 1.3^{\circ}\text{F}$).
 - .2 room temperature sensors constructed for surface or recessed wall box mounting, complete with an adjustable set-point reset slide switch with a $\pm 1.66^{\circ}\text{C}$ ($\pm 3^{\circ}\text{F}$) range, individual heating/cooling set-point slide switches as required, a momentary override request pushbutton for activation of after-hours operation, an analogue thermometer;
 - .3 outside air sensors designed and constructed for ambient temperatures and to withstand environmental conditions to which they are exposed, complete with a NEMA 3R enclosure, solar shield, and a perforated plate surrounding sensor element where exposed to wind velocity pressure;
 - .4 insertion duct mounting sensors type with lock nut and mounting plate, designed to mount in an electrical box (weather-proof with gasket and cover where outside) through a hole in duct;
 - .5 for ducts greater than 1.2 m (4') or for ducts where air temperature stratification occurs, averaging type sensors with multiple sensing points, and for plenums for applications such as mixed air temperature measurement to account for air turbulence and/or stratification, an averaging string of sensors with capillary supports on the sides of duct/plenum;
 - .6 factory solid-state relative humidity sensors with an element that resists contamination, weather-proof with a NEMA 3R enclosure for outside air applications, supplied with a type 304 stainless steel probe with mounting bracket and hardware for duct mounting, each complete with a factory calibrated humidity transmitter which is accurate (including lead loss and analog to digital conversion) to 3% between 20% to 80% RH at 25°C (77°F) and equipped with non-interactive span and zero adjustments, and a 2-wire isolated loop powered, 4-20 mA, 0 to 100% linear proportional output;
 - .7 carbon dioxide sensors for air quality control purposes having a maximum 20 second response time, suitable for operating conditions from 0°C to 50°C (32°F to 122°F) and 0 to 100% RH non-

condensing, complete with a calibration kit (to be handed to Owner) and characteristics as follows:

- .1 measurement range: 0 to 2000 ppm;
- .2 accuracy: ± 100 ppm;
- .3 repeatability: ± 20 ppm;
- .4 drift: ± 100 ppm per year;
- .5 output signal: 0 to 10 VDC proportional over the 0 to 2000 ppm range.

- .3 Pressure transmitters are to be constructed to withstand 100% pressure over-range without damage and to hold calibrated accuracy when subject to a momentary 40% over-range input. Pressure transmitters are to transmit a 0 to 5 VDC, 0 to 10 VDC, or 4 to 20 mA output signal. Differential pressure transmitters used for flow measurement are to be sized to the flow sensing device and supplied with a tee fitting and shut-off valves in the high and low sensing pick-up lines to allow permanent ease of use connection for balancing, etc. Transmitter housing is to suit mounting location. Standalone pressure transmitters are to be mounted in a minimum NEMA 1 (NEMA 2 in sprinklered area) by-pass valve assembly panel with high and low connections piped and valved, air bleed units, by-pass valves, and compression fittings. Transmitters are to be as follows:

- .1 low differential water pressure, 0 to 5 kPa (0 to 20" wc): equal to Setra or Mamac industrial quality transmitter capable of transmitting a linear 4 to 20 mA output in response to variation of flow meter differential pressure or water pressure sensing points, each complete with non-interactive zero and span adjustments adjustable from outside the cover, and performance as follows:
 - .1 maintain accuracy up to 20 to 1 ratio turndown;
 - .2 reference accuracy: +0.2% of full scale.
- .2 medium to high differential water pressure, over 5 kPa (20" wc): equal to Setra or Mamac transmitters as specified above for low pressure transmitters but with a pressure range of from 2.5 kPa (10" wc) to 2070 kPa (300 psi), a reference accuracy of $\pm 1\%$ of full span (includes non-linearity, hysteresis, and repeatability);
- .3 building differential air pressure: equal to Setra or Johnson Controls Inc. industrial quality transmitter with a range suitable for the application, capable of transmitting a linear 4 to 20 mA output in response to variation of differential pressure or air pressure sensing points, each complete with non-interactive zero and span adjustments adjustable from outside the cover, and performance as follows:
 - .1 maintain accuracy up to 20 to 1 ratio turndown;
 - .2 reference accuracy: +0.2% of full span.
- .4 low differential air pressure, 0 to 1.25 kPa (0" to 5" wc): equal to Setra or Johnson Controls Inc. industrial quality transmitter with a range suitable for the application, capable of transmitting a linear 4 to 20 mA output in response to variation of differential pressure or air pressure sensing points, each complete with non-interactive zero and span adjustments adjustable from outside the cover, and performance as follows:
 - .1 maintain accuracy up to 20 to 1 ratio turndown;
 - .2 reference accuracy: +0.2% of full span.

- .5 medium differential air pressure, over 1.5 kPa (5" wc): equal to Setra or Johnson Controls Inc. transmitters as specified above for low pressure air transmitters but performance requirements as follows:
 - .1 zero and span: (c/o F.S./Deg. F); .04% including linearity, hysteresis, and repeatability;
 - .2 accuracy: 1% F.S. (best straight line); static pressure effect: 0.5% F. S.;
 - .3 thermal effects: less than +0.33 F.S./°F over 40°F to 100°F (calibrated at 70°F).
- .4 Air and water flow monitoring stations and probes are to be Air Monitor Corp., Tek-Air Systems Inc., Ebtron, or Dietrich Standard products as follows:
 - .1 Fan Inlet Air Flow Measuring Station: At fan inlet and near exit of inlet sound trap, air flow traverse probes are to continuously monitor fan air volume and system velocity pressure, and traverse probes are to be as follows:
 - .1 each probe is to be of a dual manifold, cylindrical, anodized type 3003 extruded aluminium construction probe with sensors located along the stagnation plane of approaching air flow, and the static pressure manifold is to incorporate dual offset static tops on opposing sides of averaging manifold so as to be insensitive to flow angle variations for as much as $\pm 20^\circ$ in approaching air stream;
 - .2 each probe is not to introduce a measurable pressure drop, nor is sound level within duct to be amplified by its singular or multiple presence in air stream, and each probe is to contain multiple static and total pressure sensors places at equal distances along its length in accordance with ASHRAE Standards for duct traversing.
 - .2 Single Probe Air Flow Measuring Sensor: Duct mounting hot wire anemometer type which utilizes 2 temperature sensors, one is a heater element temperature sensor and the other is to measure downstream temperature, with temperature differential related directly to air flow velocity. Sensor insertion length is to be adjustable up to 200 mm (8"), and transmitter is to produce a 4 to 20 mA or 0 to 10 VDC signal linear to air velocity.
 - .3 Duct Flow Measuring Stations: #14 gauge galvanized steel casing with duct connection flanges of a size to mate with connecting ductwork, and complete with an air directionalizer and a 98% free area parallel cell 20 mm ($\frac{3}{4}$ ") honeycomb profile suppressor across entering air stream to equalize velocity profile and eliminate turbulent and rotational flow from the air stream prior to measuring point, mechanically fastened to casing so as to withstand velocities of up to 1828 m (6000') per minute. Additional requirements as follows:
 - .1 total pressure measurement side (high side) is to be designed and spaced to requirements of Industrial Ventilation Manual, 16th Edition, page 9-5, and self-averaging manifolding is to be constructed of brass and copper components;
 - .2 static pressure sensing probes (low side) is to be bullet-nose shaped, per detailed radius, as illustrated in Industrial Ventilation Manual referred to above, page 9-5;
 - .3 main take-off point from both total pressure and static pressure manifolds is to be symmetrical, and manifolds are to terminate with external ports for connection to control tubing;
 - .4 each station is to be equipped with a label on casing indicating unit model number, size, area, and specified air flow capacity;
 - .5 each station is to have a self-generated sound rating of less than NC 40, and sound level within duct is not to be amplified nor is additional sound to be generated.

- .4 Static Pressure Traverse Probe: Duct mounting, complete with multiple static pressure sensors located along exterior surface of cylindrical probe.
- .5 Shielded Static Air Probe: Indoor type or outdoor type as required, each with multiple sensing ports, an impulse suppression chamber, and air flow shielding.
- .6 Water Flow Monitoring: Equal to Onicon microprocessor-based electromagnetic water flow meters with an accuracy of 0.25%.
- .5 Power (amps) monitoring is to be performed by a combination of a current transformer and a current transducer with transformer sized to reduce full amperage of monitored circuit to a maximum 5 ampere signal which will be converted to a 4 to 20 mA DDC compatible circuit for use by building automation system. Current transformer and current transducer are as follows:
 - .1 equal to Veris Industries split core current transformer with an operating frequency of from 50 to 400 Hz, 0.6 Kv class, 10 Kv BIL insulation, and 5 ampere secondary;
 - .2 equal to Veris Industries current to voltage or current to mA transducer with an accuracy of $\pm 5\%$, a minimum load resistance of 30 kOhm, an input of 0 to 20 amperes and an output of 4 to 20 mA, and a 24 VDC regulated power supply.
- .6 Duct mounting smoke detectors supplied as part of electrical work for mounting as part of control system work.
- .7 Double contact switches to monitor equipment status and safety conditions, and generate alarms when a failure or abnormal condition occurs. Status and safety switches are to be as follows:
 - .1 current sensing switches: equal to Veris Industries self-powered dry contact output switches for sensing run status of motor loads, each calibrated to indicate a positive run status only when motor is operating under load, and each consisting of a current transformer, a solid-state current sensing circuit, adjustable trip point, solid-state switch, SPDT relay, and a LED to indicate on or off status;
 - .2 air filter status switches: equal to Johnson Controls Inc. or Cleveland Controls automatic reset type differential pressure switches, each complete with SPDT contacts rated for 2 amperes at 120 VAC, a scale range and differential pressure adjustment appropriate for the service, and an installation kit which includes static pressure taps, tubing, fittings, and air filters;
 - .3 air flow switches: equal to Johnson Controls Inc. or Cleveland Controls pressure flow switches, bellows actuated mercury switch or snap-acting micro-switch type with an appropriate scale range and pressure adjustment;
 - .4 air pressure safety switches: equal to Johnson Controls Inc. or Cleveland Controls manual reset switches, each complete with SPDT contacts rated for 2 amperes at 120 VAC and an appropriate scale range and pressure adjustment;
 - .5 water flow switches: equal to Johnson Controls Inc. Model P74;
 - .6 low temperature limit switches: manual reset type equal to Johnson Controls Inc. Model A70, each complete with DPST snap acting contacts rated for 16 amperes at 120 VAC, a minimum 4.5 m (15') sensing element for mounting horizontally across duct/plenum with sensing reaction from coldest 450 mm (18") section of element, and where sensing element does not provide full coverage of air stream, additional switches are to be supplied as required.
- .8 Control relays as follows:
 - .1 control pilot relays: equal to Johnson Controls Inc. or Lectro modular plug-in design with snap-mount mounting bases, retaining springs or clips, DPDT, 3 PDT or 4 PDT as required for the application, with contacts rated for 10 amperes at 120 VAC;

- .2 lighting control relays: latching type with integral status contacts rated for 20 amperes at 120 VAC, each complete with a split low voltage coil that moves the voltage contact armature to On or Off latched position, each controlled by a pulsed tri-state output (preferred) or pulsed paired binary outputs, and each designed so power outages will not result in a change-of-state and so multiple same state commands will simply maintain commanded state.
- .9 Electronic signal isolation transducers equal to Advanced Control Technologies for installation whenever an analog output signal from building automation system is to be connected to an external control system as an input (i.e. equipment control panel), or is to receive as an input signal from a remote system, and to provide ground plane isolation between systems.
- .10 Each manual override station is to be complete with contacts rated minimum 1 ampere at 24 VAC and is to provide following:
 - .1 integral H-O-A switch to override controlled device pilot relay;
 - .2 status input to building automation system to indicate whenever switch is not in the Auto position;
 - .3 status LED to illuminate whenever output is On;
 - .4 override LED to illuminate whenever H-O-A switch is in either the Hand or Off position.
- .11 Electronic/pneumatic transducers equal to Johnson Controls Inc. transducers with an output of from 3 to 15 psig, an input of from 4 to 20 mA or 10 VDC, manual output adjustment, a pressure gauge, and an external replaceable supply air filter.
- .12 Thermostats:
 - .1 Wall mounting adjustable set-point thermostats, each suitable in all respects for equipment (and operating sequence) they are provided for, equipped with a thermometer, a cover and any required mounting and connection accessories.
 - .2 Pneumatic thermostats are to be of bimetal element construction, double valve type, operating without constant waste of air.
 - .3 Line voltage thermostats are to be 115 volt.
 - .4 Low voltage thermostats are to be 24 volt electronic type.
 - .5 Set-point adjustment for thermostats in public spaces is to be concealed behind cover. Set-point adjustment for other thermostats is to be accessible through cover.
 - .6 Covers are to be removable, tamper-proof covers with temperature set-point and thermometer displays.
 - .7 Guards for thermostats are to be clear, ventilated acrylic covers with allen key locking hardware.
- .13 Humidistats:
 - .1 Direct or reverse acting (to suit system), proportional type, adjustable humidity controllers, each corrosion resistant, suitable in all respects for the application and complete with a nylon element, replaceable cartridge type air filter, internally adjustable limit stops for maximum and minimum settings, a cover, and required mounting and connection accessories.
 - .2 Pneumatic humidistats are to be 2 pipe type and complete with plug-in air connections.
 - .3 Electric humidistats are to be line voltage (115 volt), or 24 volt electronic type.
 - .4 Wall mounting humidistats are to be complete with a tamper-proof display type cover.

- .5 Duct mounting humidistats are to be complete with a display type cover, duct sampling chamber with 300 mm (12") long extruded pick-up tube for duct mounting, a moulded mounting base, and a ventilated cover.
- .14 Hardware to permit building automation system control and monitoring of input/output points in accordance with Section 25 05 02 - Building Automation System, points schedule, and drawing control diagrams and operation sequences. All such hardware is to be suitable in all respects for interface with the building automation system.

2.05 SYSTEM WIRING MATERIALS

- .1 System wiring, conduit, boxes, and similar materials are to be in accordance with requirements specified in appropriate Section(s) of Electrical Work specification.

3 Execution

3.01 GENERAL RE: INSTALLATION OF CONTROLS

- .1 Provide complete systems of control and instrumentation to control and supervise building equipment and systems in accordance with this Section and drawings.
- .2 Control systems are to generally be as indicated on drawing control diagrams and are to have all the elements therein indicated or implied.
- .3 Control diagrams show only the principal components controlling the equipment and systems. Supplement each control system with all relays, transformers, sensors, etc., required to enable each system to perform as specified and to permit proper operation and supervision.
- .4 Brace and secure control system equipment in accordance with requirements specified in Section 20 05 48.16 - Seismic Controls for Mechanical Systems.

3.02 SUPPLY OF AUTOMATIC CONTROL VALVES AND OPERATORS

- .1 Unless otherwise specified, supply required automatic control valves. Hand valves to appropriate piping trades at site in locations they are required for installation as part of piping work. Ensure each valve is properly located and installed.
- .2 Provide an operator for each valve.

3.03 INSTALLATION OF THERMOSTATS

- .1 Unless otherwise noted, provide required thermostats.
- .2 Provide a ventilated clear acrylic cover for each thermostat located in finished areas, and a wire type guard for each thermostat located in unfinished areas and in areas such as mechanical rooms where thermostat is subject to damage.
- .3 Unless otherwise indicated, mount room thermostats 1.5 m (5 ft.) above finished floor level. Thermostats intended to be used by building occupants in a barrier-free path of travel to be mounted at 1.2m. Confirm exact location of all thermostats prior to roughing-in.
- .4 Provide stand-off mounting and an insulated sub-base for thermostats on outside walls.
- .5 Perform control wiring associated with installation of electric or electric-electronic thermostats.

3.04 INSTALLATION OF CONTROL SYSTEM COMPONENTS

- .1 Provide required control system components and related hardware. Refer to drawing control diagrams and sequences.
- .2 Where components are pipe, duct, or equipment mounted supply components at proper time, coordinate installation with appropriate trade, and ensure components are properly located and mounted.

3.05 CONTROL WIRING

- .1 Perform required control wiring work for control systems except:
 - .1 power wiring connections to equipment and panels, except as noted below;
 - .2 control wiring associated with mechanical plant equipment and systems whose control is not part of work specified in this Section;
 - .3 starter interlock wiring.
- .2 Except as specified below, install wiring in conduit. Unless otherwise specified, final 600 mm (2') connections to sensors and transmitters, and wherever conduit extends across flexible duct connections is to be liquid-tight flexible conduit.
- .3 Control wiring in ceiling spaces and wall cavities may be plenum rated cable installed without conduit but neatly harnessed, secured, and identified.
- .4 Wiring work is to be in accordance with certified wiring schematics and instructions, and wiring standards specified in appropriate Sections of Electrical Work Specification.

3.06 IDENTIFICATION AND LABELLING OF EQUIPMENT AND CIRCUITS

- .1 Refer to identification requirements specified in Section 20 05 00 – Common Work Results for Mechanical.
- .2 Identify equipment as follows:
 - .1 enclosures and components: engraved laminated nameplates with wording listed and approved prior to manufacture of nameplates;
 - .2 wiring: numbered sleeves or plastic rings at both ends of conductor, with numbering corresponding to conductor identification on shop drawings and "as-built" record drawings.

3.07 TESTING, ADJUSTING, CERTIFICATION, START-UP, AND TRAINING

- .1 When control work is complete, check installation of components and wiring connections, make any required adjustments, and coordinate adjustments with personnel doing HVAC testing, adjusting and balancing work.
- .2 For equipment/system manufacturer certification requirements, refer to Section 20 05 00 – Common Work Results for Mechanical.
- .3 For equipment/system start-up requirements, refer to Section 20 05 00 – Common Work Results for Mechanical.
- .4 Include for 2 full, 8 hour days on-site operation demonstration and training sessions. Training is to be a full review of all components including but not limited to a full operation and maintenance demonstration, with abnormal events.

- .5 Include for 2 follow-up site training and troubleshooting visits, one 6 months after Substantial Completion and other at end of warranty period, both when arranged by Owner and for a full, 8 hour day to provide additional system training as required, and to demonstrate troubleshooting procedures.

End OF Section

1 General

1.01 SUMMARY

- .1 Section Includes
 - .1 Circuit breaker retrofit installations. The existing low voltage switchboard is equipped with low voltage metal enclosed fusible disconnect switchboard structures of an obsolete vintage with little to no product support except unreliable retrofitted replacements, or the available product support is not available in the required device size.
 - .2 Related Requirements
 - .1 Section 26 28 16.02 – Molded Case Circuit Breakers.

1.02 REFERENCES

- .1 Execute the work in accordance with the requirements of Ontario Electrical Safety Code, the Canadian Electrical Code, the Ontario Building Code and all Authorities Having Jurisdiction (AHJ).

1.03 SUBMITTALS

- .1 Provide detailed drawings of planned switchboard modifications after internal survey has been completed.
- .2 Submit circuit breaker and accessory submittals in accordance with Section 26 28 16.02.
- .3 Submit a detailed Method of Procedures (MOP) document that provides detailed step-by-step instructions for how the work is to be executed.

1.04 CLOSEOUT SUBMITTALS

- .1 Record documentation:
 - .1 Exact modifications performed to the existing electrical distribution equipment.
 - .2 Inspection certificate from AHJ.

2 Products

2.01 MOLDED CASE CIRCUIT BREAKERS

- .1 In accordance with Section 26 28 16.02.
- .2 Interrupting capacity to match that of the upstream breaker.

2.02 BUSSING KITS

- .1 Copper, ampacity to match existing.
- .2 Provide all accessories required for a complete installation.

3 Execution

3.01 INSTALLERS

- .1 Installers List
 - .1 Bibico Electric Inc.

- .2 Commercial Switchgear Ltd.
- .3 Approved equal.

3.02 EXAMINATION

- .1 Preparation and Scheduling
 - .1 Provide 12 weeks notice to Owner's personnel, and to the Consultant, prior to scheduled power shutdown dates.
 - .2 Shutdown to occur during overnight weekend hours.
 - .3 Provide power shutdown schedule for approval by the Owner.
- .2 Survey of Internal Bussing
 - .1 During shutdown, survey the existing bussing to confirm available space for connecting the new devices.
 - .2 Coordinate site visits with circuit breaker vendors.
 - .3 Check and verify all dimensions on the job site. Exact bus orientation and configuration is to be verified by breaker manufacturer, or its representative.

3.03 INSTALLATION

- .1 Include under this tender price for bus and bucket modification costs.
- .2 Relocate existing branch circuit devices and branch feeders to allow space for new devices.
- .3 Modify existing breaker bus to accept new molded case circuit breakers.
- .4 Install new circuit breakers as indicated on the drawings.
- .5 Make good existing breaker control wiring with new breaker controls. Bring replacement to pre-replacement status.
- .6 Make good blank-off plates.
- .7 Identify all new equipment. New switchboard branch breakers to be permanently identified with etched lamacoid nameplates in accordance with Section 26 05 53.

3.04 FIELD TESTS AND INSPECTIONS

- .1 Test new devices in accordance with Section 26 28 16.02.
- .2 Employ the services of the manufacturer's representative to perform testing, verification and commissioning of new breakers, new bus bar inter-connections and overall integrity of the modified switchboard.
- .3 Provide for the costs of the Authority Having Jurisdiction to inspect and accept the work prior to re-energizing the switchboard.

3.05 SYSTEM STARTUP

- .1 At conclusion of installation, use appropriate arc flash protection during re-energizing of the equipment.

3.06 CLEANING

- .1 Before energizing any systems, inspect and clean the inside of switchgears, duct assembly, and cabinets to ensure that they are completely free from dust and debris. Clean all polished, painted and plated work bright. Remove all debris, surplus material, and all tools. Carry out additional cleaning operating of systems as specified in other sections of this division.

End of Section

1 General

1.01 SECTION INCLUDES

- .1 Common requirements for electrical work.
- .2 Mounting heights for electrical equipment and devices.

1.02 RELATED REQUIREMENTS

- .1 Provisions of this section apply to all sections of Division 26, Division 27, Division 28, and sections related to electrical utilities in Division 33.
- .2 Document 00 64 01 – Request for Electronic Files Form.
- .3 Section 07 60 00 – Flashing and Sheet Metal.
- .4 Section 07 84 00 – Firestopping.
- .5 Section 08 31 00 – Access Doors and Panels.
- .6 Section 09 91 00 – Painting.
- .7 [All sections related to heat tracing].
- .8 This section is to be read in conjunction with Division 00 documents, and Division 01 specification sections, which take precedence as described in CCDC 2-2020.
 - .1 General Conditions.
 - .2 Supplementary General Conditions.
 - .3 General Requirements.

1.03 INTENT

- .1 Include all material, labour, equipment, and plant construction as necessary to make a complete installation as shown and specified hereinafter.
- .2 Leave complete systems ready for continuous and efficient satisfactory operation.
- .3 Discipline and Trade Jurisdiction
 - .1 In accordance with CCDC 2-2020 GC 1.1.9: Neither the organization of the Specifications nor the arrangement of Drawings shall control the Contractor in dividing the work among Subcontractors and Suppliers.
 - .2 MasterFormat's organizational structure used in a project manual does not imply how the work is assigned to various design disciplines, trades, or subcontractors. MasterFormat is not intended to determine which particular elements of the project manual are prepared by a particular discipline. Similarly, it is not intended to determine what particular work required by the project manual is the responsibility of a particular trade. A particular discipline or trade is likely to be responsible for subjects from multiple Divisions, as well as from multiple Subgroups.

1.04 DRAWINGS AND SPECIFICATIONS

- .1 The drawings and specifications are complementary each to the other and what is called for by one to be binding as if called for by both. Should any discrepancy appear between the drawings and specifications, which leaves the Contractor in doubt as to the true intent and meaning of plans and specifications, a

- ruling is to be obtained from the Consultant in writing before submitting Bid. If this is not done, the maximum, the most expensive alternate or option will be provided in base tender bid.
- .2 All drawings and all Divisions of these specifications shall be considered as a whole, and work of this Division shown anywhere therein shall be furnished under this Division.
 - .3 Drawings are diagrammatic and indicate the general arrangement of equipment and pathways. Most direct routing of conductors and wiring is not assured. Exact requirements are governed by architectural, structural, and mechanical conditions of the job. Consult all other drawings in preparation of the bid. Extra lengths of wiring or addition of pull and junction boxes, etc. necessitated by such conditions are to be included in the bid. Check all information and report and apparent discrepancies before submitting the bid.
 - .4 Contractor shall determine the exact locations of equipment and rough-ins, and the exact routing of pathways so as to best fit the layout of the job. Plan, coordinate, and establish exact locations and routing of services with affected trades prior to installation such that services clear each other, as well as other obstructions.
 - .5 Determine final locations of major work within ceiling spaces based on the largest equipment first.
 - .6 Unless otherwise shown or specified, conceal work in finished areas, and conceal work in partially finished and/or unfinished areas to extent made possible by the area construction. Install services as high as possible to conserve headroom and/or ceiling space. Notify the Consultant where headroom or ceiling space appears to be inadequate prior to installation of the work.
 - .7 Scaling off the drawings will not be sufficient or accurate for determining these locations. Where job conditions require reasonable changes in indicated arrangement and locations, such changes shall be made at no additional cost to the Owner.
 - .8 Because of the scale of the drawings, certain basic items, such as junction boxes, pull boxes, conduit fittings, etc. may not be shown, but where such items are required by other sections of the specifications of where there are required for proper installation of the work, such items are to be furnished and installed.
 - .9 Before ordering any conduit, cable tray, conductors, wireways, raceway bus duct, fittings, etc., verify all pertinent dimensions at the job site and be responsible for their accuracy.
 - .10 If obvious ambiguities or omissions are noticed when tendering refer same to the Consultant for a ruling and obtain the ruling in writing in the form of an Addendum. Claims for extras for ambiguities or omission of items brought to the attention of the Consultant after the award of a contract which, due to the nature of the ambiguity or omission, should have been brought to the attention of the Consultant during the tendering period, will not be allowed.
 - .11 The drawings are performance drawings, diagrammatic, and show locations for apparatus and materials. The drawings are intended to convey the scope of work and do not intend to show Architectural and Structural details. The locations shown are approximate, and may be altered, when approved by the Consultant, to meet requirements of the material and/or apparatus, other equipment and systems being installed, and of the building. Do not scale drawings.
 - .12 Control devices, equipment requiring maintenance, junction boxes, and similar products, particularly such products located above suspended ceilings must be located for easy access for servicing and/or removal. Products which do not meet this location requirement are to be relocated to an accessible location at no additional cost.
 - .13 Be responsible for making necessary changes, at no additional cost, to accommodate structural and building conditions that were foreseeable by a review of existing conditions or a review of drawings prepared by other disciplines.

- .14 Where drawings indicate that acoustic tile ceiling is being suspended below existing plaster ceilings, coordinate the design of framework used to support this suspended ceiling, lighting, diffusers, and other components that are mounted within or through ceiling. Do not mount devices to suspended ceilings. Secure and mount to ceiling slab above. Seal ceiling openings to maintain required fire rating.
- .15 Provide any fitting, offset, transformation, etc., required to suit architectural and structural details but not shown.

1.05 WORK RESTRICTIONS

- .1 Refer to Section 01 14 00.
- .2 [Existing buildings:]
 - .1 Examine the existing building, the site and surrounding areas and be fully informed as to the conditions and limitations under which the work has to be executed. Claims for additional costs will not be entertained with respect to conditions which could reasonably be ascertained by an inspection prior to Tender closing.
 - .2 All work in the existing building, other than minor works required to permit construction of the new addition, is to be performed in such a manner as to not disrupt the building operations.
 - .3 All systems are to be kept in full operation during normal building hours.
 - .4 Note that any noise generating works that disrupt the building operation shall be coordinated accordingly and carried out after/before normal operating hours.
 - .5 Cut, modify, or extend as necessary or as directed by the Consultant, the existing material or equipment to be reused or relocated to suit work under this contract.
 - .6 Existing materials and equipment which are to be used in new work shall be repaired and refinished as necessary. Provide additional new materials and components as required to facilitate reinstallation of such existing materials and equipment.
 - .7 Co-ordinate with the Owner, and refer to General Conditions.
 - .8 Do work in existing areas to best suit available space and not interfere with or obstruct use of existing facilities.
 - .9 Where disruptions of existing services are required, coordinate shut down with the Owner's operating staff and do the work at a time and in a manner mutually acceptable. Carefully schedule disruptions to keep "down time" to a minimum.
- .3 Do all cutting, patching and making good to leave in a finished condition and to make the several parts of the Work come together properly. Co-ordinate work to keep cutting and patching to a minimum.
- .4 Quality of workmanship and materials used in patching, making good and refinishing of existing construction and/or compartments shall be of a standard equal to that specified for new construction and if not specified, equal to or exceeding that of original existing work.
- .5 Prior to cutting openings, examine wall, floor and ceiling construction for buried electrical cables and pipes; and take adequate protection. Conduct cable locating tests to locate buried cables in existing work.

1.06 ALLOWANCES

- .1 Cash allowances are to be carried as indicated in Section 01 21 00 for the items indicated, each including all equipment, wiring material, labour, incidentals, profit, overhead, taxes, etc.
 - .1 [Access Control and Intrusion Detection Systems.]

- .2 [Integrated Telephone/Public Address (PA) System.]
- .3 [Communications structured cabling.]
- .4 [Electric utility requirements for new service.]
- .5 [Supply of temporary generator, fuel, and equipment as described in Section 26 01 21.81.]
- .2 Conduit and wireway rough-in for the above systems is part of this contract, and is excluded from the above allowances.

1.07 SUBSTITUTION PROCEDURES

- .1 Refer to Section 01 25 00 and General Provisions of the Contract.
- .2 Additionally, "Approved equal" shall be defined as an alternate approved by the Consultant.
- .3 If during the tender bid process, the bidding contractor wishes to substitute the specified equipment for an "Approved equal", the bidding contractor must submit shop drawings to the Consultant before the tender close for approval. If no substitution request is made, the as-specified equipment is that to be provided.
- .4 Where several manufacturers' names are given, the first named manufacturer constitutes the basis for job design and establishes the equipment quality required to be used in this contract.
- .5 This contractor, at his option, may use equipment as manufactured by any of the listed manufacturers. This Contractor is responsible to ensure that all items submitted by these other manufacturers meets are requirements of the drawings and specification and fits in the allocated space. The final determination of a product being equivalent is to be determined by the Consultant when a catalog number is not listed, or listed in part.
- .6 Any material, article or equipment of other unnamed manufacturers which will adequately perform the services and duties imposed by the design and is of a quality equal to or better than the material, article or equipment identified by the drawings and specifications may be used if approval is secured in writing from the Consultant as described in the General Provisions of the Contract for Submittals. The Contractor bears full responsibility for the unnamed manufacturers' equipment adequately meeting the intent of the design. The Owner or the Consultant may reject manufacture at time of shop drawing submittal.
- .7 In addition to manufacturer's products base specified or named as acceptable, other manufacturers of products may be proposed as substitutions to the Consultant for review and consideration for acceptance, listing in each case a corresponding credit for each substitution proposed. However, base Bid Price on products base specified or named as acceptable. Certify in writing to the Consultant that proposed substitution meets space, power, design, energy consumption, and other requirements of base specified or acceptable product. It is understood that there will be no increase in Contract Price by reason of any changes to associated equipment, mechanically, electrically, structurally or architecturally, required by acceptance of proposed substitution. Consultant has sole discretion in accepting any such proposed substitution of product. Indicate any proposed substitutions in areas provided on Bid Form. Do not order such products until they are accepted in writing by the Consultant.

1.08 CONTRACT MODIFICATION PROCEDURES

- .1 When submitting quotations in response to changes in the contract, quotations for electrical work are to include a breakdown of all material, including material unit rates, and labour units as indicated in the NECA Manual of Labor Units (MLU).

1.09 COORDINATION

- .1 Refer to Section 01 31 00.

- .2 Coordinate work with other trades to avoid conflict and to provide correct rough-in and connection for equipment furnished under other trades that require electrical connection. Inform Contractors of other trades of the required access to and clearances around electrical equipment to maintain serviceability and code compliance.
- .3 Verify equipment dimensions and requirements with provision specified under this Section. Check actual job conditions before fabricating work. Report necessary changes in time to prevent needless work. Changes or additions subject to additional compensation, which are made without written authorization and an agreed price, shall be at Contractor's risk and expense.
- .4 Read specifications and drawings of other trades and conform with their requirements before proceeding with any work specified in this Division related to other trades. Co-operate with all other trades on the job, so that all equipment can be satisfactorily installed, and so that no delay is caused to any other trades.
- .5 Coordinate utility service outages with the owner. Obtain permission from Owner at least 24 hours before partially or completely disabling system. Minimize outage duration.
- .6 [Existing Fire Alarm System: Maintain existing system in service. Disable system only to make switch overs and connections. Notify Owner at least 24 hours before partially or completely disabling system. Minimize outage duration.]
- .7 [Provide temporary wiring and connections to maintain existing systems in service during construction. When work must be performed on energized equipment or circuits, use personnel experienced in such operations.]
- .8 Co-ordinate work with all trades to ensure a proper and complete installation. Notify all trades concerned of the requirement for openings, sleeves, insets and other hardware necessary for the installation and, where work is to be integrated with the work of other trades or is to be installed in close proximity with the work of other trades, carefully co-ordinate the work prior to installation.
- .9 Working Detail Drawings
 - .1 The contractor is to prepare working detail drawings supplementary to the contract drawings, when deemed necessary by the Consultant, for all areas where a multiplicity of materials and or apparatus occur, or where the work due to architectural and structural considerations involves special study and treatment. Such drawings may be prepared jointly by all trades affected, or by the one trade most affected with due regard for and approval of the other trades, all as the Consultant will direct in each instance. Such drawings must be reviewed by the Consultant before the affected work is installed.
 - .2 Carry out all alterations in the arrangement of work which has been installed without proper study and approval, even if in accordance with the contract documents, in order to make such work come within the finished lines of walls, floors and ceilings, or to allow the installation of other work, without additional cost. In addition, make any alterations necessary in other work required by such alterations, without additional cost.

1.10 SUBMITTAL PROCEDURES

- .1 Refer to Section 01 33 00.
- .2 Before delivery to site of any item of equipment, submit shop drawings complete with all data, pre-checked and stamped accordingly, for review by the Consultant. Indicate project name on each brochure or sheet, make reference to the number and title of the appropriate specification section, type identifier such panelboard ID or luminaire type as indicated on appropriate schedule, and provide adequate space to accommodate the Consultant's review stamp(s).
- .3 Verify field measurements and affected adjacent Work are coordinated, including passageway clearances for movement of equipment into location.

- .4 Submit shop drawings to the Consultant in electronic (PDF) format, as coordinated after award of contract. Where submittals are derived from digital originals, do not print and rescan documents; submittals made as such will be immediately rejected.
- .5 Submit a schedule of shop drawings within one week after award of contract. Group submittals by specification division as appropriate.
- .6 Shop Drawings
 - .1 Submit for review, properly identified shop drawings showing in detail the design and construction of all equipment and materials as requested in sections of the specification governed by this Section.
 - .2 Obtain and comply with the manufacturer's installation instructions.
 - .3 Endorse each shop drawing copy "CERTIFIED TO BE IN ACCORDANCE WITH ALL REQUIREMENTS", stamp each copy with your company name, date each copy with the submittal date, and sign each copy. Shop drawings which are received and are not endorsed, dated and signed will be returned for re-submittal.
 - .4 The Consultant will stamp shop drawings as follows:
 - .1 Reviewed ()
 - .2 Reviewed as Modified ()
 - .3 Revise and Re-Submit ()
 - .4 Not Reviewed ()
 - .5 If "REVIEWED" is checked-off, the shop drawing is satisfactory. If "REVIEWED AS MODIFIED" is checked-off, the shop drawing is satisfactory subject to requirements of remarks put on shop drawing copies. If "REVISE AND RE-SUBMIT" is checked-off, the shop drawing is entirely unsatisfactory and must be revised in accordance with comments written on shop drawing copies and resubmitted. If "NOT REVIEWED" is checked-off, the shop drawing is in error of submission, not applicable for this project.
 - .6 This review by the Consultant is for the sole purpose of ascertaining conformance with the general design concept. This review shall not mean that the Consultant approved the detail design inherent in the shop drawings, responsibility for which shall remain with the Contractor, and such review shall not relieve the Contractor of responsibility for errors or omissions in the shop drawings or of responsibility for meeting all requirements of the contract documents. Be responsible for dimensions to be confirmed and correlated at the job site, for information that pertains solely to fabrication processes or to techniques of construction and installation, and for co-ordination of the work as well as compliance with codes and inspection authorities such as CSA, etc.
- .7 Confirm layouts of major electrical equipment rooms with the dimensions of as-procured equipment, and submit a layout sketch to the Consultant showing the major equipment and required clear spaces. The contractor may, at their option, revise the layout of the major electrical equipment rooms, but take responsibility for these new layouts and meeting the requirements of the local electrical utilities. Capture final room layouts on as-built drawings.

1.11 SAFETY REQUIREMENTS

- .1 Refer to Section 01 35 29.

- .2 Be responsible for the safety of workers and the equipment on the project in accordance with all applicable safety legislation passed by Federal, Provincial, and local authorities governing construction safety. The more stringent regulations prevail.

1.12 REGULATORY REQUIREMENTS

- .1 Refer to Section 01 41 00.
- .2 Codes and Standards
 - .1 Ontario Electrical Safety Code including all bulletins and amendments.
 - .2 Ontario Building Code and its referenced standards.
 - .3 Applicable CSA and ULC standards.
 - .4 [All work shall be in accordance with Owner's Design Guidelines.]
- .3 Permits and Fees
 - .1 Obtain and pay for all permits and fees required for the execution and inspection of the electrical work and pay all charges incidental to such permits. Submit to Electrical Inspection Department and Supply authority necessary number of drawings and specifications for examination and approval prior to commencement of work. Arrange and pay for any special inspection of equipment specified if and when required.
 - .2 Apply, pay and obtain all permits as required for the electrical work.
 - .3 Upon substantial completion of your work, supply and turn over to the Consultant all required inspection certificates from governing authorities to certify that the work as installed conforms to the rules and regulations of the governing authorities.
- .4 Patents
 - .1 Pay all royalties and licence fees, and defend all suits or claims for infringement of any patent rights, and save the Owner, Architect, Project Manager and Consultants harmless of loss or annoyance on account of suit, or claims of any kind for violation or infringement of any letters patent or patent rights, by this Subcontractor or anyone directly or indirectly employed by him or by reason of the use by him or them of any part, machine, manufacture or composition of matter on the work, in violation or infringement or such letters patent or rights.

1.13 REFERENCES

- .1 CSA Group
 - .1 CSA C22.1-18, Canadian Electrical Code, Part 1 (24th Edition), Safety Standard for Electrical Installations.
 - .2 CSA C235:19, Preferred voltage levels for AC Systems up to 50 000 V.
 - .3 Do underground systems in accordance with CSA C22.3 No. 7-15, Underground systems, except where specified otherwise.
 - .4 Ontario Electrical Safety Code (27th edition/2018), and all bulletins.
- .2 Electrical and Electronic Manufacturer's Association of Canada (EEMAC)
 - .1 EEMAC 2Y-1-1958, Light Gray Colour for Indoor Switch Gear.
- .3 Health Canada / Workplace Hazardous Materials Information System (WHMIS)

- .1 Material Safety Data Sheets (MSDS).
- .4 Electrical utility requirements and local applicable codes and regulations.
- .5 Institute of Electrical and Electronics (IEEE)/National Electrical Safety Code Product Line (NESC)
 - .1 IEEE SP1122-2000, The Authoritative Dictionary of IEEE Standards Terms, 7th Edition.
- .6 2012 Ontario Building Code.

1.14 DEFINITIONS

- .1 Electrical and electronic terms: unless otherwise specified or indicated, terms used in these specifications, and on drawings, are those defined by IEEE SP1122.

1.15 QUALITY ASSURANCE

- .1 Refer to Section 01 43 00.
- .2 The specifications contained herein are set forth as the minimum acceptable requirements. This does not relieve the Contractor from executing other quality assurance measures to obtain a complete operating system within the scope of this project.
- .3 Ensure that all workmanship, all materials employed, all required equipment and the manner and method of installation conforms to accepted construction and engineering practices, and that each piece of equipment is in satisfactory working condition to satisfactorily perform its functional operation.
- .4 Provide quality assurance tests and operational check on all components of the electrical distribution system, all lighting fixtures, and communication systems.
- .5 Only first class workmanship will be accepted, not only in regards to durability, efficiency and safety, but also in regards to neatness of detail. Present a neat and clean appearance on completion to the satisfaction of the Consultant. Any unsatisfactory workmanship will be replaced at no extra cost.
- .6 Conform to the best practices applicable to this type of work. Install all equipment and systems in accordance with the manufacturer's recommendations, but consistent with the General Requirements of this specification. Electrical Contractor will be held responsible for all damage to the work of his own or any other trade, resulting from the execution of his work. Store all electrical equipment and materials in dry locations.
- .7 Provide foreman in charge of this work at all times.
- .8 The contractor shall be fully liable to provide and maintain in force during the life of this Contract, such insurance, including Public Liability Insurance, Product Liability Insurance, Auto Liability Insurance, Worker's Compensation, and Employer's Liability Insurance.
- .9 Governing Federal, Provincial and Municipal codes and regulations will be considered minimum standards for the work and where these are at variance with the drawings and specification, the more stringent ruling will apply.
- .10 Where any code, regulation, bylaw, or standard is quoted it shall mean the current edition including all revisions or amendments at the time of the tender.
- .11 In case of conflict, the codes and regulations take precedence over the Contract Documents. In no instance reduce the standard or scope of work or intent established by the drawings and specifications by applying any of the codes referred to herein.

1.16 QUALITY CONTROL

- .1 Refer to Section 01 45 00.

- .2 Provide a full time Superintendent to oversee and coordinate all sub-trades in these divisions.

1.17 TEMPORARY UTILITIES

- .1 Refer to Section 01 51 00.
- .2 Do not use any of the permanent facility systems during construction except as may be specified, or unless written approval is obtained from the Consultant.
- .3 The use of permanent facilities for temporary construction service will not affect in any way the commencement day of the warranty period.
- .4 Temporary heating during the construction period will be provided as described in Division 01.

1.18 TEMPORARY FACILITIES AND CONTROLS

- .1 Refer to Section 01 56 00.
- .2 Prior to start of each work period in occupied area, install temporary protection to prevent damage to any personal property or furnishing. Coordinate with Owner's representative if any furniture must be relocated to facilitate work.
- .3 [Submit temporary protection plan to Owner's Representative for approval prior to use.]
- .4 Take necessary steps to ensure that required firefighting apparatus is accessible at all times. Flammable materials shall be kept in suitable places outside the building.

1.19 PRODUCT REQUIREMENTS

- .1 Refer to Section 01 61 00.
- .2 The design, manufacture and testing of electrical equipment and materials shall conform to or exceed the latest applicable CSA, IEEE, and ANSI standards.
- .3 All materials must be new and be ULC or CSA listed. Any materials not covered by the aforementioned listing standards shall be tested and approved by an independent testing laboratory, Technical inspection Services, or other government agency.
- .4 Materials and equipment are specifically described and named in this Specification in order to establish a standard of material and workmanship.
- .5 Materials required for performance of work shall be new and the best of their respective kinds and of uniform pattern throughout work.
- .6 Materials shall be of Canadian manufacture where obtainable. Materials of foreign manufacture, unless specified, shall be approved before being used.
- .7 Equipment items shall be standard products of approved manufacture. Identical units of equipment shall be of same manufacture. In any unit of equipment, identical component parts shall be of same manufacture, but the various component parts comprising the unit need not be of one manufacture.
- .8 Chemical and physical properties of materials and design performance characteristics and methods of construction and installation of items of equipment, specified herein, shall be in accordance with latest issue of applicable Standards or Authorities when such are either mentioned herein, or have jurisdiction over such materials or items of equipment.
- .9 Materials shall bear approval labels as required by Code and/or Inspection Authorities.
- .10 Install materials in strict accordance with manufacturer's recommendations.

- .11 Include items of material and equipment not specifically noted on Drawings or mentioned in Specification but which are necessary to make a complete and operating installation.
- .12 Remove materials, condemned as not approved for use, from job site and deliver and install suitable approved materials in their place.
- .13 Unless otherwise noted, equipment and material specifications in Sections of the Specification governed by this Section are based on products of a manufacturer selected by the Consultant for the purpose of setting a standard of quality, size, performance, capacity, appearance and serviceability.
- .14 In most instances the names of acceptable manufacturers are also stated for materials and equipment, and you may base your tender price on equipment and materials produced by either the specified manufacturer or a manufacturer listed as acceptable.
- .15 For any items of equipment, material, or for any system where acceptable manufacturers are not stated, you must provide only the equipment, material or system specified.
- .16 If materials or equipment manufactured and/or supplied by a manufacturer named as acceptable are used in lieu of products of the manufacturer specified, be responsible for ensuring that the substituted material or equipment is equivalent in size, performance and operating characteristics to the specified materials or equipment, and it shall be understood that all costs for larger starters, additional space, larger power feeders, and changes to associated or adjacent work required as a result of providing materials and equipment named as acceptable in lieu of the specified product will be borne by Contractor.
- .17 In addition to the manufacturers specified or named as acceptable, the Contractor may propose alternative manufacturers of equipment and/or apparatus to the Consultant for acceptance, listing in each case a corresponding credit for each alternative proposed, however, the tender price must be based on apparatus or materials specified or named as acceptable. Certify in writing to the Consultant that the alternative meets all space, power, design, and all other required of the specified or equivalent material or apparatus. In addition, it shall be understood that all costs for larger starters, space, power feeders, and changes to associated equipment, mechanical and/or electrical, required by acceptance of proposed alternatives, will be borne by the party making the proposal. Alternative equipment requiring greater than specified energy requirements or unduly limiting service space requirements will not be accepted.
- .18 Where a manufacturer is not listed for a particular product, it will be deemed to mean that the contractor will provide the specified manufacturer's product.

1.20 EXAMINATION AND PREPARATION

- .1 Refer to Section 01 71 00.
- .2 Examine the existing equipment, the site and surrounding areas and be fully informed as to the conditions and limitations under which the work has to be executed. Claims for additional costs will not be entertained with respect to conditions which could reasonably have been ascertained by an inspection prior to Tender closing.
- .3 Examine work upon which your work depends. Report in writing defects in such work. Application of your work shall be deemed acceptance of work upon which your work depends.
- .4 Drawings are, in part, diagrammatic and are intended to convey scope of work and indicate general and approximate location, arrangement and sizes of equipment, piping, and similar items. Obtain more accurate information about locations, arrangement and sizes from study and coordination of drawings, including shop drawings and manufacturers' literature and become familiar with conditions and spaces affecting these matters before proceeding with work.
- .5 Where job conditions require reasonable changes in indicated locations and arrangements, make such changes with approval of the Consultant at no additional cost to the Owner. Similarly, where existing conditions interfere with new installation and require relocation, such relocation is included in work.

1.21 CUTTING AND PATCHING

- .1 Refer to Section 01 73 00.
- .2 The Electrical Contractor will be responsible for all cutting and patching required for the electrical installation. Structural members are not to be cut without the consent of the Consultant.
- .3 All cutting and patching required under Division 26, Division 27, and Division 28 shall be in accordance with Division 01. Layout such work for approval before undertaking same.
- .4 Cutting shall be kept to an absolute minimum and performed in a neat and workmanlike manner using the proper tools and equipment. Caution shall be exercised in all cutting and procedures to ensure that concealed services are not affected. Do not cut if in doubt. Request the Consultant's presence to determine if concealed services exist.
- .5 Assume responsibility for prompt installation of Work in advance of concrete pouring or similar Work. Should any cutting or repairing of finished/unfinished Work be required because such installation was not done, employ the particular trade, whose Work is involved, to do such cutting and patching. Pay for any resulting costs. Layout such Work for approval before undertaking same.

1.22 CLEANING AND WASTE MANAGEMENT

- .1 Refer to Section 01 74 00.
- .2 The Contractor and associated sub trades, at all times during construction, to keep the site free of all debris, boxes, packing, etc., resulting from work of this trade. At the completion of this work, the electrical installation is to be left in a clean and finished condition to the satisfaction of the Consultant.
- .3 Clean and repair existing materials and equipment which remain or are to be reused.
- .4 Luminaires to be reinstalled: Remove existing luminaires for cleaning. Use mild detergent to clean all exterior and interior surfaces; rinse with clean water and wipe dry. Replace lamps, ballasts and broken electrical parts.
- .5 Assume responsibility for removing tools and waste materials on completion of Work, and leave Work in clean and perfect condition.

1.23 STARTING AND ADJUSTING

- .1 Refer to Section 01 75 00.
- .2 Conduct acceptance tests to demonstrate that the equipment and systems actually meet the specified requirements. Tests may be conducted as soon as conditions permit, and consequently make all changes, adjustments, or replacements required as the preliminary tests may indicate prior to the final tests. Tests shall be as specified in various sections of this Division. Carry out tests in the presence of the Consultant. Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project. The Electrical Contractor shall be in charge of the plant during tests. He shall assume responsibility for damages in the event of injury to the personnel, building, equipment, and shall bear all costs for liability, repairs, and restoration in this connection. Submit test results.
- .3 Make tests of equipment and wiring at times requested.
- .4 Tests shall include meggered insulation values, voltage and current readings to determine balance of panels and feeders under full load, and operation of each piece of equipment for correct operation.
- .5 Supply meters, materials and personnel as required to carry out these tests.

- .6 Test electrical work to standards and function of Specification and applicable codes in an approved manner. Replace defective equipment and wiring with new material and leave entire system in complete first class operating condition.
- .7 Connect single phase loads so that there is the least possible unbalance of the supply phases.
- .8 Submit all test results in report format.
- .9 Trial Usage
 - .1 The Consultant reserves the right to use any system, piece of equipment, device, or material for such reasonable lengths of time and at such times as may be required to make a complete and thorough test of the same, or for the purpose of learning operational procedures, before the final completion and acceptance of the work. Such tests shall not be construed as evidence of acceptance of the work, and it is agreed and understood that no claim for damage will be made for injury or breakage to any part or parts of the above due to the aforementioned tests, where such injuries or breakage are caused by a weakness or inaccuracy of parts, or by defective materials or workmanship of any kind. Supply all labour and equipment required for such tests.
 - .2 Perform and pay for all costs associated with any testing required on the system components where, in the opinion of the Consultant the equipment manufacturer's ratings or specified performance is not being achieved.

1.24 CLOSEOUT PROCEDURES

- .1 Refer to Section 01 77 00.
- .2 The Consultant will carry out inspections and prepare deficiency list for action by the Contractor, during and on completion of project.
- .3 Furnish a Certificate of Acceptance from Inspection Department on completion of work.

1.25 CLOSEOUT SUBMITTALS

- .1 Refer to Section 01 78 00.
- .2 Project Record Documents
 - .1 Extra sets of white prints will be provided on which to make, as the job progresses, all approved changes and deviations from the original drawings. Complete Record Drawings accurately marked up in red ink must be submitted for approval before the contract is considered to be completed.
 - .2 Changes and deviations include those made by addenda, change orders, and supplemental instructions, and changes and deviations to be marked on the white print record drawings indicated on supplemental drawings issued with addenda, change orders, and supplemental instructions. Maintain the "as-built" white prints at the site for periodic inspection by the Consultant throughout the duration of the work.
 - .3 Upon substantial completion of the work, obtain a set of reproducible white prints of the drawings and neatly amend the print in accordance with the marked-up white prints to produce a true "as-built" set of drawings.
 - .4 As-built drawings are to indicate all circuiting as installed and all distribution junction box locations as well as conduit routes.
 - .5 Trace routing of existing panelboard feeders for all panelboards and indicate on as-built drawings.
 - .6 As-Built AutoCAD Drawings

- .1 Submit completed Document 00 64 01 to the Consultant[, and remit payment as indicated] for release of the Consultant's AutoCAD files.
- .2 Request CAD release form from the Consultant, and submit completed form back to the Consultant.
- .3 Transfer the information from the "as-built" white prints to the files, and submit to the Consultant for review.
- .4 Employ a competent computer draftsman to indicate changes on the electronic set of record drawings. Provide drawings in PDF and AutoCAD formats.
- .5 Submit three (3) USB flash drives including as-built drawings in AutoCAD format, one with each O&M manual.
- .6 Provide three (3) sets of full size as-built drawings in hard copy format, one with each O&M manual.
- .7 As-built Single Line Diagram
 - .1 Provide in Main Electrical Room one wall mounted copy of as-built Single Line Diagram on 6 mm (1/4 in) foam board.
 - .2 As-built Single Line Diagram to indicate manufacturer name and catalogue numbers of as-installed products.
- .3 Operations and Maintenance (O&M) Data
 - .1 Submit two complete sets of Operation and Maintenance instruction manuals in hard copy, and one in electronic format. Include in each copy of the manual:
 - .1 Verification certificates for installation of life safety systems by the manufacturer's representative.
 - .2 A copy of "reviewed" shop drawings.
 - .3 Complete explanation of operating principles and sequences.
 - .4 Recommended maintenance practices and precautions.
 - .5 Complete wiring and connection diagrams.
 - .6 Certificates of guarantees.
 - .2 Ensure that operating and maintenance instructions are specific and apply to the model and types of equipment provided.
 - .3 Include attendance records for each training session in the O&M manual.
- .4 Warranties
 - .1 Submit a written guarantee to the Owner for one year from the date of acceptance. This guarantee shall bind the contractor to correct, replace or repair promptly any defective equipment workmanship without cost to the Owner.
 - .2 All equipment, materials and workmanship shall be unconditionally guaranteed for a minimum period of one year from the date of acceptance.

- .3 Provide warranty certificates, wherever given or required, in excess of the normal warranty period showing the name of the firm giving the warranty, dated and acknowledged, on specific equipment and systems.
- .4 Warranties for temperature controls and building automation systems will start on the date of verification of acceptance by the Consultant.
- .5 Include these certificates with the maintenance and operating manuals in the appropriate sections.

2 Products – Not Used

3 Execution

3.01 DEMOLITION

- .1 Refer to Division 02 and Section 26 05 05.
- .2 Remove all electrical equipment and devices on redundant structures. Make safe all circuits, and provide continuity of remaining circuits.
- .3 To make safe: Withdraw redundant wiring and remove unwanted conduit/wiring and accessories. Position breakers to OFF position and update panel schedules.
- .4 Make safe any redundant mechanical devices as shown on mechanical drawings.
- .5 Maintain continuity of existing services for other circuits/devices serving areas outside the Work area. Provide additional wiring/conduits/boxes etc. to suit existing services to be maintained and also implement new Work as detailed.
- .6 Allow for this work in Tender Price.
- .7 Turn over designated equipment to the Owner. Dispose of unwanted materials and equipment.

3.02 CONCRETE WORK

- .1 Refer to Division 03 – Concrete.
- .2 Provide all concrete work required for the electrical work. Reinstall surfacing as per architectural requirements.
- .3 Provide a 100 mm (4 inch) high concrete housekeeping pad for floor mounted electrical distribution equipment, such as the following:
 - .1 Transformers.
 - .2 Switchgear and switchboards.
 - .3 Distribution panelboards.
 - .4 Engine Generators.
 - .5 Uninterruptible Power Supplies and batteries.
 - .6 Transfer Switches.

3.03 LINTELS

- .1 Refer to Division 04 – Masonry.
- .2 Lintels for openings in masonry shall conform with requirements of by-laws, and as approved by the Structural Engineer.
- .3 Pay all costs for lintels over openings, required solely by the electrical trades, not shown on architectural or structural drawings.

3.04 METALS

- .1 Refer to Division 05 – Metals.
- .2 Steel construction required solely for the work of this trade, and not shown on architectural or structural drawings shall be provided by this Division to the requirements of Division 05.

3.05 FLASHING AND SHEET METAL

- .1 Refer to Section 07 60 00.
- .2 Flash all conduits and systems passing through roof or built into an outside wall, or a waterproof floor.
- .3 Provide copper flashing for sleeves passing through exterior walls or waterproof floors.

3.06 FIRESTOPPING

- .1 Provide firestopping in accordance with Section 07 84 00.
- .2 Ensure that fire ratings of floors and walls are maintained.
- .3 Provide ULC classified firestopping products by 3M, Hilti, STI, or approved equal which have been tested in accordance with ULC-S115.
- .4 Pack clearance spaces, fill all spaces between openings, pipes and ducts passing through fire separations and install firestopping systems in accordance with the appropriate ULC system number for the products and type of penetration.
- .5 Install firestopping systems using personnel trained or instructed by the product manufacturer.

3.07 ACCESS DOORS

- .1 Provide access doors in accordance with Section 08 31 00.
- .2 Group conduit work to ensure the minimum number of access doors is required.
- .3 Access doors are to be installed by the trade responsible for the particular type of construction in which the doors are required.

3.08 PAINTING AND FINISHES

- .1 Refer to Section 09 91 00.
- .2 Shop finish metal enclosure surfaces by application of rust resistant primer inside and outside, and at least two coats of finish enamel.
- .3 Repair and finish factory finished equipment, damaged or scratched during installation, in an approved manner.

- .4 All structural steel including hangers, brackets, supports and other ferrous metals shall be shop or factory prime painted wherever practicable. Wherever structural steel including hangers, brackets, supports, and other ferrous metals cannot be shop or factory prime painted, wire brush to remove all traces of rust, clean of all traces of dirt, oil, and grease, and apply one coat of an approved rust inhibiting primer in accordance with CGSB-GB-40d, and leave ready to receive finish paint.
- .5 Primary and final painting for Work, other than items specified as factory primed or finished, will be performed as described in Division 09 – Finishes.
- .6 All electrical fittings, supports, hanger rods, pull boxes, channel frames, conduit racks, outlet boxes, brackets, clamps etc., to have galvanized finish or paint finish over corrosion-resistant primer.
- .7 All panelboards, motor starters etc., to be factory finished with baked on enamel. All enamel to be baked on gloss over corrosion resistant primer.
- .8 Touch up minor damage to finish on factory finished equipment. Items suffering major damage to finish shall be replaced at the direction of the Consultant.
- .9 Protect work so that finishes will not be damaged or marred during construction. Maintain the necessary protection until completion of the work.
- .10 Provide all exposed ferrous metal work on equipment with at least one factory prime coat, or paint one prime coat on job. Clean up or wire brush all equipment, etc., before painting.
- .11 For factory applied finishes, repaint or refinish surfaces damaged during shipment, erection or construction work.

3.09 LOCATION OF OUTLETS

- .1 Refer to Architectural drawings for dimensions denoting exact locations.
- .2 The Consultant reserves the right to change the location of outlets to within 3 m from the point indicated on the plans without extra charge providing the Contractor is advised before installation is made.
- .3 Location of lighting, convenience, telephone, power and communication outlets shall be subject to change, without extra cost to Owners, provided information is given prior to installation. No extra amount will be paid for extra labour and materials for relocating outlets up to 3000 mm from their original location nor will credits be anticipated where relocation up to 3000 mm reduces materials and labour. Other cases will be considered on their individual merits.
- .4 Coordinate location of boxes with latest architectural drawings and instructions to suit door swings, millwork etc. prior to rough-in.

3.10 MOUNTING HEIGHTS AND DEVICE LOCATIONS

- .1 Refer to architectural drawings for exact location of electrical equipment and devices.
- .2 Architectural elevations take precedence over electrical elevations. If there are conflicts between architectural and electrical, adjust locations of electrical equipment at no additional cost to the owner.
- .3 Prior to roughing-in, the contractor is to mark locations of electrical equipment and devices for conflicts with architectural, studs, etc. If conflicts are noted, inform the Consultant for a decision prior to commencing the rough-in.
- .4 Mounting heights of equipment and devices listed below is from finished floor to centreline of equipment, unless specified or indicated otherwise.
- .5 If mounting height of equipment is not specified or indicated, verify before proceeding with installation.

- .6 Install electrical equipment at following heights above finished floor (AFF). Dimensions are to centre of device unless indicated otherwise.
 - .1 Power door operator push buttons: 1000 mm.
 - .2 HVAC thermostats and manual HVAC controls: 1200 mm.
 - .3 Local switches, and manual lighting control devices:
 - .1 1100 mm.
 - .2 Locate on lock side of door.
 - .4 System furniture service fittings: to suit furniture layout.
 - .5 Wall receptacles:
 - .1 General: min. 400 mm AFF.
 - .2 Above top of counters: 175 mm.
 - .3 Above top of continuous baseboard heater, or mechanical heating/radiation units: 75 mm to bottom of device.
 - .4 In fan rooms, mechanical rooms, and electrical rooms: 1100 mm.
 - .5 For electric ranges: 130 mm.
 - .6 Outlets in raceways or millwork to be located as per Architectural details.
 - .7 Door bell pushbuttons: 1100 mm.
 - .8 Panelboards: as indicated in Section 26 24 16.
 - .9 Emergency lighting remote heads: 300 mm below finished ceiling, or 2400 mm AFF for exposed areas or areas with ceiling height above 2750 mm (9 feet).
 - .10 Communications:
 - .1 Typical communication outlets (voice and data): 400 mm.
 - .2 Communications outlets for wall mounted telephones, intercom, or similar: 1100 mm.
 - .3 Television outlets: 200 mm below finished ceiling.
 - .4 Wall mounted public address speakers: 2100 mm.
 - .5 Clocks: 2100 mm.
 - .11 Access control card readers and keypads: 900 mm.
 - .12 Fire alarm manual pull stations: 1200 mm.
 - .13 Wall mounted fire alarm audible devices, including bells or horns:
 - .1 2300 mm to the top of the device in areas of ceiling height 2450 mm or greater.
 - .2 150 mm below the finished ceiling for ceiling heights less than 2450 mm, measured to the top of the device.
 - .14 Wall mounted fire alarm visible signal devices, including strobes: 2300 mm.

- .15 Fire Alarm emergency telephones: 1400 mm.

3.11 MANUFACTURER'S INSTRUCTIONS

- .1 Where the specifications call for an installation to be made in accordance with Manufacturer's recommendations, a copy of such recommendations shall be at all times be kept on the job site and be available to the Owner's Representative.
- .2 Follow manufacturer's instructions where they cover points now specifically indicated on the drawings and specifications. If they are in conflict with the drawings and specifications obtain clarification from the Consultant before starting work.

3.12 TESTS AND ACCEPTANCE

- .1 The operation of the equipment and electrical system does not constitute an acceptance of the work by the Owner. The final acceptance is to be made after the Contractor has adjusted his equipment and demonstrated that it fulfills the requirements of the drawings and the specifications.
- .2 Testing of all systems shall be performed in the presence of the Owner's designated representative. The contractor shall give 72 hours advance notice to the Owner before beginning the tests.
- .3 Upon completion of the installation, the Contractor shall furnish certificates of approval from all authorities having jurisdiction, as applicable. Contractor shall demonstrate that work is complete and in perfect operating condition, with raceway and conduit systems properly grounded, wiring free from grounds, shorts, and that the entire installation is free for any physical defects.

3.13 CLOSEOUT ACTIVITIES

- .1 Refer to Section 01 79 00.
- .2 In the presence of the Owner, demonstrate the proper operation of all systems.
- .3 Instruct the Owner's designated representatives in all aspects of the operation and maintenance of systems and equipment listed in the trade sections governed by this Section. Obtain in writing from the Consultant a list of the Owner's representatives qualified to receive instructions.
- .4 Arrange for and pay for the services of qualified service technicians and other manufacturer's representatives required for instruction of specialized portions of the installation.

End of Section

1 General

1.01 SECTION INCLUDES

- .1 Work in existing facilities.
- .2 Electrical demolition.

1.02 RELATED REQUIREMENTS

- .1 Section 02 41 19 – Selective Demolition.

1.03 SCHEDULING

- .1 Refer to Section 01 14 00, and Section 01 73 00.
- .2 All work in the existing building, other than minor works required to permit construction of the new Work, is to be performed in such a manner as to not disrupt the building operations.
- .3 All systems are to be kept in full operation during normal building hours.
- .4 Coordinate any noise generating works that disrupt the building operation to be carried out after/before normal operating hours.

2 Products

2.01 MATERIALS

- .1 Materials and equipment for patching and extending work: As specified in individual sections.

3 Execution

3.01 EXAMINATION

- .1 Verification of Conditions
 - .1 Verify field measurements and circuiting arrangements are as shown on Drawings.
 - .2 Verify that abandoned wiring and equipment serve only abandoned facilities.
 - .3 Demolition drawings are based on casual field observation. Report discrepancies to the Consultant before disturbing existing installation.
 - .4 Beginning of demolition means installer accepts existing conditions.
- .2 Tracing Existing Electrical Circuits
 - .1 Trace all circuits in the area of work listed as existing, and verify existing conditions prior to any modifications as indicated.
 - .2 Where drawings indicate “connect to existing circuit”, use a spare breaker, where available. Otherwise, verify existing load with a meter and advise the Consultant if the additional load will cause a circuit to trip.
 - .3 Where provided panelboard schedules indicate "Existing Circuit" or similar, provide the correct description for the circuit. Existing Circuit will not be acceptable in the final panelboard schedules submitted as part of closeout submittals.

- .3 Existing Cabling in Return Air Plenums
 - .1 In ceilings being used as a return air-plenum, Contractor to review existing low-voltage cabling uncovered as part of the work.
 - .2 Immediately notify the Consultant if any cables identified are not plenum rated (i.e. CMP, or FT6 rated).

3.02 PREPARATION

- .1 Coordinate utility service outages with utility company.
- .2 Provide temporary wiring and connections to maintain existing systems in service during construction. When work must be performed on energized equipment or circuits, use personnel experienced in such operations.
- .3 Existing electrical service: Maintain existing system in service until new system is complete and ready for service. Disable system only to make switch overs and connections. Obtain permission from Owner at least 24 hours before partially or completely disabling system. Minimize outage duration. Make temporary connections to maintain service in areas adjacent to work area.
- .4 Existing Telephone System: Maintain existing system in service. Notify Owner at least 24 hours before partially or completely disabling system. Minimize outage duration. Make temporary connections to maintain service in areas adjacent to work area.
- .5 Existing Fire Alarm System: Maintain existing system in service. Minimize outage duration. Provide fire watch as required. Make temporary connections to maintain service in areas adjacent to work area.

3.03 DEMOLITION

- .1 Disconnect electrical systems in walls, floors, and ceilings scheduled for removal.
- .2 Demolish and extend existing electrical work to Section 02 41 19, and this Section.
- .3 Remove, relocate, and extend existing installations to accommodate new construction.
- .4 Remove abandoned wiring to source of supply.
- .5 When relocating or removing equipment, should any circuits be abandoned, the conductors to these circuits must be removed or properly terminated as detailed in Ontario Electrical Safety Code (OESC) bulletin 12-25-1, or latest revision.
- .6 Remove exposed abandoned conduit, including abandoned conduit above accessible ceiling finishes. Cut conduit flush with walls and floors, and patch surfaces.
- .7 Disconnect abandoned outlets and remove devices. Remove abandoned outlets if conduit servicing them is abandoned and removed. Provide blank cover for abandoned outlets which are not removed.
- .8 Disconnect and remove abandoned panelboards and distribution equipment.
- .9 Disconnect and remove electrical devices and equipment serving utilization equipment that has been removed.
- .10 Disconnect and remove abandoned luminaires. Remove brackets, stems, hangers, and other accessories.
- .11 Repair adjacent construction and finishes damaged during demolition and extension work.
- .12 Extend existing installations using materials and methods compatible with existing electrical installations, or as specified.

- .13 Maintain continuity of existing services for other circuits/devices serving areas outside the Work area. Provide additional wiring/conduits/boxes etc. to suit existing services to be maintained and also implement new Work as detailed.

3.04 RESTORATION

- .1 Install relocated materials and equipment under the provisions of Division 01.

3.05 CLEANING

- .1 Clean and repair existing materials and equipment which remain or are to be reused.
- .2 Luminaires: Remove existing luminaires for cleaning. Use mild detergent to clean all exterior and interior surfaces; rinse with clean water and wipe dry. Replace lamps, ballasts, and broken electrical parts.
- .3 Waste Management
 - .1 Turn over designated equipment to the Owner.
 - .2 Dispose of unwanted materials and equipment.

3.06 PROTECTION

- .1 Maintain access to existing electrical installations which remain active. Modify installation or provide access panels as appropriate.

End of Section

1 General

1.01 SECTION INCLUDES

- .1 Building wire and cable.
 - .1 Armoured cable.
 - .2 Metal clad cable.
 - .3 Wiring connectors and connections.
- .2 Permitted voltage drop for feeder and branch circuits.
- .3 Conductor sizes are based on copper unless indicated as aluminum or "AL".

1.02 REFERENCES

- .1 CSA Group:
 - .1 CSA C22.1-18, Canadian Electrical Code, Part 1 (24th Edition), Safety Standard for Electrical Installations.
 - .2 Ontario Electrical Safety Code (27th edition/2018).
 - .3 CSA C22.2 No. 0.3-09 (R2019), Test methods for electrical wires and cables.
 - .4 CSA C22.2 No. 48-15, Nonmetallic sheathed cable.
 - .5 CSA C22.2 No. 51-14, Armoured cables.
 - .6 CSA C22.2 No. 52-15, Underground secondary and service-entrance cables.
 - .7 CSA C22.2 No. 65-13, Wire connectors.
 - .8 CSA C22.2 No. 75-17, Thermoplastic insulated wires and cables.
 - .9 CSA C22.2 No. 123-16, Aluminum sheathed cables.
 - .10 CSA C22.2 No. 131-14, Type TECK 90 cable.
- .2 NECA (National Electrical Contractors Association) - Standard of Installation.
- .3 NETA (International Electrical Testing Association) - ATS-2003 - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.
- .4 CAN/ULC-S139:2017 – Standard Method of Fire Test for Evaluation of Integrity of Electrical Power, Data and Optical Fibre Cables.

1.03 ALTERNATES

- .1 [Submit bid based on copper conductors only, unless aluminum conductors are explicitly indicated on the drawings. Submit with bid an alternative price indicating the credit to substitute [600 volt] [208 volt and 600 volt] copper feeders rated above [100] [400] amps with equivalent feeders of aluminum [or NUAL]. Contractor bears responsibility for increased wire size, and corresponding changes in the size of conduits, supports, penetrations, etc. associated with the related change in conductor material. Provide appropriate lugs that are rated for aluminum conductors and provide appropriate oxidation inhibitor (i.e. Noalox or equal).]

1.04 COORDINATION

- .1 Where wire and cable destination is indicated, and routing is not shown, determine exact routing and lengths required.

1.05 CLOSEOUT SUBMITTALS

- .1 Record Documents: Indicate as-constructed feeder sizes on single line diagram.
- .2 Megger test results.

1.06 QUALIFICATIONS

- .1 Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years' experience.

2 Products

2.01 MANUFACTURERS

- .1 American Wire Group.
- .2 BICC Phillips.
- .3 General Cable.
- .4 Nexans.
- .5 Prysmian.
- .6 Southwire.

2.02 REGULATORY REQUIREMENTS

- .1 Provide products listed and classified by CSA Group as suitable for the purpose specified and indicated.

2.03 CONDUCTOR MATERIAL

- .1 Submit bid based on copper conductors only, unless aluminum is explicitly indicated on the drawings.

[OR]

- .2 [Aluminum alloy conductors (NUAL) permitted for feeders explicitly noted on the drawings, or in accordance with article "Alternatives" in PART 1 of this Section.]

2.04 BUILDING WIRE

- .1 RW90:
 - .1 Single copper conductor.
 - .2 Minimum #12 AWG for branch circuit wiring.
 - .3 Minimum #14 AWG for 120 V control wiring.
 - .4 Chemically cross-linked polyethylene insulation.
 - .5 Rated for 90 degrees C, [600 V].
 - .6 Suitable for handling to minus 40 degrees C.

- .7 For interior installations in conduit.
- .2 RWU90:
 - .1 Single copper conductor.
 - .2 Minimum 12 AWG for branch circuit wiring.
 - .3 Minimum 14 AWG for 120 V control wiring.
 - .4 Chemically cross-linked polyethylene insulation.
 - .5 Rated for 90 degrees C, 600 V.
 - .6 Suitable for handling to minus 4 degrees C.
 - .7 For exterior installations in conduit.
- .3 T90 Nylon:
 - .1 Single copper conductor.
 - .2 Thin wall PVC insulation with nylon covering.
 - .3 Rated for 90 degrees C, 600 V.
 - .4 May be used up to size 10 AWG for interior installations.
 - .5 Base conduit fill on RW90 cable diameters.

2.05 ARMoured CABLE

- .1 General
 - .1 Connectors: standard as required, complete with anti-short rings.
 - .2 Runs to be limited to fixture drops and in walls, maximum exposed run 1.5 m.
 - .3 Do not daisy chain (leap frog) luminaires with armoured cable.
- .2 Type AC.
 - .1 Two, three or four copper conductors rated RW90, 1000 V.
 - .2 Bare copper ground wire.
 - .3 Insulation Voltage Rating: 600 volts.
 - .4 Insulation Temperature Rating: 90 degrees C (194 degrees F).
 - .5 Insulation Material: Thermoplastic.
- .3 Type SPC90:
 - .1 Use for LED lighting, fluorescent dimming controls, and other SMART building applications.
 - .2 Colour coded cable with power, control and signal under one cable.
 - .3 12-2C Power with a 16-2C Control, .
 - .4 Bare copper ground wire.

- .5 Insulation Voltage Rating: 600 volts.
- .6 Insulation Temperature Rating: 90 degrees C (194 degrees F).
- .7 Insulation Material: Thermoplastic.

2.06 FIRE RATED CABLES

- .1 General:
 - .1 2 hour fire rating to ULC S139 and to meet 2020 Ontario Building Code Rule 3.2.7.10.
 - .2 Alternative means of compliance:
 - .1 Conduits encased in a minimum of [50 mm (2 in)] of concrete.
 - .2 Be protected by a fire rated assembly listed to achieve the minimum fire rating as indicated.
- .2 Manufacturers:
 - .1 nVent Pyrotenax 1850 series.
 - .2 VITALink MC Brand Type MC, manufactured by Marmon Wire & Cable Inc. (listed by ULC under ULC category code 'FHIT7' or 'FHJR7', dated 19 May 2015).
 - .1 Request quotation from manufacturer or manufacturer's representative for field certification of installed Vitalink cables prior to requesting Consultant's construction field review.
 - .2 2-Hour rated Vitalink RC90 power cable must be installed according to UL protocol FHIT7.120 – Electrical circuit integrity systems certified in Canada.
- .3 Substitution Limitations:
 - .1 "Lifeline" installed in conduit may only be considered if listed by ULC under ULC Category Codes 'FHIT7' or 'FHJR7'.

2.07 TECK90 CABLE

- .1 Single, three, or four conductors as indicated on drawings.
- .2 Cable to CAN/CSA-C22.2 No. 131.
- .3 Conductors:
 - .1 Grounding conductor: copper.
 - .2 Circuit conductors: copper, size as indicated.
- .4 Insulation: Cross-linked polyethylene (XLPE), type RW90, rating: 600 V.
- .5 Inner jacket: polyvinyl chloride.
- .6 Armour: interlocking aluminum.
- .7 Overall covering: thermoplastic.
- .8 Fastenings:

- .1 One-hole steel straps to secure surface cables 50 mm diameter and smaller. Two-hole steel straps for cables larger than 50 mm diameter.
- .2 Channel type supports for two or more cables at 1500 mm centres.
- .3 Threaded rods: 6 mm diameter to support suspended channels.
- .9 Connectors: Watertight, approved for TECK cable.

2.08 WIRING TERMINATION

- .1 Lugs, terminals, or screws used for termination of wiring to be suitable for copper conductors. Identify wiring with permanent indelible identifying markings, either numbered or coloured plastic tapes, on both ends of phase conductors of feeders and branch circuit wiring. Maintain phase sequence and colour coding throughout.
- .2 Splice wire, up to and including No. 6 gauge, with nylon insulated expandable spring type connectors.
 - .1 Thomas & Betts – Marr Max Series
- .3 Splice large conductors using compression type connections insulated with heat shrink sleeves.
 - .1 Thomas & Betts – 5400 Series lugs & heat shrink type #s series

2.09 CONDUCTORS, WIRES, AND CABLES

- .1 Indoor wiring installed in conduit, unless otherwise noted: 600 volt "RW90 XLPE".
- .2 Wiring in channel back of fluorescent lighting fixtures: 600 volt type GTF or TEW.
- .3 Lighting and power branch circuit wiring:
 - .1 Copper, minimum No. 12 gauge.
 - .2 Home runs to lighting and receptacle panels, which exceed 22 m (75 feet) in length: minimum No. 10 gauge.
- .4 Size wires for 2 per cent maximum voltage drop to farthest outlet on a maximum 80 per cent loaded circuit.
- .5 Outdoor wiring: "RWU90 XLPE".
- .6 Conductors shall be colour coded. Conductors No. 10 gauge and smaller shall have colour impregnated into insulation at time of manufacture. Conductors size No. 8 gauge and larger may be colour coded with adhesive colour coding tape but only black insulated conductors shall be employed in this case, except for neutrals which shall be white wherever possible.
- .7 Colour coding as follows:
 - .1 Phase "A" - Red
 - .2 Phase "B" - Black
 - .3 Phase "C" - Blue
 - .4 Control - Orange
 - .5 Ground - Green
 - .6 Neutral - White

- .8 Neatly train circuit wiring in cabinets, panels, pull boxes and junction boxes and hold with nylon cable ties.

3 Execution

3.01 EXAMINATION

- .1 Verify that field measurements are as indicated.
- .2 Wire and cable routing indicated is approximate unless dimensioned.
- .3 Voltage Drop
 - .1 Ensure voltage drop in power and control conductors is in accordance with the requirements of the OESC.
 - .2 Size conductors accordingly when sizes are not identified.
 - .1 Feeder conductors: maximum voltage drop of 2 per cent.
 - .2 Branch circuit conductors: maximum voltage drop of 3 per cent.
- .4 Verify that mechanical work likely to damage wire and cable has been completed.
- .5 Verify that raceway installation is complete and supported.

3.02 PREPARATION

- .1 Completely and thoroughly swab raceway before installing wire.

3.03 INSTALLATION

- .1 Route wire and cable as required to meet project conditions.
- .2 Install cable to CSA C22.1 and per manufacturer's installation guidelines.
- .3 Conduit and cable supports:
 - .1 All wiring to be installed in EMT at all exposed areas and in partitions unless otherwise specified.
 - .2 All mechanical equipment to be connected with liquid tight flexible conduit.
 - .3 Support cables above accessible ceiling, using spring metal clips to support cables from structure. Do not rest cable on ceiling panels.
- .4 Conductors
 - .1 Provide separate neutral for each circuit. Common neutrals not permitted.
 - .2 Use solid conductor for feeders and branch circuits 10 AWG and smaller.
 - .3 Use stranded conductors for control circuits.
 - .4 Use conductor not smaller than 12 AWG for power and lighting circuits.
 - .5 Use conductor not smaller than 16 AWG for control circuits.
 - .6 Armoured cable (commonly referred to as BX) is only to be used for light fixture connections and limited to maximum 1830 mm in length.
 - .7 Use 10 AWG conductors for 20 ampere, 120 volt branch circuits longer than 25 m.

- .5 Pulling conductors
 - .1 Pull all conductors into raceway at same time.
 - .2 Use suitable wire pulling lubricant for building wire 4 AWG and larger.
 - .3 Neatly train and lace wiring inside boxes, equipment, and panelboards.
 - .4 Protect exposed cable from damage.
- .6 Connectors
 - .1 Use suitable cable fittings and connectors.
 - .2 Clean conductor surfaces before installing lugs and connectors.
 - .3 Make splices, taps, and terminations to carry full ampacity of conductors with no perceptible temperature rise.
 - .4 Use split bolt connectors for copper conductor splices and taps 6 AWG and larger. Tape uninsulated conductors and connector with electrical tape to 150 per cent of insulation rating of conductor.
 - .5 Use solderless pressure connectors with insulating covers for copper conductor splices and taps, 8 AWG and smaller.
 - .6 Use insulated spring wire connectors with plastic caps for copper conductor splices and taps, 10 AWG and smaller.
- .7 Identification
 - .1 Identify and colour code wire and cable to Section 26 05 53. Identify each conductor with its circuit number or other designation indicated.
 - .2 Where colour-coded tape is utilized, apply a minimum of 50 mm (2 inches) at terminations, junction and pull boxes and conduit fittings. Do not paint conductors under any condition.
 - .3 Utilize colour coding on bussing in panels and, switchgear, disconnects, and metering cabinets to match conductor colour coding.

3.04 SITE TESTS AND INSPECTIONS

- .1 Perform continuity tests of all feeders, motor circuits, and branch circuits.
- .2 Perform insulation-resistance test (megger test) on each feeder. Submit report to the Consultant.

End of Section

1 General

1.01 SECTION INCLUDES

- .1 Low-voltage control cabling.
- .2 Control-circuit conductors.

1.02 REFERENCES

- .1 CSA Group:
 - .1 CSA C22.1-18, Canadian Electrical Code, Part 1 (24th Edition), Safety Standard for Electrical Installations.
 - .2 Ontario Electrical Safety Code (27th edition/2018).
 - .3 CSA C22.2 No. 0.3-09 (R2019), Test methods for electrical wires and cables.
 - .4 CSA C22.2 No. 48-15, Nonmetallic sheathed cable.
 - .5 CSA C22.2 No. 51-14, Armoured cables.
 - .6 CSA C22.2 No. 65-13, Wire connectors.
 - .7 CSA C22.2 No. 75-17, Thermoplastic insulated wires and cables.
 - .8 CSA C22.2 No. 208-14, Fire alarm and signal cable.
- .2 NECA (National Electrical Contractors Association) - Standard of Installation.

1.03 QUALIFICATIONS

- .1 Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years' experience.

1.04 COORDINATION

- .1 Where wire and cable destination is indicated and routing is not shown, determine exact routing and lengths required.

2 Products

2.01 REGULATORY REQUIREMENTS

- .1 Conform to CSA C22.1.
- .2 Provide products listed and classified by CSA Group as suitable for the purpose specified and indicated.

2.02 LOW VOLTAGE WIRING

- .1 LVT:
 - .1 Multi conductor PVC insulated.
 - .2 Bare copper ground conductor.
 - .3 Overall PVC jacket.
 - .4 Rated 30 V.

- .5 CMP (FT6) rated if cable is exposed.
- .6 CMR (FT4) rated if cable is installed in conduit.
- .2 Category 5e Network Cabling.
 - .1 CMP (FT6) rated if cable is exposed.
 - .2 CMR (FT4) rated if cable is installed in conduit.

2.03 TERMINATIONS AND SPLICES

- .1 All terminations and splices shall be of an approved type for the conductors being used.
- .2 Where conductors are terminated or spliced, it shall be done in the following manner:
 - .1 Where a single solid conductor is terminated in a device under one screw or clamping mechanism, no additional terminating hardware is required.
 - .2 Where multiple or stranded conductors are terminated in a device under one screw or clamping mechanism, self insulated crimp-on cable ends or approved equal shall be used up to and including No. 10 sized conductors. Approved compression lugs shall be used for larger conductor sizes.
 - .3 Where multiple conductors are spliced, properly sized Wing Nut connectors, or approved equal, shall be used for up to two No. 8 or three No. 10 AWG conductors. Pressure type sleeve cable connectors, splices, tee's, etc., shall be used for all larger size connections and terminations.
 - .4 Insulate all bare surfaces of splices with heat shrink sleeving or equivalent.
 - .5 Conductors connected to ground rods for service or equipment grounding or to building structural or architectural elements shall be terminated, connected and spliced using a thermoweld process or approved non-mechanical compression type connectors.
- .3 Install all service and feeder conductors as continuous lengths without breaks, measured and cut based on site dimensions.

3 Execution

3.01 EXAMINATION

- .1 Verify that mechanical work likely to damage wire and cable has been completed.
- .2 Verify that raceway installation is complete and supported.
- .3 Verify that field measurements are as indicated.
- .4 Wire and cable routing indicated is approximate unless dimensioned.

3.02 PREPARATION

- .1 Completely and thoroughly swab raceway before installing wire.

3.03 INSTALLATION

- .1 Route control cabling as required to meet project conditions.
- .2 Install cable to the CSA C22.1.

- .3 Conduit and supports
 - .1 All wiring to be installed in EMT at all exposed areas and in partitions unless otherwise specified.
 - .2 All mechanical equipment to be connected with liquid tight flexible conduit.
 - .3 Support cables above accessible ceiling, using spring metal clips to support cables from structure. Do not rest cable on ceiling panels.
- .4 Conductors
 - .1 Use stranded conductors for control circuits.
 - .2 Use conductor not smaller than 16 AWG for control circuits.
- .5 Pulling conductors
 - .1 Pull all conductors into raceway at same time.
 - .2 Neatly train and lace wiring inside boxes, equipment, and panelboards.
 - .3 Neatly train circuit wiring in cabinets, panels, pull boxes and junction boxes and hold with nylon cable ties.
 - .4 Protect exposed cable from damage.
- .6 Connectors
 - .1 Use suitable cable fittings and connectors.
 - .2 Clean conductor surfaces before installing lugs and connectors.
 - .3 Use solderless pressure connectors with insulating covers for copper conductor splices and taps, 8 AWG and smaller.
 - .4 Use insulated spring wire connectors with plastic caps for copper conductor splices and taps, 10 AWG and smaller.
- .7 Identification
 - .1 Identify and colour code wire and cable to Section 26 05 53. Identify each conductor with its circuit number or other designation indicated.
 - .2 Where colour coded tape is utilized, apply a minimum of 50 mm (2 inches) at terminations, junction and pull boxes and conduit fittings. Do not paint conductors under any condition.

End of Section

1 General

1.01 SECTION INCLUDES

- .1 Grounding electrodes and conductors.
- .2 Equipment grounding conductors.
- .3 Bonding.
- .4 The terms “connect” and “bond” are used interchangeably in this Specification and have the same meaning.

1.02 RELATED REQUIREMENTS

- .1 Section 09 65 36.13 – Static-Dissipative Resilient Flooring: Grounding of static dissipative tile (SDT).
- .2 Section 09 69 00 – Access Flooring: Grounding of raised floor pedestals.
- .3 Section 27 05 26 – Grounding and Bonding for Communications Systems.

1.03 REFERENCES

- .1 CSA Group
 - .1 CSA C22.1-18, Canadian Electrical Code, Part 1 (24th Edition), Safety Standard for Electrical Installations.
 - .2 Ontario Electrical Safety Code (27th edition/2018).
 - .3 CSA C22.2 No.0.4-17, Bonding of electrical equipment.
 - .4 CSA C22.2 No. 41-13, Grounding and bonding equipment.
 - .5 CSA C22.2 No. 75-17, Thermoplastic insulated wires and cables.
- .2 ANSI/TIA/EIA J-STD-607-A - Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications.
- .3 Institute of Electrical and Electronics Engineers, Inc.
 - .1 IEEE 81-1983 - IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System.

1.04 ACTION SUBMITTALS

- .1 Product Data: Provide for grounding electrodes and connections.

1.05 INFORMATIONAL SUBMITTALS

- .1 Test Reports: Indicate overall resistance to ground and resistance of each electrode.
- .2 Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

1.06 CLOSEOUT SUBMITTALS

- .1 Project Record Documents: Record actual locations of components and grounding electrodes.

- .2 Certificate of Compliance: Indicate approval of installation by authority having jurisdiction.

1.07 QUALIFICATIONS

- .1 Manufacturer: Company specializing in manufacturing the products specified in this section with minimum three years' experience.

1.08 REGULATORY REQUIREMENTS

- .1 Products: Listed and classified testing firm acceptable to the authority having jurisdiction as suitable for the purpose specified and indicated.

2 Products

2.01 MANUFACTURERS

- .1 B-Line by Eaton.
- .2 Hubbell (Burndy).
- .3 Panduit.
- .4 Thomas & Betts.

2.02 PERFORMANCE CRITERIA

- .1 Grounding System Resistance: 5 ohms.
- .2 Provide all equipment grounding as required regardless of whether it has been shown on drawings or called for in this specification. Arrange grounds so that under normal operating conditions no injurious amount of current will flow in any grounding conductor.

2.03 GROUNDING AND BONDING CONDUCTORS

- .1 Electrical grounding conductors shall be CSA C22.2 No. 75 insulated stranded copper, except that sizes #10 AWG and smaller shall be solid copper. Insulation colour shall be continuous green for all equipment grounding conductors.
- .2 Bonding conductors shall be ASTM B8 bare stranded copper, except that sizes #10 AWG and smaller shall be ASTM B1 solid bare copper wire.

2.04 ROD ELECTRODES

- .1 Material: Copper-clad steel.
- .2 Diameter: 19 mm.
- .3 Length: 3000 mm.

2.05 GROUND RODS

- .1 Copper clad steel, 19 mm (3/4 inch) diameter by 3000 mm (10 feet) long, conforming to CSA C22.2 No. 41.
- .2 Quantity of rods shall be as required to obtain the specified ground resistance.

2.06 SPLICES AND TERMINATION COMPONENTS

- .1 Components shall meet or exceed CSA C22.2 No. 41, and be clearly marked with the manufacturer, catalog number, and permitted conductor size(s).

2.07 GROUND CONNECTIONS

- .1 Below Grade: Exothermic-welded type connectors.
- .2 Above Grade:
 - .1 Bonding Jumpers: compression type connectors, using zinc-plated fasteners and external tooth lockwashers.
 - .2 Ground Busbars: Two-hole compression type lugs using tin-plated copper or copper alloy bolts and nuts.

2.08 GROUND TERMINAL BLOCKS

- .1 At any equipment mounting location (e.g. backboards and hinged cover enclosures) where rack-type ground bars cannot be mounted, provide screw lug-type terminal blocks.

2.09 SPLICE CASE GROUND ACCESSORIES

- .1 Splice case grounding and bonding accessories shall be supplied by the splice case manufacturer when available. Otherwise, use 6 AWG insulated ground wire with shield bonding connectors.

2.10 MECHANICAL CONNECTORS

- .1 Material: Bronze.

2.11 WIRE

- .1 Material: Stranded copper.
- .2 Foundation Electrodes: 2/0 AWG.
- .3 Grounding Electrode Conductor: Size to meet Ontario Electrical Safety Code requirements.

2.12 GROUNDING WELL COMPONENTS

- .1 Well Pipe: 200 mm by 600 mm long concrete pipe with belled end.
- .2 Well Cover: Cast iron with legend "GROUND" embossed on cover.

3 Execution

3.01 EXAMINATION

- .1 Verify that final backfill and compaction has been completed before driving rod electrodes.

3.02 INSTALLATION

- .1 General
 - .1 Ground in accordance with the Ontario Electrical Safety Code, as shown on drawings, and as hereinafter specified.
 - .2 System Grounding:

- .1 Secondary service neutrals: Ground at the supply side of the secondary disconnecting means and at the related transformers.
- .2 Separately derived systems (transformers downstream from the service entrance): Ground the secondary neutral.
- .3 Equipment Grounding: Metallic structures (including ductwork and building steel), enclosures, raceways, junction boxes, outlet boxes, cabinets, machine frames, and other conductive items in close proximity with electrical circuits shall be bonded and grounded.
- .4 Ground electrical equipment and wiring in accordance with Ontario Electrical Safety Code and Local Inspection Authority's Rules and Regulations.
- .5 Install grounding conductors, outside Electric Rooms and Electrical Closets in conduit and conceal where possible. Make connections to water mains, all metallic piping systems, neutral and equipment with brass, copper or bronze bolts and connectors or weld using Cadweld or Thermoweld processes.
- .6 Provide grounding conductors, sized as per Code, and connect to grounding bus or water main wherever non-raceways are installed.
- .2 Provide grounding electrode conductor and connect to reinforcing steel in foundation footing. Bond steel together.
- .3 Provide bonding to meet Regulatory Requirements.
- .4 Bond together metal siding not attached to grounded structure; bond to ground.
- .5 Install ground grid under access floors indicated.
- .6 Bond together each metallic raceway, pipe, duct and other metal object entering space under access floors. Bond to underfloor ground grid. Use #6 AWG bare copper conductor.
- .7 Equipment Grounding Conductor: Provide separate, insulated conductor within each feeder and branch circuit raceway. Terminate each end on suitable lug, bus, or bushing.
- .8 Ground Resistance
 - .1 Grounding system resistance to ground not to exceed 5 ohms. Make necessary modifications or additions to the grounding electrode system for compliance without additional cost to the Owner. Final tests shall assure that this requirement is met.
 - .2 Resistance of the grounding electrode system shall be measured using a four-terminal fall-of-potential method as defined in IEEE 81. Ground resistance measurements shall be made before the electrical distribution system is energized and shall be made in normally dry conditions not less than 48 hours after the last rainfall. Resistance measurements of separate grounding electrode systems shall be made before the systems are bonded together below grade. The combined resistance of separate systems may be used to meet the required resistance, but the specified number of electrodes must still be provided.
 - .3 Services at power company interface points shall comply with the power company ground resistance requirements.
- .9 Ground Rod Installation
 - .1 Drive each rod vertically in the earth, not less than 3000 mm (10 feet) in depth.

- .2 Where permanently concealed ground connections are required, make the connections by the exothermic process to form solid metal joints. Make accessible ground connections with mechanical pressure type ground connectors.
- .3 Where rock prevents the driving of vertical ground rods, install angled ground rods or grounding electrodes in horizontal trenches to achieve the specified resistance.
- .10 Inaccessible Grounding Connections
 - .1 Make grounding connections, which are buried or otherwise normally inaccessible (except connections for which periodic testing access is required) by exothermic weld.
- .11 Secondary Equipment and Circuits
 - .1 Main Bonding Jumper: Bond the secondary service neutral to the ground bus in the service equipment.
 - .2 Metallic Piping, Building Steel, and Supplemental Electrode(s):
 - .1 Provide a grounding electrode conductor sized per code between the service equipment ground bus and all metallic water and gas pipe systems, building steel, and supplemental or made electrodes. Jumper insulating joints in the metallic piping. All connections to electrodes shall be made with fittings that conform to CSA C22.2 No 41.
 - .2 Provide a supplemental ground electrode and bond to the grounding electrode system.
 - .3 Conduit Systems:
 - .1 Ground all metallic conduit systems. All metallic conduit systems shall contain an equipment grounding conductor.
 - .2 Non-metallic conduit systems shall contain an equipment grounding conductor, except that non-metallic feeder conduits which carry a grounded conductor from exterior transformers to interior or building-mounted service entrance equipment need not contain an equipment grounding conductor.
 - .3 Conduit containing only a grounding conductor, and which is provided for mechanical protection of the conductor, shall be bonded to that conductor at the entrance and exit from the conduit.
 - .4 Feeders and Branch Circuits: Install equipment grounding conductors with all feeders and power and lighting branch circuits.
 - .5 Boxes, Cabinets, Enclosures, and Panelboards:
 - .1 Bond the equipment grounding conductor to each pull box, junction box, outlet box, device box, cabinets, and other enclosures through which the conductor passes (except for special grounding systems for intensive care units and other critical units shown).
 - .2 Provide lugs in each box and enclosure for equipment grounding conductor termination.
 - .3 Provide ground bars in panelboards, bolted to the housing, with sufficient lugs to terminate the equipment grounding conductors.
 - .6 Receptacles shall not be grounded through their mounting screws. Ground with a jumper from the receptacle green ground terminal to the device box ground screw and the branch circuit equipment grounding conductor.
 - .7 Raised Floors: Provide bonding of all raised floor components.

.12 Corrosion Inhibitors

- .1 When making ground and ground bonding connections, apply a corrosion inhibitor to all contact surfaces. Use corrosion inhibitor appropriate for protecting a connection between the metals used.

.13 Conductive Piping

- .1 Bond all conductive piping systems, interior and exterior, to the building to the grounding electrode system. Bonding connections shall be made as close as practical to the equipment ground bus.

3.03 FIELD QUALITY CONTROL

- .1 Perform inspections and tests listed in NETA ATS, Section 7.13.

End of Section

1 General

1.01 SECTION INCLUDES

- .1 Conduit and equipment supports.
- .2 Anchors and fasteners.

1.02 REFERENCES

- .1 CSA C22.1-18, Canadian Electrical Code, Part 1 (24th Edition), Safety Standard for Electrical Installations.
- .2 Ontario Electrical Safety Code (27th edition/2018).
- .3 CECA - Canadian Electrical Contractors Association.

1.03 CLOSEOUT SUBMITTALS

- .1 Submit the following in the Operation and Maintenance Manual for products used over the course of the project:
 - .1 Product Data: Provide manufacturer's catalogue data for fastening systems.
 - .2 Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of product.

1.04 REGULATORY REQUIREMENTS

- .1 Provide products listed and classified by Canadian Standards as suitable for purpose specified and shown.

2 Products

2.01 MANUFACTURERS

- .1 B-line by Eaton.
- .2 Burndy Canada Ltd. (Hubbell).
- .3 Erico Caddy.
- .4 E. Myatt & Co. Inc.
- .5 Hilti Canada.
- .6 Thomas & Betts.
- .7 Unistrut.
- .8 Approved equal.

2.02 GENERAL

- .1 All supporting devices, strut channel, threaded rod, anchors, etc. to be used shall be of the "hot dipped" galvanized type. Electrogalvanized components will not be accepted.
- .2 Materials and Finishes: Provide adequate corrosion resistance.

- .3 Provide materials, sizes, and types of anchors, fasteners and supports to carry the loads of equipment and conduit. Consider weight of wire in conduit when selecting products.
- .4 Anchors and Fasteners:
 - .1 Concrete Structural Elements: Use expansion anchor and preset inserts.
 - .2 Steel Structural Elements: Use beam clamps and welded fasteners.
 - .3 Concrete Surfaces: Use self-drilling anchors and expansion anchors.
 - .4 Hollow Masonry, Plaster, and Gypsum Board Partitions: Use toggle bolts and hollow wall fasteners.
 - .5 Solid Masonry Walls: Use expansion anchors and preset inserts.
 - .6 Sheet Metal: Use sheet metal screws.
 - .7 Wood Elements: Use wood screws.

2.03 ANCHORS AND HANGERS

- .1 Hangers for electrical conduit shall be galvanized after fabrication.
- .2 Perforated strapping: not permitted.

2.04 INSERTS

- .1 Use only factory-made threaded or toggle type.
- .2 Where inserts cannot be placed, use factory-made expansion shields for light weights, where approved by the Consultant.
- .3 Do not use powder-activated tools except with the written permission of the Consultant.

2.05 SLEEVES

- .1 Through interior walls, use standard weight steel pipes, conduit, or 18 gauge galvanized steel. Cut flush with finished surfaces. Check room finish schedules.
- .2 Through exterior walls above grade, floors, and roof use standard weight steel pipes, machine cut, flush with finished surface inside and to suit flashing outside.
- .3 Through exterior walls below grade, water-proofed floors, and other water-proof walls, use heavy weight cast iron pipes, machine cut. Extend sleeves 100 mm (4 inches) above finished floors, and cut flush with underside of floor.

2.06 STEEL CHANNEL

- .1 Description: Painted steel.

2.07 SUPPORTS

- .1 Steel supports in wet or dry locations to be galvanized after fabrication.
- .2 Where galvanized members are bolted together use cadmium plated bolts.
- .3 For hanger rods use minimum 10 mm (3/8 inch) diameter steel threaded rod. Use clevis type attachment.
- .4 Provide minimum 100 mm (4 inch) high concrete bases for all floor mounted equipment.

2.08 SUPPORTS AND BASES

- .1 Submit proposed method of attachment of hangers and beam clamps, to cellular steel deck for approval before proceeding with Work.
- .2 Supply and erect special structural Work required for the installation of electrical equipment. Provide anchor bolts and other fastenings unless noted otherwise. Mount equipment required to be suspended above floor level, where details are not shown, on a frame or platform bracketed from the wall or suspended from the ceiling. Carry supports to either the ceiling or the floor, or both as required, at locations where, because wall thickness is inadequate, it is not permitted to use such brackets.
- .3 Electrical panels, switches or other electrical equipment shall be complete with suitable bases or mounting brackets.
- .4 Provide channel or other metal supports where necessary, to adequately support lighting fixtures. Do not use wood unless wood forms part of the building structure.
- .5 Support hangers, in general, from inserts in concrete construction or from building structural steel beams, using beam clamps. Provide additional angle or channel steel members, required between beams for supporting conduits and cables.
- .6 Provide any additional supports required from existing concrete construction for any piping or equipment, by drilling same and installing expansion bolt cinch anchors.
- .7 Do not use explosive drive pins in any section of Work without obtaining prior approval.

2.09 THREADED ROD COVERS

- .1 Protect cable from abrasion caused by contact with threaded rod.
- .2 To meet UL 94V-0 specifications.
- .3 Colour: Black.
- .4 Example product: Panduit TRC18FR-X20Y.

3 Execution

3.01 INSTALLATION

- .1 Obtain permission from the Consultant before drilling or cutting structural members.
- .2 Fabricate supports from structural steel or steel channel. Rigidly weld members or use hexagon head bolts to present neat appearance with adequate strength and rigidity. Use spring lock washers under all nuts.
- .3 Install surface-mounted cabinets and panelboards with minimum of four anchors.
- .4 In wet and damp locations use steel channel supports to stand cabinets and panelboards 25 mm (1 inch) off wall.
- .5 Use sheet metal channel to bridge studs above and below cabinets and panelboards recessed in hollow partitions.
- .6 [Where threaded rod is exposed in data centre, provide threaded rod cover.]
- .7 Provide inserts, sleeves, equipment supports and hangers, sealing of sleeves and openings, as required for all electrical work. Ensure that the load onto structures does not exceed the maximum loading per square metre as shown on Structural Drawings or as directed by the Consultant.

- .8 Provide insets, holes, anchor bolts and sleeves in time when walls, floors, and roof are erected.
- .9 Place insets only in structural members and not in the finishing material.
- .10 Secure all supports and hangers to the structure unless noted otherwise.
- .11 Suspend hanger rods from approved concrete inserts and from beam clamps. Obtain Consultant's approval before welding to steel structural members.
- .12 Secure supports to precast concrete members to inserts originally cast into the members or by rods passing between the members and connected to a steel plate bearing.
- .13 Sealing of Sleeves and Openings to Maintain Fire Rating
 - .1 Use Dow-Corning #3-6548 'Silicone RTV' foam, Thomas & Betts 'Flamesafe' firestop system, Electrovert 'Flameseal' firestop putty, or approved equal materials installed in accordance with the manufacturer's specifications and recommendations.
 - .2 Submit data sheets for review prior to installation.
- .14 Supports
 - .1 All conduits, panels, etc. to be securely and adequately supported.
 - .2 Where more than three conduits run together, conduit racks to be used.
 - .3 Single runs of conduit to be supported by galvanized conduit straps or ring bolt type hangers. Tie wire or perforated metal strap hangers will NOT be accepted.

End of Section

1 General

1.01 SECTION INCLUDES

- .1 Rigid steel conduit.
- .2 Flexible metal conduit.
- .3 Liquid tight flexible metal conduit.
- .4 Electrical metallic tubing (EMT).
- .5 Electrical non-metallic tubing (ENT).
- .6 Rigid PVC conduit.
- .7 Fittings and conduit bodies.

1.02 REFERENCES

- .1 Canadian Standards Association
 - .1 CSA C22.1-18, Canadian Electrical Code, Part 1 (24th Edition), Safety Standard for Electrical Installations.
 - .2 Ontario Electrical Safety Code (27th edition/2018).
 - .3 CAN/CSA-C22.2 No. 18 – Outlet Boxes, Conduit Boxes, Fittings and Associated Hardware.
 - .4 CSA C22.2 No. 45 – Rigid Metal Conduit.
 - .5 CSA C22.2 No. 45.1 – Rigid Metal Conduit - Steel.
 - .6 CSA C22.2 No. 56-17, Flexible metal conduit and liquid-tight flexible metal conduit.
 - .7 CSA C22.2 No. 83.1 – Electrical Metallic Tubing - Steel.
 - .8 CSA C22.2 No. 211.1 – Rigid Types EB1 and DB2/ES2 PVC Conduit.
 - .9 CSA C22.2 No. 211.2 – Rigid PVC (Unplasticized) Conduit.
 - .10 CSA C22.2 No. 211.3 – Reinforced Thermosetting Resin Conduit (RTRC) on Fittings.
 - .11 CSA C22.2 No. 227.1 – Electrical Nonmetallic Tubing.
 - .12 CSA C22.2 No. 227.2.1 – Liquid-Tight Flexible Nonmetallic Conduit.

1.03 RECORD DOCUMENTATION

- .1 Accurately record actual routing of conduits larger than 51 mm.
- .2 Accurately record actual routing of all conduits installed below grade, regardless of size, including whether direct buried or installed in concrete duct bank.

1.04 REGULATORY REQUIREMENTS

- .1 Provide products listed and classified by CSA (Canadian Standards Association) as suitable for purpose specified and shown.

1.05 DELIVERY, STORAGE, AND HANDLING

- .1 Accept conduit on site. Inspect for damage.
- .2 Protect conduit from corrosion and entrance of debris by storing above grade. Provide appropriate covering.

1.06 PROJECT CONDITIONS

- .1 Verify that field measurements are as shown on drawings.
- .2 Verify routing and termination locations of conduit prior to rough-in.
- .3 Conduit routing, if shown on drawings, is approximate unless dimensioned. Route as required to provide a complete wiring system.

2 Products

2.01 MANUFACTURERS

- .1 Where products are listed in this section based on a single manufacturer, the equivalent product from the following manufacturers is acceptable:
 - .1 Appleton.
 - .2 Columbia-MBF.
 - .3 Crouse-Hinds by Eaton.
 - .4 Hubbell.
 - .5 Thomas & Betts Ltd.

2.02 RIGID METAL CONDUIT

- .1 Rigid metal conduit: to CSA C22.2 No. 45, hot dipped galvanized steel, threaded.
- .2 Epoxy coated conduit: to CSA C22.2 No. 45, with zinc coating and corrosion resistant epoxy finish inside and outside.
- .3 Fittings and conduit bodies: Material to match conduit.

2.03 FLEXIBLE METAL CONDUIT

- .1 Flexible metal conduit: to CSA C22.2 No. 56, interlocked steel construction.
- .2 Fittings: CSA C22.2 No. 56.

2.04 LIQUID TIGHT FLEXIBLE METAL CONDUIT

- .1 Description: Interlocked steel construction with PVC jacket.
- .2 Fittings: CSA C22.2 No. 56.

2.05 ELECTRICAL METALLIC TUBING (EMT)

- .1 Description: CSA C22.2 No. 83.1; galvanized tubing.
- .2 Fittings and Conduit Bodies: CSA C22.2 No. 83.1; steel type.

2.06 ELECTRICAL NON-METALLIC TUBING (ENT)

- .1 To CSA C22.2 No. 227.1.

2.07 CONDUIT, FITTINGS, AND ACCESSORIES

- .1 Conduit accessories, conduits and fittings conforming to CSA Standard C22.2 No. 18-1972.
- .2 Provide rain tight connectors, couplings, fittings, junction boxes, pull boxes and surface outlet boxes shall be used for surface conduit installations exposed to moisture or in sprinklered buildings.
- .3 Rigid conduit bushings:
 - .1 Thomas & Betts Ltd. - Series 5031.
- .4 EMT Connectors:
 - .1 Thomas & Betts Ltd. - Steel City TC 121E Series.
- .5 Ground Bushings:
 - .1 Thomas & Betts – Blackjack or 1220 Series.
- .6 Flexible conduit connectors:
 - .1 Thomas & Betts Ltd. - Series 3110.
 - .2 EMT couplings: steel concrete tight to match connectors.
- .7 Terminate rigid conduit entering boxes or enclosures with nylon insulated steel threaded bushings.
 - .1 Thomas & Betts – 8125 Series.
- .8 Terminate EMT entering boxes or enclosures with nylon insulated steel concrete tight connectors.
- .9 Terminate flexible conduit entering boxes or enclosures with nylon insulated steel connectors.
 - .1 Thomas & Betts – 5332 Series.

3 Execution

3.01 PREPARATION

- .1 Produce layout sketches of conduit runs through mechanical and electrical service areas, through corridors, and other congested areas in order to resolve any interferences with other work, and to determine the most efficient route to run the conduit.

3.02 INSTALLATION

- .1 Minimum size: 21 mm (3/4 inch) unless otherwise specified.
- .2 All conduit shall be concealed except in mechanical rooms and electrical rooms, or unless otherwise indicated in this specification, or noted on the drawings. Surface conduit work is not permitted unless specifically noted.
- .3 Install wiring in conduit unless otherwise specified. Where conduit sizes are not shown on drawings, provide conduits sized in accordance with Ontario Electrical Safety Code, CSA C22.1. When conduits are indicated, they are the minimum size required, and must be increased to suit the length of run or voltage drop requirements.

- .4 Conduit use:
 - .1 Unless otherwise specified below or shown on the drawings, all systems shall be installed in electrical metallic tubing (EMT).
 - .2 Outdoor locations:
 - .1 Above grade: use rigid steel.
 - .2 Use liquid tight flexible metal conduit for connections to transformers, motors, and equipment, subject to vibration and movement.
 - .3 Underground: Use rigid PVC conduit for wiring in slabs on grade and wiring below grade.
 - .4 Wet and damp locations:
 - .1 Use rigid steel.
 - .2 Use liquid tight flexible metal conduit for connections to transformers, motors, and equipment, subject to vibration and movement.
 - .5 Dry locations:
 - .1 Concealed in metal stud partitions:
 - .1 Use electrical metallic tubing.
 - .2 Use of AC90 (Bx) as described in Section 26 05 19.
 - .2 Concealed in concrete: Use electrical non-metallic tubing or rigid PVC.
 - .3 Exposed areas: Use electrical metallic tubing.
 - .4 Use flexible metal conduit for connections to transformers, motors, and equipment, subject to vibration and movement.
 - .5 Use liquid tight flexible metal conduit below raised floors for connections to all devices.
 - .6 Aluminium conduit may be used, in lieu of steel conduit, in clean and dry locations, but shall not be used in poured concrete, or for signal and intercommunication systems wiring.
 - .7 Raceways installed less than 2 m above grade in an area where they are subject to mechanical damage, including parking garages, loading docks, warehouse spaces, and service rooms shall be of the rigid steel type or protected by a steel guard of not less than no. 10 MSG, adequately secured in place.
 - .8 Use epoxy coated conduit in corrosive areas.
 - .6 Telecommunications conduits: in accordance with Section 27 05 28.
- .5 Arrangement and supports
 - .1 Arrange supports to prevent misalignment during wiring installation.
 - .2 Arrange conduit to maintain headroom and present neat appearance.
 - .3 Support conduit using coated steel or malleable iron straps, lay-in adjustable hangers, clevis hangers, and split hangers.

- .4 Group related conduits; support using conduit rack.
 - .5 Construct rack using steel channel; provide space on each for 25 per cent additional conduits.
 - .6 Fasten conduit supports to building structure and surfaces to Section 26 05 29.
 - .7 Do not support conduit with wire or perforated pipe straps.
 - .8 Remove wire used for temporary supports
 - .9 Do not attach conduit to ceiling support wires.
 - .10 Route exposed conduit parallel and perpendicular to walls.
 - .11 Route conduit installed above accessible ceilings parallel and perpendicular to walls.
 - .12 Route conduit in and under slab from point-to-point.
 - .13 In damp and unheated areas, avoid moisture traps; provide junction box with drain fitting at low points in conduit system.
 - .14 Provide suitable fittings to accommodate expansion and deflection where conduit crosses expansion joints.
- .6 Clearances
- .1 Maintain adequate clearance between conduit and piping.
 - .2 Maintain 300 mm (12 inch) clearance between conduit and surfaces with temperatures exceeding 40 degrees C.
- .7 Conduit bends
- .1 Install no more than equivalent of three 90 degree bends between boxes.
 - .1 Use conduit bodies to make sharp changes in direction, as around beams.
 - .2 Use hydraulic one-shot bender to fabricate bends in metal conduit larger than 50 mm size or provide prefabricated conduit bends.
 - .8 Install wall entrance seals where conduits pass through exterior walls below grade.
 - .9 Provide expansion coupling in conduit runs at building expansion joints and in long runs subject to thermal expansion, all in accordance with manufacturer recommendations.
 - .10 Cut conduit square using saw or pipe cutter; de-burr cut ends.
 - .11 Bring conduit to shoulder of fittings; fasten securely.
 - .12 Use suitable caps to protect installed conduit against entrance of dirt and moisture.
 - .13 Use conduit hubs or sealing locknuts to fasten conduit and to cast boxes.
 - .14 Provide suitable pull string in each empty conduit except sleeves and nipples.
 - .15 Ground and bond conduit to Section 26 05 26.

- .16 Identify conduit to Section 26 05 53.
- .17 Flexible conduit and armoured cable will be accepted for a maximum length of 1500 mm for final connection to lighting fixtures. Do not connect from fixture to fixture.

3.03 CLEANING

- .1 Conduit manufacturer's touch-up enamel shall be used to repair all scratches and gouges on epoxy-coated conduit.

End of Section

1 General

1.01 SECTION INCLUDES

- .1 Wall and ceiling outlet boxes.
- .2 Pull and junction boxes.

1.02 RELATED REQUIREMENTS

- .1 Section 26 09 23 – Lighting Control Devices.
- .2 Section 26 27 16 – Electrical Cabinets and Enclosures.
- .3 Section 26 27 26 – Wiring Devices: Wall plates in finished areas, floor box service fittings, fire-rated poke-through fittings, and access floor boxes.
- .4 Section 26 27 26.13 – Floor Box Assemblies.

1.03 REFERENCES

- .1 CSA C22.1-18, Canadian Electrical Code, Part 1 (24th Edition), Safety Standard for Electrical Installations.
- .2 Ontario Electrical Safety Code (27th edition/2018).
- .3 CAN/CSA-C22.2 No. 18 - Outlet Boxes, Conduit Boxes, Fittings and Associated Hardware.
- .4 CSA C22.2 No. 18.1 (CSA/UL/ANCE) - Metallic Outlet Boxes.
- .5 CSA C22.2 No. 40 - Cutout, Junction and Pull Boxes.
- .6 CAN/CSA-C22.2 No. 85 - Rigid PVC Boxes and Fittings.

1.04 CLOSEOUT SUBMITTALS

- .1 Record actual locations and mounting heights of outlet, pull, and junction boxes on project record documents.

1.05 REGULATORY REQUIREMENTS

- .1 Provide products listed and classified by CSA (Canadian Standards Association) as suitable for the purpose specified and indicated.

2 Products

2.01 OUTLET BOXES

- .1 Sheet Metal Outlet Boxes: CSA C22.2 No. 18, galvanized steel.
 - .1 Luminaire and Equipment Supporting Boxes: Rated for weight of equipment supported; include 13 mm male fixture studs where required.
 - .2 Concrete Ceiling Boxes: Concrete type.
- .2 Non-metallic Outlet Boxes: CSA C22.2 No. 18.
- .3 Cast Boxes: CSA C22.2 No. 18, Type FD, aluminum. Provide gasketed cover by box manufacturer. Provide threaded hubs.

- .4 Wall Plates for Finished Areas: As specified in Section 26 27 26.

2.02 PULL BOXES AND JUNCTION BOXES

- .1 Sheet Metal Boxes: CSA C22.2 No. 18, galvanized steel.
- .2 Hinged Enclosures: As specified in Section 26 27 16.
- .3 Surface Mounted Cast Metal Box: CSA C22.2 No. 18, Type 4; flat-flanged, surface mounted junction box:
 - .1 Material: Cast aluminum.
 - .2 Cover: Provide with ground flange, neoprene gasket, and stainless steel cover screws.

2.03 OUTLET BOXES

- .1 Conform to CSA C22.2 No. 18.
- .2 Where 103 mm (4 inch) square outlet boxes are installed in exposed concrete or cinder block finished areas, blocks will be cut as described in Division 04 as instructed under this Section. Cut openings to provide a close fit to boxes and covers so that edges of openings are not visible after installation of plates. Use of mortar to patch up openings that are cut too large or to patch ragged edges is not permitted.
- .3 Ceiling boxes: 103 mm (4 inch) octagon or square, complete with fittings, where required to support fixtures.
- .4 Switch and receptacle boxes:
 - .1 103 mm (4 inch) square with plaster ring, where flush mounted in plaster walls.
 - .2 Iberville 1104 series box, or equal, where flush mounted in wood or drywall, with stud fasteners as required.
 - .3 Masonry boxes in masonry walls.
- .5 Where boxes are surface mounted in unfinished areas they shall be FS conduits.
- .6 Standard outlet boxes manufactured from code gauge galvanized steel.
- .7 Provide a suitable outlet box for each light, switch, receptacle or other outlet, approved for the particular area it is to be installed.
- .8 Support outlet boxes independently of conduit and cable.
- .9 Locate outlet boxes, mounted in hung ceiling space, so they do not obstruct or interfere with the removal of lay-in ceiling tiles.
- .10 Offset outlet boxes, shown back to back in partitions, horizontally a minimum 150 mm (6 inch) to minimize noise transmission between adjacent rooms.
- .11 Use gang boxes at locations where more than one device, of the same system only, is to be mounted. Utilize separate boxes for each system.
- .12 Use tile wall covers where 103 mm (4 inch) square outlet boxes are installed in exposed concrete or cinder block in finished areas.
- .13 Provide flush mount boxes, panels, cabinets and electrical devices, which are installed in finished areas, with suitable flush trims and doors or covers, unless specifically noted otherwise.

- .14 Provide pre-formed polyethylene vapour barriers for all boxes located in walls with internal vapour barriers.

3 Execution

3.01 EXAMINATION

- .1 Verify locations of floor boxes prior to rough-in.

3.02 INSTALLATION

- .1 Install boxes to CSA C22.1.
- .2 Install in locations as shown on drawings, and as required for splices, taps, wire pulling, equipment connections and compliance with regulatory requirements.
- .3 Set wall mounted boxes at elevations to accommodate mounting heights indicated.
- .4 Electrical boxes are shown on drawings in approximate locations unless dimensioned. Adjust box location up to 3 m (10 feet) if required to accommodate intended purpose.
- .5 Orient boxes to accommodate wiring devices oriented as specified in Section 26 27 26.
- .6 Maintain headroom and present neat mechanical appearance.
- .7 Install pull boxes and junction boxes above accessible ceilings and in unfinished areas only.
- .8 Inaccessible Ceiling Areas: Install outlet and junction boxes no more than 150 mm (6 inch) from ceiling access panel or from removable recessed luminaire.
- .9 Install boxes to preserve fire resistance rating of partitions and other elements, using materials and methods.
- .10 Coordinate mounting heights and locations of outlets mounted above counters, benches, and backsplashes.
- .11 Locate outlet boxes to allow luminaires positioned as shown on reflected ceiling plan.
- .12 Align adjacent wall mounted outlet boxes for switches, thermostats, and similar devices.
- .13 Use flush mounting outlet box in finished areas.
- .14 Locate flush mounting box in masonry wall to require cutting of masonry unit corner only. Coordinate masonry cutting to achieve neat opening.
- .15 Do not install flush mounting box back-to-back in walls; provide minimum 150 mm separation. Provide minimum 600 mm separation in acoustic rated walls.
- .16 Secure flush mounting box to interior wall and partition studs. Accurately position to allow for surface finish thickness.
- .17 Use stamped steel bridges to fasten flush mounting outlet box between studs.
- .18 Install flush mounting box without damaging wall insulation or reducing its effectiveness.
- .19 Use adjustable steel channel fasteners for hung ceiling outlet box.
- .20 Do not fasten boxes to ceiling support wires.

- .21 Support boxes independently of conduit.
- .22 Use gang box where more than one device is mounted together. Do not use sectional box.
- .23 Use gang box with plaster ring for single device outlets.
- .24 Use cast outlet box in exterior locations exposed to the weather.
- .25 Use cast outlet box in wet locations.
- .26 Set floor boxes level.
- .27 Large pull boxes: Use hinged enclosure in interior dry locations, surface-mounted cast metal box in other locations.

3.03 ADJUSTING

- .1 Adjust floor box flush with finish flooring material.
- .2 Adjust flush-mounting outlets to make front flush with finished wall material.
- .3 Install knockout closures in unused box openings.

3.04 CLEANING

- .1 Clean interior of boxes to remove dust, debris, and other material.
- .2 Clean exposed surfaces and restore finish.

End of Section

1 General

1.01 SECTION INCLUDES

- .1 Metal Raceway is an enclosed pathway used for surface distribution of branch circuit electrical wiring, and cabling for voice, data, multi-media, low voltage, and optical fiber. Raceway is typically installed in existing building structures, or after construction is complete. A complete raceway system includes raceway, covers, mounting hardware, various fittings, and outlet boxes installed at specific locations. Specific codes and standards apply to electrical wires and telecommunications cables that are deployed within metal raceway. Compliance to codes and standards is required for installation, grounding and bonding, and cable deployment.

1.02 RELATED REQUIREMENTS

- .1 Section 26 05 33.13 – Conduit for Electrical Systems.
- .2 Section 26 05 33.16 – Boxes for Electrical Systems.

1.03 QUALITY ASSURANCE

- .1 Product free from defects in material or workmanship.
- .2 Materials and work specified in this document shall comply with, and are not limited to the codes, standards, and regulations listed below.
 - .1 CSA C22.1 - Canadian Electrical Code, Part I, Safety Standard for Electrical Installations.
 - .2 National Electrical Manufacturer's Association (NEMA)
 - .1 ANSI/NEMA WD-6-2002: Wiring Devices – Dimensional Requirements
 - .2 NEMA 250-2003: Enclosures for Electrical Equipment.
- .3 Performance Requirements:
 - .1 Metal raceway and fittings UL Listed and CSA certified.

1.04 SUBMITTALS

- .1 Product Data Sheet.
- .2 Manufacturer's Instructions.
- .3 Product Catalog Literature.
- .4 Product Drawings.

1.05 WARRANTY

- .1 Product is warranted free of defects in material or workmanship.
- .2 Product is warranted to perform the intended function within design limits.

2 Products

2.01 MANUFACTURERS

- .1 Wiremold Legrand.

- .2 Hubbell.
- .3 Thomas & Betts Canada.

2.02 SURFACE MOUNTED RACEWAY, GENERAL

- .1 The raceway and all system components must be UL Listed and exhibit non-flammable self-extinguishing characteristics tested to comparable specifications of UL94V-0. The raceway base and cover shall be manufactured by rigid compound, available in ivory or white colours, and allow for field painting.

2.03 METAL RACEWAY

- .1 Metal raceway shall be a one-piece design with base and cover, factory assembled, with mounting hardware and instructions included.
- .2 Metal raceway, cover, surface boxes, shall be a formed steel construction with a thickness of 0.040", and zinc plated. Related fittings shall be galvanized on all surfaces.
- .3 Metal raceway, cover, and related fittings shall have an Ivory color powder coat paint finish on all external surfaces.
- .4 Have tools available for field cutting and bending.
- .5 Assembly and disassembly of raceway base, cover, and fittings requiring no special tools.
- .6 Available fittings including couplings, internal and external elbows, tees, entrance fittings, conduit adapters and bushings.
- .7 Available fittings including internal, external and flat elbows, and tee fitting, with a 1 ½" radius to accommodate communications UTP and fiber cabling minimum bend radius requirements.
- .8 Installed fittings designed to overlap the raceway to cover exposed or uneven edges from field cutting.

2.04 DEVICE BOXES

- .1 Compatible device boxes shall have a removable knockout portion to permit metal raceway entry and exit.
- .2 Device boxes available in standard NEMA single- and double-gang, and multiple gang up to six-gang. Device box depth shall range from 1.125" to 2.75".
- .3 Device boxes shall have a single seam construction with rounded corners to eliminate sharp edges.
- .4 Assembled device box front face design to permit flush mounting of standard wall plates to minimize perimeter profile exposure.
- .5 Device boxes shall have threaded standoff posts attached to the base, to facilitate mounting of covers with short screws for ease of alignment during installation.

3 Execution

3.01 PREPARATION

- .1 Submit layout drawings of the raceway system for reviewed prior to installation.
- .2 Installation of metal raceway in wet areas is not permitted.
- .3 Manufacturer's instructions for installing raceway and fittings shall be followed by the installer.

- .4 All wall surfaces, or other permanent structures to which raceway is mounted shall be finished complete.

3.02 INSTALLATION

- .1 Mount base and cover together to wall or structure using the appropriate fasteners and clips, per manufacturer's instructions.
- .2 Securely support raceway in intervals not exceeding 3 m (10 feet) or per manufacturer's instructions.
- .3 Install fittings and device boxes in the specified locations, per manufacturer's instructions and per contract drawing specifications.
- .4 Completed raceway installation shall be mechanically continuous and connected to all electrical outlets, device boxes, and enclosures with no gaps or exposed cuts.
- .5 Provide insulated ground wire for power raceways per OESC requirements. Raceway shall not be used as the primary ground path.
- .6 Prior to wire and cable installation, the raceway system shall be installed complete, including insulating bushings, adapters, fittings, outlets, boxes, and enclosures. Unused raceway openings shall be closed.
- .7 Make wiring connections with the proper approved insulated wire connectors or lugs. Exposed conductors at harness wiring junctions are not permitted regardless of connection method.
- .8 Provide a physical barrier in raceway and boxes to separate power and communication wiring.
- .9 Install covers on raceway, boxes and fittings after wiring is complete, or if wire and cable installation is to be done at a later date.

3.03 FIELD QUALITY CONTROL

- .1 Verify layout of system to contract drawings.
- .2 Raceway system shall be free of dents, scratches, bare metal edges, and exposed uneven cuts.
- .3 Securely fasten all outlets, boxes, and enclosures walls or permanent structures.
- .4 Verify that all wiring junctions or connections have no exposed conductors prior to energizing the circuits.
- .5 Verify that all bonding locations are code and standards compliant.
- .6 Verify that power and communications wiring are separated by a physical barrier in raceway and boxes.

End of Section

1 General

1.01 SECTION INCLUDES

- .1 Sleeves, sealing of sleeves and openings, as required for all electrical work.

1.02 SUBMITTALS

- .1 Submit data sheets for firestopping in accordance with Section 01 33 00.
- .2 Submit copies of firestopping drawings with ULC certificate and system number for each specific installation.
- .3 Submit schedule of opening locations and sizes, penetrating items, and required listed design numbers to seal openings to maintain fire resistance ratings.
- .4 Submit dimensioned location drawings indicating required sleeves and formed openings in structural poured concrete or precast concrete construction or in roofing, and locations of cutting or drilling required for Electrical work.

2 Products

2.01 SLEEVES

- .1 Galvanized steel sleeves:
 - .1 No. 24 gauge with an integral flange at one (1) end to secure sleeve to formwork construction.
 - .2 Schedule 40 pipe.
- .2 Schedule 40 PVC sleeves.

2.02 SLEEVE SEALS

- .1 Manufacturers
 - .1 Hilti Canada.
 - .2 Specified Technologies Inc.
 - .3 3M Canada Inc.
 - .4 Tremco.
 - .5 A/D Fire Protection Systems.
 - .6 Nelson.
 - .7 Approved equal.
- .2 Asbestos-free, elastomeric materials and intumescent materials, tested, listed and labelled by ULC in accordance with CAN/ULC-S115, and CAN/ULC-S101 for installation in ULC designated firestopping, and smoke seal systems to provide a positive fire, water and smoke seal and a fire resistance rating (flame, hose stream and temperature) no less than fire rating for surrounding construction.
- .3 Materials are to be compatible with abutting dissimilar materials and finishes and complete with primers, damming and back-up materials, supports, and anchoring devices in accordance with firestopping manufacturer's recommendations and ULC tested assembly. Coordinate material requirements with trades supplying abutting areas of materials.

- .4 Maintain fire rating of separation in accordance with architectural drawings.

3 Execution

3.01 INSTALLATION

- .1 Where conduits and conductors pass through structural poured concrete, provide sleeves of type suitable for application, and approved by local governing codes.
- .2 Sleeves in concrete slabs, except as noted below, are to be No. 24 gauge or equivalent, with an integral flange to secure sleeves for formwork construction.
- .3 Sleeves in waterproof concrete slabs and in other slabs where waterproof sleeves are required are to be lengths of Schedule 40 pipe sized to extend 100 mm (4") above floor.
- .4 Sleeves in poured concrete walls and foundation are to be Schedule 40 pipe.
- .5 Through interior walls, use standard weight steel pipes, conduit, or galvanized steel. Cut flush with finished surfaces. Check room finish schedules.
- .6 Through exterior walls above grade, floors, and roof use standard weight steel pipes, machine cut, flush with finished surface inside and to suit flashing outside.
- .7 Through exterior walls below grade, water-proofed floors, and other water-proof walls, use heavy weight cast iron pipes, machine cut. Extend sleeves 100 mm (4") above finished floors, and cut flush with underside of floor.
- .8 Size sleeves, unless otherwise noted, to leave 13 mm (1/2") clearance around conduit, duct, conductor, etc. Void between sleeves and conduit, duct, conductors, etc., to be packed and sealed for length of sleeves as in accordance with article entitled "Sleeve Seals" specified in this Section. Pack and seal sleeves set in exterior walls with governing authority approved materials suitable for application and pack both ends of sleeves watertight with approved permanently flexible and water tight materials. Coordinate exact responsibility of work with General Trades Contractor.
- .9 Submit to concrete reinforcement detailer at proper time, drawings indicating required sleeves, recesses and formed openings in poured concrete work. Completely and accurately dimension such drawings and relate sleeves, recesses and formed openings to suitable grid lines and elevation datum.
- .10 Supply sleeves of a water protecting type in accordance with detail found on drawings for installation in following locations:
 - .1 in Mechanical and Fan Room floor slabs, except where on grade;
 - .2 in slabs over Mechanical, Fan, Electrical and Telephone Equipment Rooms or closets;
 - .3 in floors equipped with waterproof membranes.
- .11 "Gang" type sleeving to be permitted only with approval of Owner and reviewed with the Consultant.
- .12 Terminate sleeves for work which is exposed, so that sleeve is flush at both ends with wall, partition, or slab surface such that sleeve may be covered completely by escutcheon plates.
- .13 Sleeves are not required in interior walls and dry area floors where conduit is installed ahead of floor construction.
- .14 Seal all openings and sleeves after installation of equipment:
 - .1 With an approved material to maintain fire rating where sleeves and openings pass through fire separations and floors.

- .2 With an approved material to maintain fire rating for sleeves and openings provided for future equipment.
- .1 Flash all conduits and systems passing through roof or built into an outside wall, or a waterproof floor.
- .2 Provide copper flashing for sleeves passing through exterior walls or waterproof floors.
- .15 Provide all flashing and waterproofing for sleeves through roof and exterior walls to the requirements of Division 07.
- .16 Firestop sleeves in accordance with the manufacturer's specifications and recommendations.

End of Section

1 General

1.01 SECTION INCLUDES

- .1 Tested firestop systems used in penetrations for the passage of cables, conduit, and other electrical equipment through fire-rated vertical barriers (walls and partitions), horizontal barriers (floor/ceiling assemblies), and vertical service shaft walls and partitions.

1.02 RELATED REQUIREMENTS

- .1 Coordinate work of this section with work of other sections as required to properly execute the work and as necessary to maintain satisfactory progress of the work of other sections, including:
 - .1 Section 07 84 00 – Firestopping.
 - .2 Section 27 05 44 – Sleeves and Sleeve Seals for Communications Pathways and Cabling.

1.03 REFERENCES

- .1 Underwriter’s Laboratories (UL) and Underwriters Laboratories of Canada (ULC):
 - .1 Test Requirements: CAN/ULC-S115:2018, Standard Method of Fire Tests of Firestop Systems.
 - .2 Underwriters Laboratories of Canada (ULC) runs CAN/ULC-S115:2018 under their designation of ULC-S115:2018 and publishes the results in their "FIRE RESISTANCE RATINGS DIRECTORY" that is updated annually.
 - .3 Underwriters Laboratories (UL) of Northbrook, IL runs ASTM E-814 under their designation of UL 1479 and publishes the results in their "FIRE RESISTANCE DIRECTORY" that is updated annually. UL tests that meet the requirements of ULC-S115-M are given a cUL listing and are published by UL in their “Products Certified for Canada (cUL) Directory”.
 - .4 CAN/ULC-S102:2018, Standard Test Method for Surface Burning Characteristics of Building Materials and CAN/ULC-S101 Fire Endurance Tests of Building Construction and Materials.
- .2 ASTM:
 - .1 Omega Point Laboratories runs ASTM E-814 and publishes the results annually in their “Omega Point Laboratories Directory”.
 - .2 Inspection Requirements: ASTM E 2174, “Standard Practice for On-site Inspection of Installed Fire Stops.”, and ASTM E2393 Standard Practice for On-Site Inspection of Installed Fire Resistive Joint Systems and Perimeter Fire Barriers.
 - .3 Test Requirements: ASTM E 2307, “Standard Test Method for Determining Fire Resistance of Perimeter Fire Barrier Systems Using Intermediate-Scale, Multi-story Test Apparatus”.
 - .4 ASTM D6904, “Standard Practice for Resistance to Wind Driven Rain for Exterior Coatings Applied on Masonry”.
 - .5 ASTM C 679, “Standard Test Method for Tack-Free Time of Elastomeric Sealants”.
- .3 International Firestop Council Guidelines for Evaluating Firestop Systems Engineering Judgments.
- .4 Ontario Building Code.
- .5 Ontario Electrical Safety Code.

1.04 DEFINITIONS

- .1 Firestopping: Material or combination of materials used to retain integrity of fire-rated construction by maintaining an effective barrier against the spread of flame, smoke, and hot gases through penetrations in fire rated wall and floor assemblies.

1.05 SUBMITTALS

- .1 Submit Product Data: Manufacturer's specifications and technical data for each material including the composition and limitations, documentation of ULC or cUL firestop systems to be used and manufacturer's installation instructions to comply with Section 01 33 00.
- .2 Manufacturer's engineering judgment identification number and drawing details when no ULC or cUL system is available for an application. Engineered judgment must include both project name and contractor's name who will install firestop system as described in drawing.
- .3 Submit material safety data sheets provided with product delivered to job-site.
- .4 Submit shop drawings in accordance with Section 01 33 00:
 - .1 Submit complete cUL, ULC, or equivalent approved systems for all applications. Ensure the listing is clearly noted on the submittal.
- .5 [Submit certificate by firestopping manufacturer proving that the products supplied comply with LEED requirements for indoor environmental quality credit including printed statement of VOC.]

1.06 CLOSEOUT SUBMITTALS

- .1 On completion of firestopping and smoke sealing installation, submit a Letter of Assurance to the Consultant certifying the firestopping and smoke sealing installation has been carried out throughout the building to electrical service penetrations and that installation has been done in strict accordance with requirements of the Ontario Building Code, any applicable municipal bylaws, ULC requirements, and manufacturer's instructions.

1.07 QUALITY ASSURANCE

- .1 Fire-Test-Response Characteristics: Provide through-penetration fire stop systems and fire-resistive joint systems that comply with specified requirements of tested systems.
- .2 Firestop System installation must meet requirements of CAN/ULC-S115 tested assemblies that provide a fire rating as shown in Section 2.1 Clauses 4, 5, 6, and 7 below.
- .3 Proposed firestop materials and methods shall conform to applicable governing codes having local jurisdiction.
- .4 Firestop Systems do not re-establish the structural integrity of load bearing partitions/assemblies, or support live loads and traffic. Installer shall consult the structural engineer prior to penetrating any load bearing assembly.
- .5 For those firestop applications that exist for which no ULC or cUL tested system is available through a manufacturer, a manufacturer's engineering judgment derived from similar ULC or cUL system designs or other tests will be submitted to local authorities having jurisdiction for their review and approval prior to installation. Engineering judgment drawings must follow requirements set forth by the International Firestop Council.

1.08 INSTALLER QUALIFICATIONS

- .1 Engage an experienced Installer who is certified, licensed, or otherwise qualified by the firestopping manufacturer as having the necessary training to install manufacturer's products per specified

requirements. A supplier's willingness to sell its firestopping products to the Contractor or to an Installer engaged by the Contractor does not in itself confer qualification on the buyer.

- .2 Installation Responsibility: assign installation of through-penetration fire stop systems and fire-resistive joint systems in Project to a single sole source firestop specialty contractor.
- .3 The work is to be installed by a contractor with at least one of the following qualifications:
 - .1 FM 4991 approved contractor.
 - .2 UL approved contractor.
 - .3 Manufacturer's accredited fire stop specialty contractor.
- .4 Installer: Minimum 3 years experience with fire stop installation.

1.09 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver materials undamaged in manufacturer's clearly labeled, unopened containers, identified with brand, type, and ULC or cUL label where applicable.
- .2 Coordinate delivery of materials with scheduled installation date to allow minimum storage time at job-site.
- .3 Store materials under cover and protect from weather and damage in compliance with manufacturer's requirements.
- .4 Comply with recommended procedures, precautions or remedies described in material safety data sheets as applicable.
- .5 Do not use damaged or expired materials.

1.10 PROJECT CONDITIONS

- .1 Do not use materials that contain flammable solvents.
- .2 Scheduling
 - .1 Schedule installation of CAST IN PLACE firestop devices after completion of floor formwork, metal form deck, or composite deck but before placement of concrete.
 - .2 Schedule installation of Drop-In firestop devices after placement of concrete but before installation of the pipe penetration. Diameter of sleeved or cored hole to match the listed system for the device.
 - .3 Schedule installation of other firestopping materials after completion of penetrating item installation but prior to covering or concealing of openings.
- .3 Verify existing conditions and substrates before starting work. Correct unsatisfactory conditions before proceeding.
- .4 Weather conditions: Do not proceed with installation of firestop materials when temperatures exceed the manufacturer's recommended limitations for installation printed on product label and product data sheet.
- .5 During installation, provide masking and drop cloths to prevent firestopping materials from contaminating any adjacent surfaces.

2 Products

2.01 PERFORMANCE REQUIREMENTS

- .1 Provide firestopping composed of components that are compatible with each other, the substrates forming openings, and the items, if any, penetrating the firestopping under conditions of service and application, as demonstrated by the firestopping manufacturer based on testing and field experience.
- .2 Provide components for each firestopping system that are needed to install fill material. Use only components specified by the firestopping manufacturer and approved by the qualified testing agency for the designated fire-resistance-rated systems.
- .3 Provide a round fire-rated cable management device whenever cables penetrate fire rated walls, where frequent cable changes and additions may occur. The fire-rated cable management device shall consist of a corrugated steel tube with zinc coating, contain an inner plastic housing, intumescent material rings, and inner fabric smoke seal membrane. The length of the sleeve shall be 315 mm (12.4 inches). The fire-rated cable management device shall contain integrated intumescent firestop wrap strip materials sufficient to maintain the hourly rating of the barrier being penetrated. The fire-rated cable management device shall contain a smoke seal fabric membrane or intumescent firestop plugs sufficient to achieve the L-Rating requirements of the barrier type. Install device per the manufacturer's published installation instructions.
- .4 Penetrations in Horizontal Assemblies: Provide firestopping with ratings determined in accordance with CAN/ULC-S115. For penetrations through a Fire Wall or horizontal Fire Separation provide a firestop system with a "FT" Rating as determined by ULC or cUL which is equal to the fire resistance rating of the construction being penetrated.
- .5 W-ratings: in accordance with Section 07 84 00.
- .6 Provide a firestop system with an Assembly Rating as determined by CAN/ULC-S115 which is equal to the time rating of construction joint assembly.
- .7 Penetrations in Smoke Barriers: Provide firestopping with ratings determined in accordance with CAN/ULC-S115.
 - .1 L-Rating: Not exceeding 5.0 CFM/sqft of penetration opening at both ambient and elevated temperatures.
- .8 Mold Resistance: Provide penetration firestopping with mold and mildew resistance rating of [0] as determined by ASTM G21.
- .9 Rain and water resistance: provide perimeter joint sealant tested in accordance with ASTM D 6904 with less than 1 hour tack free time as tested in accordance with ASTM C 679.

2.02 MANUFACTURERS

- .1 Manufacturer List:
 - .1 AD Fire Protection Systems.
 - .2 Hilti (Canada) Corporation
 - .3 3M.
 - .4 Specified Technologies, Inc. (STI).
 - .5 Tremco, Inc.
 - .6 Approved equal.

- .2 Substitutions: Where a specific manufacturer is noted in this Section, equivalent products from the manufacturers listed above may be used, subject to compliance with through penetration firestop systems and joint systems listed in the ULC Fire Resistance Directory – Volume III, or UL Products Certified for Canada (cUL) Directory.

2.03 MATERIALS

- .1 Use only firestop products that have been ULC or cUL tested for specific fire-rated construction conditions conforming to construction assembly type, penetrating item type, annular space requirements, and fire-rating involved for each separate instance.
- .2 Accessories: provide components for each firestopping and smoke seal systems that are needed to install fill materials. Use only components specified by firestopping material manufacturer, and approved by the qualified testing agency. Accessories include, but are not limited to, the following items:
 - .1 Permanent forming, damming and backing material.
 - .2 Temporary forming material.
- .3 Pre-formed firestop devices for use with non-combustible and combustible pipes (closed and open systems), conduit and/or cable bundles penetrating concrete floors and/or gypsum walls:
 - .1 Hilti Tub Box Kit (CP 681) for use with tub installations.
 - .2 Hilti Cast-In Place Firestop Device (CP 680-PX) for use with XFR pipe.
 - .3 Hilti Cast-In Place Firestop Device (CP 680-M) for use with non-combustible penetrants.
 - .4 Hilti Speed Sleeve (CP 653) for use with cable penetrations.
 - .5 Hilti Firestop Drop-In Device (CFS-DID) for use with non-combustible and combustible penetrants.
 - .6 Hilti Cast-in Firestop sleeve (CFS-CID MD P) and (CFS-CID MD M) for use with combustible and non-combustible pipes through metal deck.
 - .7 Hilti Firestop Block (CFS-BL).
 - .8 STI SpecSeal series SSC Firestop Collars.
 - .9 STI SpecSeal series LCC Firestop Collars.
- .4 Sealants or caulking materials for use with non-combustible items including steel pipe, copper pipe, rigid steel conduit and electrical metallic tubing (EMT).
 - .1 Hilti Intumescent Firestop Sealant (FS-ONE MAX).
 - .2 Hilti Fire Foam (CP 620)/CP 660.
 - .3 Hilti Flexible Firestop Sealant (CP 606).
 - .4 Hilti Firestop Silicone Sealant Gun Grade (CFS-S SIL GG).
 - .5 Hilti Firestop Silicone Sealant Self Leveling (CFS-S SIL SL).
- .5 Intumescent sealants or caulking materials for use with combustible items (penetrants consumed by high heat and flame) including insulated metal pipe, PVC jacketed, flexible cable or cable bundles and plastic pipe.
 - .1 Hilti Intumescent Firestop Sealant (FS-ONE MAX).

- .6 Foams, intumescent sealants, or caulking materials for use with flexible cable or cable bundles.
 - .1 Hilti Intumescent Firestop Sealant (FS-ONE MAX).
 - .2 Hilti Fire Foam (CP 620)/660.
 - .3 Hilti Flexible Firestop Sealant (CP 606).
 - .4 Hilti Firestop Silicone Sealant Gun Grade (CFS-S SIL GG).
 - .5 Hilti Firestop Silicone Sealant Self Leveling (CFS-S SIL SL).
- .7 Firestop Putty Pads: Intumescent, non-hardening putty pads to be installed on metallic and non-metallic electrical switch and receptacle boxes to reduce horizontal separation between boxes to less than 610 mm (24 in):
 - .1 STI SpecSeal Series SSP Firestop Putty Pads.
 - .2 Hilti Firestop Putty Pad (CP 617).
- .8 Materials used for large size/complex penetrations made to accommodate cable trays, multiple steel and copper pipes, electrical busways in raceways.
 - .1 Hilti Firestop Block (CFS-BL).
 - .2 Hilti Composite Sheet (CFS-COS).
 - .3 Hilti Firestop Mortar (CP 637).
 - .4 Hilti Fire Foam (CP 620)/660.
 - .5 Hilti Firestop Board (CP 675T).
- .9 Non-curing, re-penetrable materials used for large size/complex penetrations made to accommodate cable trays, multiple steel and copper pipes, electrical busways in raceways.
 - .1 Hilti Firestop Block (CFS-BL).
 - .2 Hilti Firestop Board (CP 675T).
- .10 Re-penetrable, round cable management devices for use with new or existing cable bundles penetrating gypsum or masonry walls.
 - .1 Hilti Speed Sleeve (CP 653) with integrated smoke seal fabric membrane.
 - .2 Hilti Firestop Cable Collar (CFS-CC).
 - .3 Hilti Firestop Sleeve (CFS-SL SK).
 - .4 Hilti Retrofit Sleeve (CFS-SL RK) for use with existing cable bundles.
 - .5 Hilti Gangplate (CFS-SL GP) for use with multiple cable management devices.
 - .6 Hilti Gangplate Cap (CFS-SL GP CAP) for use at blank openings in gangplate for future penetrations.
- .11 For blank openings made in fire-rated wall or floor assemblies, where future penetration of pipes, conduits, or cables is expected.
 - .1 Hilti CFS-BL Firestop Block (for walls and floors).

- .2 Hilti CFS-PL Firestop Plug (for walls and floors).
- .12 Cast-In-Place Firestop Device: Single component molded firestop device installed on forms prior to concrete placement with totally encapsulated, tamper-proof integral firestop system and smoke sealing gasket. Device shall allow for a concrete floor thickness of minimum 63 mm (2-1/2 in) up to 914 mm (36 in) without the use of field applied extension tubing:
 - .1 STI SpecSeal CID Cast-In Firestop Device.
 - .2 Hilti CP 680 Cast-In Place Firestop Device (for floors only).
- .13 For single or cable bundles up to one inch diameter penetrating gypsum, masonry, concrete walls or wood floor assemblies.
 - .1 Hilti CFS-D Firestop Cable Disc.

3 Execution

3.01 INSTALLERS

- .1 Labour Use to Install Firestop Systems
 - .1 To ensure complete harmony on the project site, the installation of each scope of work is to be performed jurisdictionally correct per existing trade agreements.

3.02 PREPARATION

- .1 Verification of Conditions: Examine areas and conditions under which work is to be performed and identify conditions detrimental to proper or timely completion.
 - .1 Verify penetrations are properly sized and in suitable condition for application of materials.
 - .2 Surfaces to which firestop materials will be applied shall be free of dirt, grease, oil, rust, laitance, release agents, water repellents, and any other substances that may affect proper adhesion.
 - .3 Provide masking and temporary covering to prevent soiling of adjacent surfaces by firestopping materials.
 - .4 Comply with manufacturer's recommendations for temperature and humidity conditions before, during and after installation of firestopping.
 - .5 Do not proceed until unsatisfactory conditions have been corrected.

3.03 COORDINATION

- .1 Coordinate construction of openings, penetrations to ensure that the fire stop systems are installed according to specified requirements.
- .2 Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate through-penetration fire stop systems.
- .3 Coordinate fire stopping with other trades so that obstructions are not placed in the way prior to the installation of the fire stop systems.
- .4 Do not cover up through-penetration fire stop and joint system installations that will become concealed behind other construction until each installation has been examined by the building inspector.

3.04 INSTALLATION

- .1 Regulatory Requirements: Install firestop materials in accordance with ULC Fire Resistance Directory or UL Products Certified for Canada (cUL) Directory or Omega Point Laboratories Directory.
- .2 Manufacturer's Instructions: Comply with manufacturer's instructions for installation of through-penetration and construction joint materials.
 - .1 Seal all holes or voids made by penetrations to ensure an air and water-resistant seal.
 - .2 Consult with mechanical engineer, project manager, and damper manufacturer prior to installation of ULC or cUL firestop systems that might hamper the performance of fire dampers as it pertains to duct work.
 - .3 Protect materials from damage on surfaces subjected to traffic.

3.05 FIELD QUALITY CONTROL

- .1 Examine sealed penetration areas to ensure proper installation before concealing or enclosing areas.
- .2 Keep areas of work accessible until inspection by applicable code authorities.
- .3 Inspection of through-penetration firestopping shall be performed in accordance with ASTM E 2174, "Standard Practice for On-Site Inspection of Installed Fire Stops", or other recognized standard.
- .4 Perform under this section patching and repairing of firestopping caused by cutting or penetrating of existing firestop systems already installed by other trades.
- .5 Manufacturer's Field Services: During Installation, provide periodic destructive testing inspections to assure proper installation/application. After installation is complete, submit findings in writing indicating whether or not the installation of the tested system identified was installed correctly.

3.06 IDENTIFICATION AND DOCUMENTATION

- .1 The firestop contractor is to supply documentation for each single application addressed. This documentation is to identify each penetration location on the entire project.
- .2 The Documentation Form for through penetrations is to include:
 - .1 A Sequential Location Number.
 - .2 The Project Name.
 - .3 Date of Installation.
 - .4 Detailed description of the penetration location.
 - .5 Tested System or Engineered Judgment Number.
 - .6 Type of assembly penetrated.
 - .7 A detailed description of the size and type of penetrating item.
 - .8 Size of opening.
 - .9 Number of sides of assemblies addressed.
 - .10 Hourly rating to be achieved.
 - .11 Installer's Name.

- .3 Copies of these documents are to be provided to the general contractor at the completion of the project.
- .4 Identify through-penetration firestop systems with pressure-sensitive, self-adhesive, preprinted vinyl labels. Attach labels permanently to surfaces of penetrated construction on both sides of each firestop system installation where labels will be visible to anyone seeking to remove penetrating items or firestop systems. Include the following information on labels:
 - .1 The words: "Warning-Through Penetration Firestop System-Do Not Disturb. Notify Building Management of Any Damage."
 - .2 Contractor's Name, address, and phone number.
 - .3 Through-Penetration firestop system designation of applicable testing and inspecting agency.
 - .4 Date of Installation.
 - .5 Through-Penetration firestop system manufacturer's name.
 - .6 Installer's Name.

3.07 ADJUSTING AND CLEANING

- .1 Remove equipment, materials and debris, leaving area in undamaged, clean condition.
- .2 Clean all surfaces adjacent to sealed holes and joints to be free of excess firestop materials and soiling as work progresses.

End of Section

1 General

1.01 SECTION INCLUDES

- .1 Switches, receptacles, wiring devices, cover plates and their installation.

1.02 RELATED REQUIREMENTS

- .1 Section 03 30 00 – Cast-in-Place Concrete.
- .2 Section 26 27 26 – Wiring Devices.

1.03 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CSA-C22.2 No.42-99 (R2004), General Use Receptacles, Attachment Plugs and Similar Devices.
 - .2 CAN/CSA-C22.2 No.42.1-00 (R2004), Cover Plates for Flush-Mounted Wiring Devices (Bi-National standard, with UL 514D).
 - .3 CSA-C22.2 No.55-M1986 (R2003), Special Use Switches.
 - .4 CSA-C22.2 No.111-00 (R2005), General-Use Snap Switches (Bi-national standard, with UL 20, twelfth edition).

1.04 SUBMITTALS

- .1 Submit shop drawings and product data in accordance with Section 01 33 00.

2 Products

2.01 OUTDOOR RECEPTACLE PEDESTALS

- .1 Aluminum pedestal complete with pedestal cap, gaskets, grounding lug, and all require accessories.
- .2 Minimum 75 mm by 75 mm (3 inch by 3 inch) cross section.
- .3 Drain hole.
- .4 Final mounting height of wiring device shall be no greater than 1200 mm above finished grade, including concrete base.
- .5 Pedestal will be approved using field evaluation or special inspection and marked by a certification organization accredited by (SCC) standards council of Canada such as "CSA" or "QPS" or "ESA" or "ENTECLA" or "UL".
- .6 Complete with base flange for concealing anchor bolts.
- .7 Receptacles to be oriented minimum 45 degrees down from horizontal to minimize cable strain.
- .8 Provide bracket for management of cables, or coiling of excess cable length.

2.02 FOUNDATIONS FOR PEDESTALS

- .1 Provide foundations for lighting standards in accordance with manufacturer's recommendations. Submit Equipment Foundation Data in accordance with referenced standards in this section.
- .2 Concrete Foundations:

.1 Provide concrete bases as specified in Section 03 30 00.

.3 Anchor Bolts

.1 Provide concealed galvanized high strength steel rod anchor bolts, in accordance with manufacturer's instructions.

2.03 SPECIAL RECEPTACLES

.1 Voltage and configurations as indicated on drawings.

.2 Receptacles of one manufacturer throughout project.

2.04 RECEPTACLE COVER PLATES

.1 Cover plates for wiring devices to: CSA-C22.2 No.42.1.

.2 Cover plates from one manufacturer throughout project.

.3 While-in-use weatherproof cover spring-loaded cast aluminum cover plates complete with gaskets for single receptacles or switches for outdoor applications. Cover shall be suitable for wet locations whether or not a plug is inserted in the receptacle.

.4 All outdoor wiring device cover plates to be labeled with riveted 3-ply engraved laminated nameplate identifying panel and circuit number for each device, and receptacle configuration.

3 Execution

3.01 INSTALLATION

.1 Receptacle Pedestal

.1 Cut opening required on gasket for wiring access and concrete screw holes.

.2 Install galvanized steel concrete screws to secure pedestal to concrete base.

.3 Apply a bead of sealant at top of pedestal for weatherproofing.

.4 Ground pedestal in accordance with Section 26 05 29.

.5 Install receptacles as indicated.

.2 Receptacles:

.1 Install receptacles in gang type outlet box when more than one receptacle is required in one location.

.2 Mount receptacles at height in accordance with Section 26 05 00 as indicated.

.3 Cover plates:

.1 Protect stainless steel cover plate finish with paper or plastic film until painting and other work is finished.

.2 Install suitable common cover plates where wiring devices are grouped.

.3 Do not use cover plates meant for flush outlet boxes on surface-mounted boxes.

3.02 WASTE MANAGEMENT

- .1 Separate and recycle waste materials in accordance with Section 01 74 19.
- .2 Divert unused metal and wiring materials from landfill to metal recycling facility as approved by Owner's Representative.

End of Section

1 General

1.01 SECTION INCLUDES

- .1 This section provides minimum acceptance requirements for vibration isolation for all electrical equipment, conduit, and piping.

1.02 RELATED REQUIREMENTS

- .1 Concrete work is described in Division 03.

1.03 SUBMITTALS

- .1 All vibration isolation systems shall be by one manufacturer.
- .2 All outdoor mounted equipment shall be restrained for the highest wind speed as specified by the project's structural engineer, the governing building code(s) or the authority having jurisdiction.
- .3 Submit shop drawings for all devices specified herein and as indicated and scheduled on the drawings. Submittals shall indicate full compliance with the device specification in Part 2. Any deviation shall be specifically noted and subject to engineer approval. Submittals shall include device dimensions, placement, attachment and anchorage requirements.

1.04 QUALITY ASSURANCE

- .1 Unless otherwise directed by the local authority having jurisdiction, the following codes and standards will apply:
 - .1 International Building Code 2009.
 - .2 American Society of Civil Engineers 7-05.
 - .3 Ontario Building Code, Latest Edition.
- .2 Manufacturer's Qualifications: Firms regularly engaged in manufacture of vibration control products of type, size, and capacity required, whose products have been in satisfactory use in similar service for not less than 5 years.

2 Products

2.01 MANUFACTURERS

- .1 Vibro-Acoustics.
- .2 Kinetics Noise Control.
- .3 BVA Systems.
- .4 Vibron Limited.
- .5 Mason Industries.

2.02 VIBRATION ISOLATION

- .1 Springs: All springs shall have a minimum additional travel to solid equal to 50% of the rated deflection. All springs except internal nested springs shall have an outside diameter not less than 0.8 of the compressed height of the spring. Ends of springs shall be square and ground for stability. Laterally stable springs shall have kx/ky ratios of at least 0.9. All springs shall be fully color-coded to indicate capacity – color striping is not considered adequate.

- .2 Corrosion Protection: All springs shall be powder-coated enamel. Housings shall be hot dipped galvanized, powder-coated enamel, or painted with rust-resistant paint.
- .3 Isolators:
 - .1 Vibration Isolation Pads: Type N – Neoprene pad type isolators, 3/8" (10 mm) minimum thick, ribbed on both sides.
 - .1 Type NSN – Sandwich neoprene pad type isolators, with 3/8" (10 mm) minimum thick ribbed neoprene pads bonded to each side of a 10 ga (3.5 mm) minimum galvanized metal plate. Isolator pads shall be selected to ensure that deflection does not exceed 20% of isolator free height.
 - .2 Rubber-in-Shear Floor Mounts: Type RD – "Double-deflection" neoprene isolators, with neoprene-coated metal surfaces, and top and bottom surfaces ribbed. Isolators shall have bolt holes in the base.
 - .3 Restrained Spring Floor Mounted Isolators: Type CSR – Laterally stable, vertically restrained spring isolators with welded steel housings and heavy top plates for supporting equipment. Springs shall be supported either with a neoprene cup or a metal base plate complete with a ribbed neoprene pad, minimum 1/4" (6 mm) thick, bonded to the base plate. Housings shall include vertically restraining limit stops. Minimum clearance around the restraining bolts and between the housing and the spring shall be 1/2" (13 mm). Top plate and restraining bolts shall be out of contact with the housing during normal operation and neoprene grommets shall be incorporated to minimize short-circuiting of restraining bolts. For outdoor applications, housing must be hot-dip galvanized. For indoor applications, powder-coated finish for the housing is acceptable.

3 Execution

3.01 GENERAL

- .1 Coordinate size, doweling, and reinforcing of concrete equipment housekeeping pads and piers with vibration isolation manufacturer to ensure adequate space and prevent edge breakout failures. Pads and piers must be adequately doweled in to structural slab.
- .2 Coordinate locations and sizes of structural supports with locations of vibration isolators (e.g., roof curbs, cooling towers, air-cooled chillers, etc.).
- .3 Isolated equipment, duct and piping located on roofs must be attached to the structure. Intermediate supports between the restraint and structure that are not attached to the structure must be approved by the restraint manufacturer.

3.02 VIBRATION ISOLATION

- .1 Ensure housekeeping pads have adequate space to mount equipment and isolator housings and shall also be large enough to ensure adequate edge distance for isolator anchors.
- .2 Select and locate vibration isolation equipment to give uniform loading and deflection, according to weight distribution of equipment.
- .3 Engine-generator set silencers and associated exhaust piping shall be supported with Type SHR isolators with a minimum 40 mm (1-1/2 inch) static deflection.
- .4 Equipment Isolation:

Equipment Type	HP and Other	RPM	Floor Span											
			Slab on Grade			Up to 20 ft.			20 to 30 ft.			30 to 40 ft.		
			Base Type	Isolat or Type	Min. Defl., in.	Base Type	Isolat or Type	Min. Defl., in.	Base Type	Isolat or Type	Min. Defl., in.	Base Type	Isolat or Type	Min. Defl., in.
Transformers and UPS's														
All	All	All	N/A	NSN	0.12	N/A	NSN	0.12	N/A	NSN	0.12	NM	RD/NSN	0.25
Engine-Driven Generators														
All	All	All	N/A	CSR	0.75	N/A	CSR	1.50	N/A	CSR	2.50	N/A	CSR	3.50
Notes:	(1) Units that are suspended overhead shall use isolation hangers in place of floor mounted isolators with equal or greater deflection. (2) Floor spans are defined as the distance between structural support columns or walls.													

- .5 There shall be no rigid contact of isolated equipment with shaft walls, floor slabs, partitions, or non-flexible conduits connections.
- .6 Where recommended by the manufacturer, isolator base plates shall be bolted to the structure or foundation. Bolting shall incorporate neoprene bushings and washers.

3.03 SITE TESTS AND INSPECTIONS

- .1 After installation, arrange and pay for the vibration isolation product manufacturer, or representative, to visit the site to verify that the vibration isolation systems are installed and operating properly, and shall submit a certificate so stating. Verify that isolators are adjusted, with springs perpendicular to bases or housing, adjustment bolts are tightened up on equipment mountings, and hangers are not cocked.

End of Section

1 General

1.01 SECTION INCLUDES

- .1 Nameplates and labels.
- .2 Wire and cable markers.
- .3 Conduit markers.
- .4 Receptacle labels.
- .5 Signage.

1.02 RELATED REQUIREMENTS

- .1 Section 27 05 53 – Identification for Communications Systems.

1.03 SUBMITTALS

- .1 Product Data: Provide catalogue data for nameplates, labels, and markers.
- .2 Provide shop drawings of nameplates for Consultant's review prior to fabrication (scale 1:1)
- .3 Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency specified under regulatory requirements. Include instructions for storage, handling, protection, examination, preparation and installation of Product.

1.04 REGULATORY REQUIREMENTS

- .1 Provide products listed and classified by CSA (Canadian Standards Association) as suitable for the purpose specified and indicated.

2 Products

2.01 NAMEPLATES AND LABELS

- .1 Nameplates:
 - .1 Engraved three-layer laminated plastic, letters on contrasting background.
 - .2 Colours to match existing building system, where applicable. If no building system exists, use the following:
 - .1 347/600 Volt system: White text on Blue Background.
 - .2 [230/400 Volt system: White text on Blue Background.]
 - .3 120/208 Volt system: Black text on White Background.
 - .4 Fire Detection system: White text on Red Background.
 - .5 Emergency Lighting system: Red text on White Background.
 - .6 LV systems: White text on Green Background.
 - .7 [230/400 Volt Uninterruptable Power Supply (UPS): Black text on Yellow Background.]
 - .8 120/208 Volt Uninterruptable Power Supply (UPS): White text on Orange Background.

- .3 Confirm colours with the Consultant prior to ordering nameplates.
- .2 Equipment Nameplates to indicate:
 - .1 Equipment/Panelboard ID
 - .2 Ampacity.
 - .3 Voltage
 - .4 Number of Phases
 - .5 Number of wires in system
 - .6 Interrupting Capacity
 - .7 Size, number of poles, Panelboard ID, and circuit number of upstream overcurrent protection device.
 - .1 Location of upstream device if not in the same room.
- .3 Coordination Study Labels to Section 26 05 73.16.
- .4 Arc Flash Study Labels to Section 26 05 73.19.
- .5 Locations:
 - .1 Distribution panelboards, and individual distribution panelboard branch breakers.
 - .2 Receptacle panelboards.
 - .3 Each electrical distribution and control equipment enclosure.
 - .4 Uninterruptible Power Supply.
 - .5 Mechanical Equipment.
 - .6 UPS Receptacles.
 - .7 Disconnects, starters and contactors: indicate equipment being controlled and voltage.
 - .8 Terminal cabinets, junction boxes, and pull boxes: indicate system and voltage.
 - .9 Transformers: indicate capacity, primary and secondary voltages.
- .6 Letter Size:
 - .1 Use 3 mm letters for identifying individual equipment and loads.
 - .2 Use 6 mm letters for identifying grouped equipment and loads.
- .7 Labels:
 - .1 Mechanically fastened with sheet metal screws, with 5 mm white letters on black background.
 - .2 White letters on red background for UPS and equipment, and devices downstream of UPS.
 - .3 Labels: embossed plastic labels with 6 mm high letters unless specified otherwise.
 - .4 Wording on nameplates and labels to be reviewed by the Consultant prior to manufacturing.

- .5 Allow for minimum of twenty-five (25) letters per nameplate and label.
- .6 Nameplates for terminal cabinets and junction boxes to indicate system and/or voltage characteristics.
- .7 Terminal cabinets and pull boxes: indicate system and voltage.

2.02 WIRING IDENTIFICATION

- .1 Identify wiring with permanent indelible identifying markings, numbered, on both ends of phase conductors of feeders and branch circuit wiring.
- .2 Maintain phase sequence and colour coding throughout.
- .3 Colour coding: to CSA C22.1.
- .4 Use colour coded wires in communication cables, matched throughout system.

2.03 WIRE MARKERS

- .1 Description: tape, split sleeve, or tubing type wire markers.
- .2 Locations: Each conductor at panelboard gutters, pull boxes, outlet and junction boxes and each load connection.
- .3 Legend:
 - .1 Power and Lighting Circuits: Branch circuit or feeder number indicated on drawings.
 - .2 Control Circuits: Control wire number indicated on shop drawings.

2.04 CONDUIT AND BOX MARKERS

- .1 Colour code conduits, boxes and metallic sheathed cables.
- .2 Location: Provide markers for each conduit longer than 2 m.
- .3 Code with plastic tape or paint at points where conduit or cable enters wall, ceiling, or floor, and at 15 m intervals.
- .4 Colours to match equipment nameplate background colour:
 - .1 347/600 Volt system: Blue.
 - .2 [230/400 Volt system: Blue.]
 - .3 120/208 Volt system: Black.
 - .4 Fire Alarm system: Red.
 - .5 Emergency Lighting system: Red/White.
 - .6 LV Systems (EPO, Remote Monitoring, Generator Control, Communications): Green.
 - .7 [230/400 Volt Uninterruptable Power Supply (UPS): Yellow.]
 - .8 120/208 Volt Uninterruptable Power Supply (UPS): Orange
- .5 Confirm colours with the Consultant prior to commencing rough-in.

2.05 JUNCTION AND PULL BOXES

- .1 Clearly identify main pull or junction boxes (excluding obvious outlet boxes) by painting outside of covers.
- .2 Spray painting: not permitted.
- .3 Paint colours to be in accordance with following schedule:
 - .1 Lighting: yellow.
 - .2 Normal power: blue.
 - .3 Emergency power: orange.
 - .4 Fire alarm: red.
 - .5 Communications systems including telephone and data: green.
 - .6 Miscellaneous signals: brown.
- .4 In addition to painting miscellaneous signal boxes, clearly identify specific system in which box is installed. Identify source panelboard for power circuits.

2.06 BRANCH BREAKER LABELS

- .1 General:
 - .1 Legibly identify every circuit and circuit modification as to its clear, evident, and specific purpose or use. Include sufficient detail to allow each circuit to be distinguished from all others.
 - .2 Label spare positions that contain unused overcurrent devices or switches.
 - .3 Do not describe any circuit in a manner that depends on transient conditions of occupancy.
- .2 Switchboards, distribution panelboards, enclosed breakers, and disconnect switches:
 - .1 Locate identification at each switch.
 - .2 Branch breaker nameplates on switchboards, distribution panelboards and switchboards, and generator load breakers to indicate:
 - .1 Locate identification at each switch on a switchboard.
 - .2 Identification of downstream equipment fed from the breaker.
 - .1 Location of downstream device if not in the same room.
 - .3 Breaker size and number of poles.
 - .4 Interrupting Capacity.
 - .5 Circuit number (where applicable).
 - .6 Do not describe any circuit in a manner that depends on transient conditions of occupancy.
- .3 Lighting and Receptacle Panelboards:
 - .1 Provide a circuit directory that is located on the face or inside of the panel door.
 - .2 Do not describe any circuit in a manner that depends on transient conditions of occupancy.

2.07 RECEPTACLE LABELS

- .1 Label all receptacles with the panelboard ID and circuit number.
- .2 Use receptacle labels by electronic labeller Brother P-Touch, model PT-20/25, Dymo-Tape or approved equal.
- .3 Location: On receptacle wall plate.

3 Execution

3.01 EQUIPMENT NAMEPLATES FROM MANUFACTURERS

- .1 Ensure manufacturer's nameplates, CSA labels and identification nameplates are visible and legible after equipment is installed.
- .2 Manufacturers' nameplates and CSA labels are to be visible and legible after equipment is installed. Provide warning signs, as specified, or to meet requirements of Inspection Department, Health and Safety, and the Consultant.
- .3 Label power outlets with circuit identification on visible portion of faceplate or surface mounted outlet box.

3.02 CONDUIT AND BOX IDENTIFICATION

- .1 Locate labels as follows:
 - .1 At every end of every conduit, duct or cable run, adjacent to item of equipment serviced.
 - .2 On each exposed conduit, duct or cable passing through a wall, partition or floor (one on each side of such wall partition or floor).
 - .3 At intervals of 15 m (50'-0") along every exposed conduit, duct or cable run exceeding 15 m (50 feet) in length.
 - .4 At every access point on concealed conduit duct or cable.
 - .5 At each junction box.
- .2 Place labels so as to be visible from 1500 mm (5'-0") above adjacent floor platform.

3.03 PREPARATION

- .1 Degrease and clean surfaces to receive nameplates and labels.

3.04 APPLICATION

- .1 Confirm colours prior to start of work.
- .2 Install nameplate and label parallel to equipment lines.
- .3 Secure nameplate to equipment front using adhesive.
- .4 Secure nameplate to inside surface of door on panelboard that is recessed in finished locations.
- .5 Identify conduit using field painting.
- .6 Paint coloured band on each conduit longer than 2 m.

- .7 Paint bands 6 m on centre.

3.05 LABELLING

- .1 Colour code wiring consistently throughout the installation and generally match colour coding of internal wiring of pre-wired components.
- .2 Label wiring with point name using Thomas & Betts 12 character polestar metalized labels with 3 rows of characters per label, or equal by Brady. Label to occur as a minimum at both ends and at pull boxes of the wiring run.
- .3 Identify all pull boxes, junction boxes, etc. (installed as part of this project or used by this project) with the exact use of the box. Indelible felt pen marker is acceptable.
- .4 Label light control items with point name using Thomas & Betts 12 character label, or equal by Brady. Label to be black lettering on clear backing.
- .5 Label relays and controllers inside panels using Thomas & Betts 12 character label, or equal by Brady.
- .6 Provide red, 13 mm (1/2 inch) diameter, sticker on emergency light fixture frame. Include circuit number on sticker with thin permanent black mark pen.

3.06 LABELS AND SIGNS

- .1 Manufacturers' nameplates and CSA labels are to be visible and legible after equipment is installed. Provide warning signs, as specified, or to meet requirements of Inspection Department, Health and Safety, and the Consultant.
- .2 Label power outlets with circuit identification on visible portion of faceplate or surface mounted outlet box.

End of Section

1 General

1.01 SECTION INCLUDES

- .1 Provide a coordination study for the [existing and] new portions of electrical distribution system. The basic analysis shall include a protective device evaluation, and a protective device coordination study.
- .2 The project shall begin at the point of utility service for the facility and continue down through the system to all downstream distribution and branch panelboards, motor control centres and significant motor locations.
- .3 The project shall include any new generators and any associated emergency power distribution equipment, including automatic transfer switches and generator ground fault protection.

1.02 RELATED REQUIREMENTS

- .1 Section 26 05 73.19 – Arc-Flash Hazard Analysis.
- .2 Single Line Diagram.

1.03 REFERENCE STANDARDS

- .1 Perform all studies in accordance with the latest applicable IEEE and ANSI standards.

1.04 SUBMITTALS

- .1 Submit the following in accordance with Section 01 33 00:
 - .1 Submit for review three copies of the protection coordination study.
 - .2 Shop drawings for equipment affected by the coordination study will not be reviewed until the coordination study has been submitted and reviewed.
 - .3 Include a one-line diagram of the system.
 - .4 Bind the final report in a three-ring binder, as well as a soft copy.
- .2 Projection System Coordination
 - .1 Prepare a graph or coordination curves, prior to manufacture of service entrance and distribution equipment on K & E No. 336E Time-Current characteristic graph paper. Time-current characteristics shall be plotted of the following:
 - .1 Supply Authorities relays or fuses protecting incoming service (Contractor under this section shall obtain this information).
 - .2 Main and feeder protective devices at every voltage level used in distribution system.
 - .3 Protective devices associated with largest motor and/or refrigeration compressor.
 - .2 Preliminary submission of graph for comment will be accepted. Submit graph to Supply Authority for approval by them as providing satisfactory co-ordination. When curves have been approved by Supply Authority, they shall be submitted for approval. After approval has been obtained, order protective devices and calibrate to conform with these curves.
 - .3 Each time-current characteristic curve sheet shall include:
 - .1 A single line diagram for the portion of the system involved.
 - .2 Transformer damage curves (where applicable).

- .3 Cable damage curves (where applicable).
- .4 Available fault levels for the portion of the system involved.
- .4 Consult manufacturer of the refrigeration compressors and obtain recommendations for settings on starters. Incorporate information in co-ordination curves and submit the associated curves to Compressor Manufacturer and obtain approval from the manufacturer.
- .5 Compressor manufacturer and mechanical trade contractor will determine and calibrate proper protection on motor starters and will ensure that it co-ordinates with protective devices on switchboard.
- .6 Co-ordination curves, mentioned above, shall be prepared by distribution equipment manufacturers as soon as possible after award of contract.
- .7 At the option of this contractor under this section, these co-ordination curves may also be prepared by an independent testing organization. In this case, the independent testing organization shall determine the proper settings of all protective relays and devices and pass them on to the Switchboard manufacturer for incorporation into the switchboards. Include all associated costs in the tender.
- .8 Distribution Equipment manufacturers shall examine drawings and specifications prior to award of contract to ensure that relays and devices being supplied by them will co-ordinate satisfactorily to Supply Authority requirements. Payment will not be allowed, after award of contract, for extra charges due to device changes to comply with recommended practices, due to oversight or negligence by distribution equipment manufacturers.

1.05 CLOSEOUT SUBMITTALS

- .1 The Engineer who prepared the report shall visit the site and confirm that the feeder sizes as installed are consistent with the report as submitted.
- .2 Submit final version of the report with as-constructed feeder lengths and feeder sizes.

1.06 QUALITY ASSURANCE

- .1 Preparer Qualifications: Firm experienced in the analysis, evaluation, and coordination of electrical distribution systems and similar to the system for this project.
- .2 The study shall be prepared in accordance with the latest edition of NETA ATS, the Canadian Electrical Code, as well as manufacturer's recommendations.
- .3 Short-Circuit Analysis and Coordination Study shall be performed by a registered Professional Engineer. Study shall be signed and sealed by the Engineer. The Engineer shall have a minimum of eight years experience in the analysis, evaluation, and coordination of electrical distribution systems.
- .4 The firm conducting the study shall have one million worth of Professional Liability Insurance in addition to standard general insurance.

2 Products

2.01 MANUFACTURERS

- .1 Independent Testing Organizations
 - .1 AC Tesla.
 - .2 Brosz and Associates.

- .3 C-INTECH.
- .4 Eastenghouse.
- .5 Enkompass.
- .6 G.T. Wood.
- .2 Electrical distribution manufacturers:
 - .1 Eaton.
 - .2 Schneider Electric.

2.02 PROTECTIVE DEVICE COORDINATION STUDY

- .1 Prepare coordination time-current characteristic curves to determine the required settings/sizes of the protective devices to maximize selectivity. The utility upstream protective device feeding the facility shall be maintained as the upper limit for coordination. These settings shall be obtained by the preparer, along with any other protective device setting requirements. The coordination curves shall be prepared on log-log paper and illustrate adequate clearing times between series devices. The curves shall be created through the use of the study software package, but must reflect actual protective devices to be installed. Adequate time-current curves shall be generated to depict coordination. In addition, protective device characteristics shall be suitably determined to reflect calculated short-circuit levels at the location.
- .2 A narrative analysis shall accompany each coordination curve sheet and describe the coordination and protection in explicit detail. All curve sheets shall be multi-color for improved clarity. Areas lacking complete coordination shall be highlighted and reasons provided for allowing condition to remain or provide solution to resolve situation. System coordination, recommended ratings, and setting of protective devices shall be accomplished by a registered professional electrical engineer with a minimum of eight years of current experience in the coordination of electrical power systems.
- .3 The following information shall be provided on all curve sheets:
 - .1 Device identification and associated settings/size.
 - .2 Voltage at which curves are plotted.
 - .3 Current multiplier.
 - .4 ANSI frequent fault damage curve.
 - .5 Cable insulation damage curves.
 - .6 Transformer inrush point.
 - .7 Single-line for the portion of the system.
 - .8 Motor starting profiles (where applicable).

2.03 SINGLE LINE DIAGRAM

- .1 The final report shall include a multi-color single-line diagram of the electrical distribution system within the scope of the project. The single-line shall include:
 - .1 Transformer rating, voltage ratio, impedance, and winding connection.
 - .2 Feeder cable phase, neutral and ground sizes, length of cable, conductor material, and conduit size and type.

- .3 Switchgear, switchboards, panelboards, MCC's, fuses, circuit breakers, ATS's and switches continuous current ratings.
- .4 Protective relays with appropriate device numbers and CT's and PT's with associated ratios.
- .5 Detailed legend indicating device type identification and other significant details.

3 Execution

3.01 SUMMARY

- .1 The results of the system studies shall be summarized in a final report.
- .2 Where required, copies of the final report shall be submitted to the Supply Authority for their review and approval. Approved copies or the report shall be submitted to the Consultant.

3.02 ADJUSTING

- .1 The contractor shall engage the manufacturer's service group or alternately a qualified independent testing firm to perform field adjustments of the protective devices as required for placing the equipment in final operating condition. The settings shall be in accordance with the approved short circuit study and protective device evaluation / coordination study.
- .2 Necessary field settings of devices and adjustments and minor modifications to equipment to accomplish conformance with the approved protective device coordination study, shall be carried out by manufacturer's service group.
- .3 Submit a final service report confirming that settings have been completed.

End of Section

1 General

1.01 SECTION INCLUDES

- .1 The contractor shall provide an Arc Flash Hazard Analysis Study per the requirements described in CSA Z462 Standard for Electrical Safety in the Workplace.
- .2 The arc flash hazard analysis shall be performed according to the IEEE 1584 equations that are obtained in CSA Z462-08, Annex D, or more recent version of the standard as cited by this Section.
- .3 The scope of the studies shall include all existing distribution equipment and all new distribution equipment supplied by the equipment Manufacturer under this contract.

1.02 RELATED REQUIREMENTS

- .1 Section 26 05 73.16 – Coordination Studies.
- .2 Single Line Diagram.

1.03 REFERENCES

- .1 Institute of Electrical and Electronics Engineers, Inc. (IEEE):
 - .1 IEEE 141 – Recommended Practice for Electric Power Distribution and Coordination of Industrial and Commercial Power Systems.
 - .2 IEEE 242 – Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems.
 - .3 IEEE 399 – Recommended Practice for Industrial and Commercial Power System Analysis.
 - .4 IEEE 241 – Recommended Practice for Electric Power Systems in Commercial Buildings.
 - .5 IEEE 1015 – Recommended Practice for Applying Low-Voltage Circuit Breakers Used in Industrial and Commercial Power Systems.
 - .6 IEEE 1584-2018 - Guide for Performing Arc-Flash Hazard Calculations.
- .2 American National Standards Institute (ANSI):
 - .1 ANSI C57.12.00 – Standard General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers.
 - .2 ANSI C37.13 – Standard for Low Voltage AC Power Circuit Breakers Used in Enclosures.
 - .3 ANSI C37.010-2016 – Standard Application Guide for AC High Voltage Circuit Breakers Rated on a Symmetrical Current Basis.
 - .4 ANSI C 37.41 – Standard Design Tests for High Voltage Fuses, Distribution Enclosed Single-Pole Air Switches, Fuse Disconnecting Switches and Accessories.
- .3 Ontario Electrical Safety Code (27th edition/2018).
- .4 CSA Z462-15, Workplace electrical safety.

1.04 SUBMITTALS

- .1 Submit the protective device coordination study to the Consultant prior to receiving final review of the distribution equipment shop drawings and/or prior to release of equipment drawings for manufacturing. If formal completion of the studies may cause delay in equipment manufacturing, approval from the

engineer may be obtained for preliminary submittal of sufficient study data to ensure that the selection of device and characteristics will be satisfactory.

1.05 CLOSEOUT SUBMITTALS

- .1 The results of the protective device coordination and arc flash hazard analysis studies shall be summarized in a final report. Three (3) bound copies of the complete final report shall be submitted. Additional copies of the complete report with input and output data shall be provided on CD in PDF format.
- .2 The report shall include the following sections:
 - .1 Executive Summary.
 - .2 Descriptions, purpose, basis and scope of the study.
 - .3 Tabulations of circuit breaker, fuse and other protective device ratings versus calculated short circuit duties.
 - .4 Protective device time versus current coordination curves, tabulations of relay and circuit breaker trip unit settings, fuse selection.
 - .5 Fault current calculations including a definition of terms and guide for interpretation of the computer printout.
 - .6 Details of the incident energy and flash protection boundary calculations.
 - .7 Recommendations for system improvements, where needed.
 - .8 Single Line Diagram.
- .3 Arc flash labels (refer to CSA Z462 Annex Q) shall be provided in hard copy only.

1.06 QUALIFICATIONS

- .1 Arc flash hazard analysis studies shall be conducted under the supervision and approval of a Registered Professional Electrical Engineer skilled in performing and interpreting the power system studies.
- .2 The Registered Professional Electrical Engineer shall be a full-time employee of the equipment manufacturer or an approved engineering firm.
- .3 The Registered Professional Electrical Engineer shall have a minimum of eight (8) years of experience in performing power system studies.
- .4 The equipment manufacturer or approved engineering firm shall demonstrate experience with Arc Flash Hazard Analysis by submitting names of at least ten actual arc flash hazard analysis it has performed in the past year.

1.07 COMPUTER ANALYSIS SOFTWARE

- .1 The studies shall be performed using the latest revision of the SKM or equivalent.

2 Products

2.01 MANUFACTURERS

- .1 Independent Testing Organizations:
 - .1 AC Tesla.

- .2 Brosz and Associates.
- .3 C-INTECH.
- .4 Eastenghouse.
- .5 Enkompass.
- .6 G.T. Wood.
- .2 Electrical distribution manufacturers:
 - .1 Eaton.
 - .2 Schneider Electric.

2.02 STUDIES

- .1 The contractor shall furnish an Arc Flash Hazard Analysis Study per CSA Z462, reference Section 4.1.8.2.2, 4.3.3.

2.03 DATA COLLECTION

- .1 Contractor shall furnish all data as required by the power system studies. The Engineer performing arc flash hazard analysis studies shall furnish the Contractor with a listing of required data immediately after award of the contract. The Contractor shall expedite collection of the data to assure completion of the studies as required for final approval of the distribution equipment shop drawings and/or prior to the release of the equipment for manufacturing.
- .2 Source combination may include present and future motors and generators.
- .3 If applicable, include fault contribution of existing motors in the study. The Contractor shall obtain required existing equipment data, if necessary, to satisfy the study requirements.

2.04 ARC FLASH HAZARD ANALYSIS

- .1 The arc flash hazard analysis shall be performed according to the IEEE 1584 equations that are presented in CSA Z462 Annex D.
- .2 The flash protection boundary and the incident energy shall be calculated at all significant locations in the electrical distribution system (switchboards, switchgear, panelboards and splitters) where work could be performed on energized parts.
- .3 The Arc-Flash Hazard Analysis shall include all significant locations in 240 volt and 208 volt systems fed from transformers equal to or greater than 112.5 kVA where work could be performed on energized parts.
- .4 Safe working distances shall be based upon the calculated arc flash boundary considering an incident energy of 1.2 calories per square centimetre.
- .5 When appropriate, the short circuit calculations and the clearing times of the phase overcurrent devices will be retrieved from the short-circuit and coordination study model. Ground overcurrent relays should not be taken into consideration when determining the clearing time when performing incident energy calculations.
- .6 The short-circuit calculations and the corresponding incident energy calculations for multiple system scenarios must be compared and the greatest incident energy must be uniquely reported for each equipment location. Calculations must be performed to represent the maximum and minimum contributions of fault current magnitude for all normal and emergency operating conditions. The minimum calculation will assume that the utility contribution is at a minimum and will assume a minimum motor contribution (all motors off). Conversely, the maximum calculation will assume a maximum contribution

from the utility and will assume the maximum amount of motors to be operating. Calculations shall take into consideration the parallel operation of synchronous generators with the electric utility, where applicable.

- .7 The incident energy calculations must consider the accumulation of energy over time when performing arc flash calculations on buses with multiple sources. Iterative calculations must take into account the changing current contributions, as the sources are interrupted or decremented with time. Fault contribution from motors and generators should be decremented as follows:
 - .1 Fault contribution from induction motors should not be considered beyond 3-5 cycles.
- .8 Fault contribution from synchronous motors and generators should be decayed to match the actual decrement of each as closely as possible (e.g. contributions from permanent magnet generators will typically decay from 10 per unit to 3 per unit after 10 cycles).
- .9 For each equipment location with a separately enclosed main device (where there is adequate separation between the line side terminals of the main protective device and the work location), calculations for incident energy and flash protection boundary shall include both the line and load side of the main breaker.
- .10 When performing incident energy calculations on the line side of a main breaker (as required per above), the line side and load side contributions must be included in the fault calculation.
- .11 Mis-coordination should be checked amongst all devices within the branch containing the immediate protective device upstream of the calculation location and the calculation should utilize the fastest device to compute the incident energy for the corresponding location.
- .12 Arc Flash calculations shall be based on actual overcurrent protective device clearing time.
- .13 Maximum clearing time will be capped at 2 seconds based on IEEE 1584.
- .14 Where it is not physically possible to move outside of the flash protection boundary in less than 2 seconds during an arc flash event, a maximum clearing time based on the specific location shall be utilized.

2.05 REPORT SECTIONS

- .1 Incident energy and flash protection boundary calculations:
 - .1 Arcing fault magnitude.
 - .2 Protective device clearing time.
 - .3 Duration of arc.
 - .4 Arc flash boundary.
 - .5 Working distance.
 - .6 Incident energy.
 - .7 Hazard Risk Category.
 - .8 Recommendations for arc flash energy reduction.

3 Execution

3.01 FIELD ADJUSTMENT

- .1 Adjust relay and protective device settings according to the recommended settings table provided by the coordination study. Field adjustments to be completed by the engineering service division of the equipment manufacturer under the Startup and Acceptance Testing contract portion.
- .2 Make minor modifications to equipment as required to accomplish conformance with short circuit and protective device coordination studies.
- .3 Notify Owner in writing of any required major equipment modifications.

3.02 ARC FLASH WARNING LABELS

- .1 The contractor of the Arc Flash Hazard Analysis shall provide a 3.5 inch by x 5 inch thermal transfer type label of high adhesion polyester for each work location analyzed.
- .2 All labels will be based on recommended overcurrent device settings and will be provided after the results of the analysis have been presented to the owner and after any system changes, upgrades or modifications have been incorporated in the system.
- .3 The label shall include the following information, at a minimum:
 - .1 Location designation.
 - .2 Nominal voltage.
 - .3 Flash protection boundary.
 - .4 Hazard risk category.
 - .5 Incident energy.
 - .6 Working distance.
 - .7 Engineering firm and issue date.
 - .8 Labels shall be machine printed, with no field markings.
- .4 Arc flash labels shall be provided in the following manner and all labels shall be based on recommended overcurrent device settings.
 - .1 For each 600 volt, and applicable 208 volt panelboard, one arc flash label shall be provided.
 - .2 For each motor control center, one arc flash label shall be provided.
 - .3 For each low voltage switchboard, one arc flash label shall be provided.
 - .4 For each switchgear, one flash label shall be provided.
 - .5 For medium voltage switches one arc flash label shall be provided.
- .5 Arc Flash Warning Label General Instructions:
 - .1 Only qualified electricians who recognize and avoid the electrical and Arc Flash hazards are allowed to place the arc flash warning labels.
 - .2 Electricians should wear suitable PPE, such as electrical safety boots, Safety Glasses, etc. while performing labeling.

- .3 Generally, arc flash label shall be put on a prominent pre-cleaned place on the front of the electrical equipment (such as switchgear, panel, disconnect switch, generator output breaker). Label should be visible and readable, displayed horizontally, attached flatly and securely, and not allowed to cover other signs or labels on the equipment.
- .4 Under the special request of the client, labels could be put on the back of the panel door when the panel is located in clean and finished spaces such as an office area.
- .5 When putting a label on small equipment with no space labeling on the wall just beside the equipment is allowed.
- .6 Special request may be attached to this General Instruction. For examples, more than one identical label is applied for large equipment; different labels could be applied for different sections of one equipment; for a splitter with several disconnect switches only one label is placed on the splitter for this group.
- .7 Take the pictures for each label to indicate both names of the label and equipment and labeling area of the equipment. Email these pictures to the Consultant for quality control and record.

End of Section

1 General

1.01 SECTION INCLUDES

- .1 Electrical connections to equipment specified in other sections.

1.02 RELATED REQUIREMENTS

- .1 Division 08 – Openings.
- .2 Division 11 – Equipment.
- .3 Division 14 – Conveying Equipment.
- .4 Division 20 – Common Mechanical Requirements.
- .5 Division 21 – Fire Suppression.
- .6 Division 22 – Plumbing.
- .7 Division 23 – Heating, Ventilating, and Air Conditioning.

1.03 REFERENCES

- .1 NEMA WD 1 - General Colour Requirements for Wiring Devices.
- .2 NEMA WD 6 - Wiring Devices - Dimensional Requirements.

1.04 COORDINATION

- .1 Coordinate work to Section 01 31 00.
- .2 Obtain and review shop drawings, product data, and manufacturer's instructions for equipment provided under other sections.
- .3 Determine connection locations and requirements.
- .4 Sequence rough-in of electrical connections to coordinate with installation schedule for equipment.
- .5 Sequence electrical connections to coordinate with start-up schedule for equipment.

1.05 SUBMITTALS

- .1 Submit to Section 01 33 00.
- .2 Product Data: Provide wiring device manufacturer's catalogue information showing dimensions, configurations, and construction.
- .3 Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of Product.

1.06 REGULATORY REQUIREMENTS

- .1 Provide products listed and classified by testing firm acceptable to authority having jurisdiction as suitable for purpose specified and shown.

2 Products

2.01 COMMON MOTOR REQUIREMENTS

- .1 Motors up to and including 1/3 HP, shall be 1 phase, 60 Hz, 120 volts.
- .2 Motors 1/2 HP and above shall be 3 phase, 60 Hz, 575 volts or 208 volts.

2.02 CORDS AND CAPS

- .1 Attachment Plug Construction: Conform to NEMA WD 1.
- .2 Configuration: NEMA WD 6; match receptacle configuration at outlet provided for equipment.
- .3 Cord Construction: NFPA 70, Type SJO multiconductor flexible cord with identified equipment grounding conductor, suitable for use in damp locations.
- .4 Size: Suitable for connected load of equipment, length of cord, and rating of branch circuit overcurrent protection.

3 Execution

3.01 WIRING OF EQUIPMENT PROVIDED UNDER OTHER DIVISIONS

- .1 Use the following procedure with regard to wiring of motors and equipment provided under other Divisions.
- .2 The following equipment shall be responsibility of the trade supplying the equipment unless otherwise noted, in accordance with the requirements laid out in the individual section, or this division:
 - .1 Motors.
 - .2 Starters.
 - .3 Variable Frequency Drives.
 - .4 Motor Control Centres.
 - .5 Control wiring.
- .3 In every instance, install starter, motor control centre, variable frequency drivers (VFD), etc. and wire to line side of the starter, the Motor Control Centre, or VFD. Extend wiring from starter, motor control centre or VFD to motor as indicated.
- .4 Provide all wiring for starters and VFD's from supply to starter to VFD and to motor. Coordinate requirements with the appropriate trade.
- .5 Provide 500 mm of liquid tight flexible metal conduit for final connection to motor. Provide disconnect switches where required by code, and as indicated on the drawings.
- .6 Where individual starters and controls are grouped together provide a panel for mounting this equipment. Provide a feeder, main fused disconnect and a splitter of adequate size and capacity and wire to line side of the starters on this panel and from starters to motors.
- .7 Equipment, General
 - .1 Ascertain exact locations of starters, motor control centres, motors, etc. from drawings and coordinate exact locations with the supplying trade.

- .2 Control wiring shall be the responsibility of the supplying trade.
 - .1 Control wiring shall be in accordance with Section 26 05 19, and Section 26 05 23.
 - .2 Control wiring shall be installed in conduit in accordance with Section 26 05 33.13.
- .8 Conveying Equipment (e.g. Elevators): in accordance with Section 26 05 83.14.
- .9 Plumbing Equipment
 - .1 Ascertain exact locations of starters, motor control centres, motors, infra-red plumbing fixture controls from Mechanical Drawings and coordinate exact locations with plumbing trade.
 - .2 Provide branch circuit wiring and an outlet for each infra-red plumbing fixture control.
 - .3 Control wiring shall be the responsibility of the plumbing trade, as described above.
- .10 HVAC Equipment
 - .1 Ascertain exact locations of starters, motor control centres, motors, motorized dampers, VAV boxes, and heating control valves from HVAC drawings and coordinate exact locations with HVAC Division.
 - .2 In the case of unit heaters, reheat coils and cabinet unit heaters, terminate wiring on terminals provided. Control wiring, thermostats, or other control devices shall be the responsibility of the HVAC trade, as described above.
 - .3 Provide branch circuit wiring and an outlet for each motorized damper, variable air volume (VAV) box, or heating control valve. Control wiring shall be the responsibility of the HVAC trade, as described above.

3.02 EXAMINATION

- .1 Verify that equipment is ready for electrical connection, wiring, and energization.

3.03 ELECTRICAL CONNECTIONS

- .1 Provide a local disconnect switch for all equipment, regardless of if a disconnect switch is shown or not shown on the plans.
- .2 Make electrical connections to equipment manufacturer's instructions.
- .3 Make conduit connections to equipment using flexible conduit. Use liquid-tight flexible conduit with watertight connectors in damp or wet locations.
- .4 Make wiring connections using wire and cable with insulation suitable for temperatures encountered in heat producing equipment.
- .5 Provide receptacle outlet where connection with attachment plug is indicated. Provide cord and cap where field-supplied attachment plug is indicated.
- .6 Provide suitable strain-relief clamps and fittings for cord connections at outlet boxes and equipment connection boxes.
- .7 Install disconnect switches, controllers, control stations, and control devices as indicated.
- .8 Modify equipment control wiring with terminal block jumpers as indicated.
- .9 Provide interconnecting conduit and wiring between devices and equipment where indicated.

- .10 Coolers and Freezers: Cut and seal conduit openings in freezer and cooler walls, floor, and ceilings.

End of Section

1 General

1.01 SECTION INCLUDES

- .1 Commissioning of all building electrical systems and component including:
 - .1 Testing and adjustment.
 - .2 Demonstration and training.
 - .3 Instructions of all procedures for Owner's personnel.
 - .4 Updating as-built data.
 - .5 Co-ordination of Operation and Maintenance material.
- .2 Provide labour and material to conduct the commissioning process as outlined in this specification section, including the hiring of an Independent Testing Contractor (ITC) as detailed below.
- .3 Provisions of this section shall apply to all sections of Division 26, Division 27, Division 28, and sections related to electrical utilities in Division 33.

1.02 RELATED REQUIREMENTS

- .1 Testing and commissioning are called for throughout the individual specifications. This does not relieve this trade from providing all testing and commissioning necessary to ensure that systems and equipment operate as required and that they interface with other systems and equipment as required.
- .2 Section 26 08 50 – Commissioning of Lighting: additional commissioning requirements for commissioning of lighting and lighting controls.

1.03 COMMISSIONING PROCESS ALLOCATION

- .1 The commissioning process shall be allocated a value equal to 5 per cent of the contract. The Electrical Contractor may draw from this allocation as the commissioning process is completed.
- .2 The Electrical Contractor shall submit all test and verification forms. The Consultant will use these forms to calculate percentage complete.
- .3 The Electrical Contractor may claim up to 3 per cent of the contract from this allocation leading up to performance testing. The remaining 2 per cent shall not be paid out until the performance testing, O&M manuals, and training have been completed satisfactorily.

1.04 DEFINITIONS

- .1 Cx – Commissioning.
- .2 Commissioning Authority
 - .1 The Commissioning Authority (CxA), also referred to as the Commissioning Consultant, shall be hired by The Owner.
 - .2 The CxA responsibilities shall include:
 - .1 preparing the commissioning plan
 - .2 co-ordinating with the contractor to schedule tests
 - .3 preparing a test form manual

- .4 witnessing selected tests
- .5 receiving all test forms
- .6 co-ordinating the contractors training
- .7 chair the commissioning meetings
- .3 The Electrical Contractor shall co-operate with the CxA.
- .4 The Electrical Contractor shall provide assistance to the CxA and have personnel available during the performance testing procedure. Each electrical system shall be tested in the operational mode.

1.05 SUBMITTALS

- .1 Conform to Section 01 33 00 for requirements for shop drawings and record drawings.
- .2 A commissioning document shall be prepared by the CxA prior to conducting these activities for use by the Commissioning Team.
- .3 The electrical sub-contractor shall be responsible for ensuring all activities are properly documented in this manual and co-ordinated through the General Contractor.
- .4 As-built drawings and data books must be available two weeks prior to commissioning for review and use by the consultant and Commissioning Team prior to the start of the commissioning activities.

1.06 CLOSEOUT SUBMITTALS

- .1 Attendance records for all training sessions.
- .2 Testing reports for system load balance measurements, infra-red test and harmonics tests.

1.07 QUALITY ASSURANCE

- .1 Provide qualified trades persons, certified testing agencies, factory trained and approved by the Commissioning Team Leader.
- .2 Submit the names of all personnel to be used during the Commissioning activities.

1.08 WARRANTY

- .1 Equipment and system warranties shall not begin until the system demonstration and turnover has been conducted successfully and accepted by the Owner.
- .2 The Electrical Contractor shall fill out the warranty form listing the equipment and systems and the start and finishing dates for warranty.
- .3 Refer to Division 01 and Section 26 05 00 for the requirements during the warranty period.

2 Products

2.01 EQUIPMENT

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

3 Execution

3.01 THE COMMISSIONING PROCESS

- .1 The purpose of the commissioning process is to fully test all building systems including architectural, mechanical and electrical components and operating procedures by challenging these systems to realistic operation conditions.
- .2 The commissioning process consists of:
 - .1 Shop Drawings and Record Drawings
 - .2 Installation inspection and equipment verification
 - .3 Independent testing contractor
 - .4 Testing of equipment and systems
 - .5 Commissioning meetings
 - .6 Operating and maintenance manuals
 - .7 Operating training
 - .8 Commissioning Agent testing
 - .9 Systems Demonstration and turnover
 - .10 Testing forms
 - .11 Warranties

3.02 PREPARATION

- .1 Provide test instruments required for all activities as defined in the commissioning documents.
- .2 Verify all systems are in compliance with the requirements of the commissioning documents prior to the pre-commissioning check out operation.
- .3 Confirm all scheduled activities have identified personnel available.
- .4 Where systems or equipment do not operate as required, make the necessary corrections or modifications, re-test and re-commission.

3.03 SYSTEM DESCRIPTION

- .1 Perform all start-up operations, control adjustment, trouble shooting, servicing and maintenance of each item of equipment as defined in the commissioning documentation.
- .2 Owner will provide list of personnel to receive instructions and will co-ordinate their attendance at agreed upon times.
- .3 Prepare and insert additional data in the operations and maintenance manuals and update as-built drawings when need for additional data becomes apparent during the commissioning exercise.
- .4 Where instruction is specified in the commissioning manual, instruct personnel in all phases of operation and maintenance using operation and maintenance manuals as the basis of instruction.
- .5 Conduct presentation on Owner's premises. Owner will provide space.

3.04 COMMISSIONING

- .1 Commission the components of the electrical system using the NETA Acceptance Testing Specifications.
- .2 Refer to the project commissioning plan prepared by the CxA.
- .3 Commissioning activities for the electrical systems must have available up to date as-built drawing information and accurate Operations and Maintenance Manuals. These documents shall be a major part of this activity.
- .4 Contractor shall be responsible to update all documentation with information and any changes duly noted during the Commissioning exercise.
- .5 Contractor shall arrange for all outside suppliers, equipment manufacturers, test agencies and others as identified in the commissioning sections of this specification. The cost associated with this requirement shall be included as part of the tender price.

3.05 FINAL REPORT

- .1 This trade shall assemble all testing data and commissioning reports and submit them to the General Contractor for submission to the Owner.
- .2 Each form shall bear signature of recorder, and that of supervisor of reporting organizer.

3.06 SCHEDULE OF ACTIVITIES

- .1 Commissioning activities shall be conducted based on pre-established schedule with all members of the commissioning team.
- .2 In addition, there will be two meetings held through the contract duration to introduce the parties of the commissioning team, establish the schedules and deadlines for the various activities and review the Commissioning Manual.
- .3 Adhering to the established schedule is very important as the co-ordination and scheduling of the participants will be difficult to alter once this is established. Close co-ordination of this schedule is important.
- .4 In the event project cannot be commissioned in the allotted time slot, the contractor shall pay for all costs associated with assembling the Commissioning Team at a later date. If the contractor has not performed his duties to reach commissioning stage as outlined earlier, he will incur all expenses of other trades and the Commissioning Team due to his non-compliance.

3.07 INSTALLATION INSPECTION AND EQUIPMENT VERIFICATION

- .1 The Electrical Contractor shall co-ordinate with the Electrical Consultant who will inspect the electrical installation.
- .2 The Electrical Contractor shall complete the equipment verification forms for each piece of equipment. The forms shall be included in the operating and maintenance manual. The equipment data shall include:
 - .1 Manufacturers name, address and telephone number.
 - .2 Distributors name, address and telephone number.
 - .3 Make, model number and serial number.
 - .4 Voltage and current ratings.

3.08 INDEPENDENT TESTING CONTRACTOR

- .1 The Independent Testing Contractor (ITC) shall be hired by the contractor and shall issue reports to the Electrical Consultant.
- .2 The ITC shall conduct load balancing measurements to verify load balancing performed in accordance with Section 26 05 00.

3.09 TESTING OF EQUIPMENT AND SYSTEMS

- .1 The Electrical Contractor shall be responsible for all tests detailed in this Section, and those tests required by a manufacturer as part of their installation requirements.
- .2 The Electrical Contractor shall schedule all tests which shall be witnessed by the Electrical Consultant or the Commissioning Consultant. The contractor shall complete and sign the testing forms.
- .3 The Electrical Contractor shall conduct tests on the following equipment as a minimum. Refer to the individual specification sections for test procedures.
 - .1 Section 26 05 19 – Low-Voltage Electrical Power Conductors and Cables.
 - .2 Section 26 05 73.16 – Coordination Studies.
 - .3 Section 26 24 13 – Switchboards.
 - .4 Section 26 24 16 – Panelboards.
 - .5 Section 26 24 19 – Motor Control Centres.
 - .6 Section 27 51 16 – Public Address Systems.
 - .7 Section 28 10 00 – Access Control.
 - .8 Section 28 46 13 – Fire-Alarm Systems.
- .4 When all testing has been completed and all mechanical and electrical systems are operational the contractor shall conduct system load balance measurements, infra-red test and harmonics tests.

3.10 COMMISSIONING MEETINGS AND REPORTING

- .1 The Electrical Contractor shall include the schedule for all tests in the construction schedule.
- .2 The Commissioning meetings shall occur during the regular construction meetings. The testing schedules and the results of all tests shall be reviewed.
- .3 All testing forms and reports associated with the electrical systems shall be directed to the Electrical Consultant, with copies to the Consultant, Commissioning Consultant, and the Owner.
- .4 The forms and reports to be issued shall include:
 - .1 Shop drawings, issued and accepted
 - .2 Equipment verification forms
 - .3 Testing forms
 - .4 Reports resulting from tests
 - .5 Testing schedule

- .6 Minutes of commissioning meetings
- .7 Manufacturers' Certificates

3.11 OPERATING AND MAINTENANCE MANUAL

- .1 Conform to the specification section for the requirements of the O&M manuals.

3.12 CLOSEOUT ACTIVITIES

- .1 Conform to section for requirements for instructions to the Building Owner for each system and equipment.
- .2 The training shall be provided by qualified technicians or electricians and shall be conducted in a classroom and at the equipment or system.
- .3 The training sessions shall be scheduled, co-ordinated and video taped by the Commissioning Consultant.
- .4 Each training session shall be structured to cover:
 - .1 The operating and maintenance manual.
 - .2 Operating procedures.
 - .3 Maintenance procedures.
 - .4 Troubleshooting procedures.
 - .5 Spare parts.
- .5 Submit a course outline to the Electrical Consultant before training commences. Provide course documentation for up to eight people.
- .6 The training session shall be scheduled and co-ordinated by the Commissioning Consultant. The Commissioning Consultant shall video tape the sessions.
- .7 Training shall be provided for the following systems:
 - .1 Electrical Systems including distribution and lighting: 8 hour minimum
 - .2 Section 27 51 16 – Public Address Systems: 1 hour minimum
 - .3 Section 28 10 00 – Access Control: 1 hour minimum
 - .4 Section 28 46 13 – Fire-Alarm Systems: 2 hours minimum
- .8 The Electrical Contractor shall conduct a walkthrough of the installation. During the walkthrough the Electrical Contractor shall:
 - .1 Identify equipment.
 - .2 Identify electrical panels.
 - .3 Identify starters and disconnects.
 - .4 Review the electrical power distribution.
 - .5 Review the light power distribution.

- .6 Review the switchgear.
- .7 Review the general maintenance procedures.

3.13 THE ELECTRICAL SYSTEM DEMONSTRATION AND TURNOVER

- .1 The system demonstration and turnover to The Owner shall occur when:
 - .1 The installation is complete.
 - .2 The acceptance test conducted by the Electrical Consultant has been completed successfully.
 - .3 Training has been completed.
 - .4 Equipment Operating and Maintenance Manuals have been accepted.
 - .5 System operating manuals have been accepted.
 - .6 Shop-drawings have been updated.
 - .7 As-built drawings have been completed.
 - .8 The commissioning process has been completed successfully and system operation accepted by the Electrical Consultant and Commissioning Consultant.
- .2 The systems demonstration shall be conducted by the Electrical Contractor and manufacturers. The demonstration shall cover a physical demonstration of equipment installation and operation.

3.14 TESTING FORMS

- .1 The Electrical Contractor and manufacturers shall fill out the forms listed in this section or provide other forms. The forms must be approved by the Electrical Consultant and the Owner before they are used.

End of Section

1 General

1.01 SECTION INCLUDES

- .1 Common requirements for commissioning of all electric lighting, including interior, exterior, and emergency lighting.
- .2 The party responsible for the functional testing shall not be directly involved in either the design or construction of the project.

1.02 RELATED REQUIREMENTS

- .1 Section 26 09 23 – Lighting Control Devices.
- .2 Section 26 09 26 – Lighting Control Panelboards.
- .3 Section 26 09 43 – Network Lighting Controls.
- .4 Section 26 51 19 – LED Interior Lighting.
- .5 Section 26 52 13.13 – Emergency Lighting.
- .6 Section 26 56 19 – LED Exterior Lighting.

1.03 REFERENCES

- .1 ASHRAE
 - .1 ASHRAE Guideline 0-2005 – The Commissioning Process.
 - .2 ANSI/ASHRAE/IES 90.1-2013 – Energy Standard for Building Except Low-Rise Residential Buildings.
- .2 Illumination Engineering Society (IES)
 - .1 IES DG-29-11 – Design Guide for the Commissioning Process Applied to Lighting and Control Systems.
- .3 Ontario Building Code
 - .1 Supplementary Standard SB-10: Energy Efficiency Requirements, December 22, 2016 update.

1.04 ACTION SUBMITTALS

- .1 Refer to Section 01 33 00.
- .2 Submit sample commissioning forms.

1.05 CLOSEOUT SUBMITTALS

- .1 Section 01 78 00: Submittals for project closeout.
- .2 Submit commissioning reports.
 - .1 Submit a floor plan or spreadsheet table checklist that indicates each local lighting control device, occupancy sensors, daylighting controls, system component.
 - .2 Submit the system sequence of operation fully describing the equipment components and functionality, including set points and alarm functions.

.3 The detailed sequence of operation shall be provided regardless of the completeness and clarity of the sequences in the controls specification and/or drawings.

.3 The functional testing party shall provide documentation certifying that the installed lighting controls meet or exceed all documented performance criteria.

2 Products – Not Used

3 Execution

3.01 SITE TESTS AND INSPECTIONS

.1 [Measure samples of each new luminaire type to be replaced as described in PART 1 of this section for demonstration of energy savings.]

.2 Sensor placement and orientation for all sensor types.

.3 Occupancy sensor function, sensitivity, and time delays.

.4 Daylight harvesting sensor calibration.

.5 Automated shade operation.

.6 Manual control placement and operation.

.7 Automated control operation, including scheduled on/off functions and dimming trims and presets.

.8 Override operation, access, and functionality.

.9 Centralized control interfaces and operation.

.10 Client education of operations.

.11 Documentation archived to client.

3.02 FUNCTIONAL TESTING

.1 Lighting control devices and control systems shall be tested to ensure that control hardware and software are calibrated, adjusted, programmed, and in proper working condition in accordance with the construction documents and manufacturer's installation instructions.

.2 When occupant sensors, time switches, programmable schedule controls, or photosensors are installed, at a minimum, the following procedures shall be performed:

.1 Confirm that the placement, sensitivity and time-out adjustments for occupant sensors yield acceptable performance, lights turn off only after space is vacated and do not turn on unless space is occupied.

.2 Confirm that time switches and programmable schedule controls are programmed to turn the lights off.

.3 Confirm that photosensor controls reduce electric lights levels based on the amount of usable daylight in the space as specified.

End of Section

1 General

1.01 SECTION INCLUDES

- .1 Materials and installation for contactors for system voltages up to 600 V.

1.02 REFERENCES

- .1 Canadian Standards Association (CSA)
 - .1 CSA C22.2 No. 14-18, Industrial Control Equipment.

2 Products

2.01 MANUFACTURERS

- .1 Allen Bradley "500L" series
- .2 Eaton.
- .3 Schneider Electric.
- .4 Siemens.

2.02 CONTACTORS

- .1 Contactors: to CSA C22.2 No. 14.
- .2 Electrically held controlled by pilot devices as indicated and rated for type of load controlled. Half size contactors not accepted.
- .3 Contactors shall be electrically held 60 Hz, 120 V coil; NEMA Type 1 general purpose enclosure.
- .4 Fused switch combination contactor as indicated.
- .5 Complete with 2 normally open and 2 normally closed auxiliary contacts unless indicated otherwise.
- .6 Mount in CSA Enclosure 1 unless otherwise indicated.
- .7 Include following options in cover:
 - .1 Red indicating lamp.
 - .2 Hand-Off-Auto selector switch.
- .8 Provided complete with control transformer, in contactor enclosure.

3 Execution

3.01 INSTALLATION

- .1 Install contactors and connect auxiliary control devices.

3.02 EQUIPMENT IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 05 53.

- .2 Size 4 nameplate indicating name of load controlled as indicated.

End of Section

1 General

1.01 SECTION INCLUDES

- .1 Occupancy and Vacancy sensors.
- .2 Power packs, and auxiliary relays, momentary switches.
- .3 Manual controls devices, including dimming switches and low voltage momentary switches.
- .4 Timer switches.
- .5 Daylight harvesting photo sensors.
- .6 Emergency lighting control units.

1.02 PRODUCTS INSTALLED BUT NOT SUPPLIED UNDER THIS SECTION

- .1 Line voltage manual control devices, as described in Section 26 27 26 – Wiring Devices.
- .2 Multi-zone scene controllers, as described in Section 26 09 36 – Modular Dimming Controls.

1.03 RELATED REQUIREMENTS

- .1 Section 26 08 50 – Commissioning of Lighting.
- .2 Section 26 27 26 – Wiring Devices.
- .3 Section 26 50 00 – Lighting.
- .4 Section 26 51 19 – LED Interior Lighting.
- .5 Section 26 56 19 – LED Exterior Lighting.

1.04 REFERENCES

- .1 CSA Group:
 - .1 CSA C22.1-18, Canadian Electrical Code, Part 1 (24th Edition), Safety Standard for Electrical Installations.
 - .2 Ontario Electrical Safety Code (27th edition/2018).
 - .3 CSA C22.2 No. 14-13 – Industrial Control Equipment
 - .4 CSA C22.2 No. 184 - Solid-State Lighting Controls
 - .5 CSA C22.2 No. 184.1 - Solid State Dimming Controls.
 - .6 CSA C22.2 No. 156 - Solid-State Speed Controls
 - .7 CSA C22.2 No. 42.1 - Cover Plates for Flush Mounted Wiring Devices
 - .8 CSA C22.2 No. 42 - General Use Receptacles
- .2 National Electrical Manufacturers Association (NEMA):
 - .1 WD1 (R2005) – General Color Requirements for Wiring Devices.
 - .2 WD6 – Dimensional Specifications

- .3 Ontario Building Code.
- .4 UL 924 - Standard for Safety of Emergency Lighting and Power Equipment.

1.05 SUBMITTALS

- .1 In accordance with Section 01 33 00.
- .2 Product Data:
 - .1 Submit manufacturer's descriptive literature and product specifications for each product.
 - .2 Manufacturer's product drawings.
 - .3 Manufacturer's installation instructions.
- .3 Where the lighting controls include the option for custom engraving or custom touchscreen interface of controls, switches, or scene controllers, the Contractor is to submit proposed engraving/labelling as part of the shop drawing submittal, the Contractor is to propose labelling for review by the Owner.

1.06 CLOSEOUT SUBMITTALS

- .1 Lighting controls functional test report.

1.07 QUALITY ASSURANCE

- .1 Manufacturer Qualifications: Products free of defects in material and workmanship.

1.08 WARRANTY

- .1 Product is warranted free of defects in material and workmanship.
- .2 Product is warranted to perform the intended function within design limits.

2 Products

2.01 MANUFACTURERS

- .1 Wattstopper DLM [(Basis of Design)].
- .2 Acuity Brands Lighting (nLight, Sensorswitch).
- .3 Cooper Lighting Solutions.
- .4 [Crestron].
- .5 Hubbell.
- .6 [Leviton.]
- .7 Lutron Vive.

2.02 GENERAL REQUIREMENTS OF ALL SENSORS AND POWER PACKS

- .1 Manufactured by an ISO 9002 certified manufacturing facility and shall have a defect rate of less than 1/3 of 1 per cent.
- .2 Five year warranty and CUL listed.
- .3 In the event of failure, provide a bypass manual "override on" feature on each sensor.

- .4 When bypass utilized, lighting to remain on constantly, or control is to be diverted to a wall switch until sensor is replaced. The override feature is to be designed for use by building maintenance personnel and not be readily achieved by building occupants.

2.03 OCCUPANCY AND VACANCY SENSORS

- .1 General:
 - .1 Sensors using passive infrared, ultrasonic, microphonic, and multi-technology adaptive technology.
 - .2 Sensor timeouts configurable by system software.
 - .3 Electrical: Rating: 24 VDC input voltage, up to 40 mA current draw.
 - .4 Mechanical: Mounting: Sensors for mounting on ceilings and walls, including corners, must be available.
 - .5 Environmental:
 - .1 Operating Temperature Range: 0 degrees C to 40 degrees C
 - .2 Relative Humidity: 0 per cent to 95 per cent non-condensing.
- .2 Dual Technology Wall Switch Sensor, 24V
 - .1 Wattstopper DW-100-24-W series (Basis of Design).
 - .2 Sensor capable of detecting presence in the control area by detecting Doppler shifts in transmitted ultrasound and passive infrared heat changes.
 - .3 Utilize a dual sensing verification principle for coordination between ultrasonic and Passive Infrared (PIR) Technologies to reduce likelihood of false triggering.
 - .4 For best results, sensor shall feature a trigger mode where the end-user can choose which technology will activate the sensor from Off mode (initial), the type of detection that will reset the time delay (maintain), and the type of detection that will cause the sensor to be turned back on immediately after the lights are turned off due to lack of motion (re-trigger). Selection of technologies for initial, maintain, and re-trigger shall be done with DIP switches.
 - .5 Sensor shall have its trigger mode factory preset to allow for quick installation in most applications. In this default setting, both technologies must occur in order to initially activate lighting systems. Detection by either technology shall maintain the lighting on, and detection by either technology shall turn lights back on after lights were turned off for 5 seconds or less in automatic mode, and 30 seconds or less in manual mode.
 - .6 Robotic test method, as referred in the NEMA WD 7 Guide, shall be utilized for minor motion coverage verification.
 - .7 Ultrasonic sensing shall be volumetric in coverage with a frequency of 40 kHz. It shall utilize Advanced Signal Processing which automatically adjusts the detection threshold dynamically to compensate for constantly changing levels of activity and air flow throughout controlled space.
 - .8 The PIR technology shall utilize a temperature compensated, dual element sensor and a multi-element Fresnel lens. The lens shall filter short wavelength IR, such as those emitted by the sun and other visible light sources. Face lens grooves in to avoid dust and residue build up which affects IR reception.
 - .9 Utilize zero crossing circuitry to reduce stress on relay, and therefore increase sensor life.

- .10 Operate at 24 VDC and halfwave rectified and utilize a power pack or lighting control system input module to supply power.
 - .11 To blend in aesthetically, sensor protrusion not more than 3/8" from the wall and utilize colour-matched lens.
 - .12 To assure detection at desktop level uniformly across the space, sensor shall have a 28 segment, 2 level, Fresnel injection molded lens.
 - .13 Sensor shall feature a walk-through mode, where lights turn off 3 minutes after the area is initially occupied if no motion is detected after the first 30 seconds, set by DIP switch.
 - .14 To avoid false ON activations and to provide immunity to RFI and EMI, Detection Signature Analysis shall be used to examine the frequency, duration, and amplitude of a signal, to respond only to those signals caused by human motion.
 - .15 Coverage up to 1,000 sq. ft. for walking motion, with a field view of 180 degrees.
 - .16 Automatic-ON or manual-ON operation, adjustable with a DIP switch.
 - .17 Sensor shall have an adjustable time delay.
 - .18 Each sensing technology shall have an LED indicator that remains active at all times, in order to verify detection within the area to be controlled.
 - .19 Sensor shall have a service switch to allow end-users to operate the sensor in the unlikely event of a failure; set by a trim pot.
 - .20 Sensor shall have a built-in light level that features simple, one-step daylighting setup that works from 8 fc to 180 fc.
 - .21 The Dual Technology wall switch sensor shall be a completely self-contained control system that replaces a standard toggle switch
- .3 Dual Technology Ceiling Mounted Sensor, 24V
- .1 Wattstopper DT-300 series (Basis of Design).
 - .2 The Dual Technology sensor shall be capable of detecting presence in the control area by detecting doppler shifts in transmitted ultrasound and passive infrared heat changes.
 - .3 Sensor shall utilize Dual Sensing Verification Principle for coordination between ultrasonic or microphonic and Passive Infrared (PIR) Technologies. Detection verification of both technologies must occur in order to activate lighting systems. Upon verification, detection by either technology shall keep the lighting on.
 - .4 Sensor shall have a retrigger feature in which detection by either technology shall retrigger the lighting system on within 5 seconds of being switched off.
 - .5 Sensors shall be ceiling mounted with a flat, unobtrusive appearance, and provide 360 degree coverage.
 - .6 Ultrasonic sensing shall be volumetric in coverage, with a frequency of 40 kHz. It shall utilize Advanced Signal Processing that automatically adjusts the detection threshold dynamically to compensate for changing levels of activity and airflow throughout a controlled space.
 - .7 To avoid false ON activations, and to provide immunity to RFI and EMI, Detection Signature Analysis shall be used to examine the frequency, duration, and amplitude of a signal, in order to respond only to those signals caused by human motion.

- .8 The PIR technology shall utilize a temperature compensated, dual element sensor and a multi-element Fresnel lens. The lens shall be Poly IR4 material to offer superior performance in the infrared wavelengths and filter short wavelength IR, such as those emitted by the sun and other visible light sources. The lens shall have grooves facing in to avoid dust and residue build up which affects IR reception.
- .9 Sensors shall operate at 24 VDC, and halfwave rectified, and utilize a 24 V power pack.
- .10 Sensors shall feature a walk-through mode, where lights turn off 3 minutes after the area is initially occupied if no motion is detected after the first 30 seconds.
- .11 The sensor shall have a built-in light level sensor that works from 10 fc to 300 fc.
- .12 The sensors shall feature terminal style wiring.
- .13 Each sensing technology shall have an LED indicator that remains active at all times in order to verify detection within the area to be controlled. The LED can be disabled for applications that require less sensor visibility.

2.04 SPECIAL PURPOSE OCCUPANCY SENSORS

- .1 Occupancy Sensors for High bay applications:
 - .1 For use in warehouses, distribution centers, and gymnasiums.
 - .2 Maximum 14 m (45 feet) mounting height.
 - .3 Surface-mount or end-mount model to suit application.
 - .4 180 degree and 360 degree coverage lenses available.
 - .5 Low-voltage, passive infrared (PIR) sensor.
 - .6 End-mount model to attach directly to industrial T5HO and T8 fixtures through an extended 13 mm (0.5 inch) chase nipple or junction box.
 - .7 Adjustable timeout for maximum energy savings.
 - .8 Basis of design: Lutron LUT-WSPSM24V-360-CPN6111 and similar.

2.05 POWER PACKS

- .1 General:
 - .1 Self-contained transformer and relay module.
 - .2 Internal relay controlling up to 20A for 120, 230, 277VAC or 347VAC ballast loads and 120VAC incandescent loads.
 - .3 Provide a 24 VDC, 150 mA output.
 - .4 Capable of parallel wiring without regard to AC phases on primary.
 - .5 Power pack can be used as a standalone, low voltage switch, or can be wired to sensor for auto control.
 - .6 Construction: high impact, UL rated plastic case
 - .7 Power pack shall be UL/CUL Listed, FCC Certified, UL 2043 plenum rated and meets ASHRAE 90.1 requirements

- .8 Shall at minimum meet the following environmental specifications:
 - .1 Operating Temperature Range: 0 degrees C to 40 degrees C
 - .2 Relative Humidity: 0 per cent to 95 per cent non-condensing
- .2 Power Pack and Auxiliary Relay, 347 V
 - .1 Power Pack: Wattstopper B347D-P Series (Basis of Design)
 - .2 Auxiliary Relay: Wattstopper S347-E-P Series (Basis of Design)
 - .3 Power pack shall be a self-contained transformer and relay module measuring 45 mm by 70 mm by 38 mm (1.75 inch by 2.75 inch by 1.5 inch).
 - .4 For ease and speed of installation, power pack shall have 12 mm (1/2") snap-in nipple for 12 mm (1/2") knockouts and mounting on outside of enclosure.
 - .5 Power pack shall have dry contacts capable of switching 15 amp ballast @ 347 VAC, 60Hz.
 - .6 Power pack shall have primary voltage input of 347 VAC.
 - .7 Power pack shall provide a 24 VDC, 114 mA output, with the relay connected.
 - .8 Power pack shall be capable of parallel wiring without regard to AC phases on primary.
 - .9 Power pack can be used as a standalone, low voltage switch, or can be wired to sensor for auto control.
 - .10 Power pack shall have hold-ON and hold-OFF inputs for integration with lighting control panels, BMS and other building systems.
 - .11 Power pack shall have overcurrent protection if the low voltage current drawn exceeds 150 mA. In the event of an overcurrent, the low voltage output current shuts down and the LED will blink to indicate a fault condition.
 - .12 Power pack shall have an LED to indicate status of relay.
 - .13 Power pack shall utilize Zero Crossing Circuitry to protect from the effects of inrush current and increase product longevity.

2.06 DECORATOR LOW VOLTAGE MOMENTARY SWITCHES

- .1 Wattstopper DCC2 series (Basis of Design).
- .2 Switch intended for use with power packs and sensors requiring a momentary contact switch that provides on/off signals.
- .3 12 VAC/VDC, 24 V Rectified, 24 VAC/VDC
- .4 50 mA Max. Internal Contact rating
- .5 500 mΩ resistance when closed
- .6 Single pole, double throw with center position rest.

2.07 DIMMING SWITCHES

- .1 Direct control of dimming luminaires up to the luminaire manufacturer's specified rating.

- .2 Coordinate dimming signal configuration (2-wire phase cut, 3-wire, 4-wire 0-10V, or 4-wire DALI) with the fixture ballast or driver per Section 26 50 00, lighting fixture schedule, and related sections.
- .3 Compatible with related lighting control devices i.e. occupancy sensors.
- .4 Submit luminaire manufacturer's dimmer compatibility documentation to demonstrate compatibility and limits of dimming level.
- .5 Manufacturers:
 - .1 Lutron NovaT* style dimmers.
 - .2 Cooper
 - .3 Leviton.
 - .4 Approved Equal.

2.08 TIMER SWITCHES

- .1 Digital time switch programmable to turn loads off after a preset time.
- .2 Capable of operating as an ON/OFF switch.
- .3 Five terminal, completely self-contained control system that replaces a standard toggle switch. Switching mechanism 30 V @ 1 A air gap relay.
- .4 24 VAC when used in conjunction with power packs. For small rooms, or small localized loads, line voltage is permitted.
- .5 No minimum load requirement.
- .6 Time scroll feature permitting manual overriding of the preset time-out period. Selecting time scroll UP shall allow time-out period to scroll up throughout the timer possibilities to the maximum. Time scroll DN (down) shall allow time-out period to scroll down to minimum.
- .7 Options available for user to enable:
 - .1 One second light flash warning at five minutes before the timer runs out and twice when the countdown reaches one minute (when used to control lighting loads).
 - .2 Beep warning sounding every five seconds once the time switch countdown reaches one minute.
- .8 Manual timer reset where pressing the ON/OFF switch for more than 2 seconds resets the timer to the programmed time-out period.
- .9 Liquid crystal display (LCD) that shows the timer's countdown.
- .10 Incorporates two pulsed, open collector NPN transistor outputs for external latching relay coil drives or lighting control panel inputs.
- .11 Fit behind a decorator style faceplate. Concealed calibration switch for setting time-out, time scroll, one second light flash, and beep warning to prevent tampering of adjustments and hardware.
- .12 Time-out period adjustable in increments of 5 minutes from 5 minutes to 1 hour, and in increments of 15 minutes from 1 hour to 12 hours.
- .13 Operate with power packs in order to control additional loads.
- .14 Utilize terminal style wiring.

- .15 For safety, in the event there is an open circuit in the low voltage line, automatically switch to OFF mode.
- .16 Warranty: 5 year warranty.
- .17 CUL listed.
- .18 Wattstopper TS-400 and TS-400-24 series (Basis of Design).

2.09 EMERGENCY LIGHTING CONTROL UNIT FOR 120 VOLT CIRCUITS

- .1 Description:
 - .1 Sequence of Operation: activate emergency lighting in the event of loss of normal utility power, regardless of control status of the luminaire.
 - .2 Provide all required functionality to allow any standard lighting control device to control emergency lighting in conjunction with normal lighting in any area within a building.
- .2 Device shall be listed to UL 924 to meet the intent of Ontario Building Code for “fail-safe operation”, and be approved for use in Canada.
- .3 Example Manufacturers
 - .1 Functional Devices Inc. ESR01P series.
 - .2 Douglas Lighting Controls WR-RIB2401B-EL.
 - .3 Philips Bodine BLCD-20B.
 - .4 Schneider Electric SLSERC1277.
 - .5 Wattstopper ELCU-200 series.
 - .6 Approved Equal.
- .4 Mounting: Able to fit in a standard junction box knockout.
- .5 Features:
 - .1 Senses local single circuit power failure.
 - .2 LED indication for emergency and normal power.
 - .3 Provides absolute fail-to-on emergency lighting.
 - .4 Emergency lights are controlled with normal lighting.
 - .5 Sequence of Operation: automatically switch emergency lighting on and off as normal lighting is switched. When normal power is not available, force and hold emergency lighting on regardless of the state of any external control device until normal power is restored.
- .6 Specifications:
 - .1 120 VAC; 60 Hz.
 - .2 Maximum Ballast Load: 10A @ 120 VAC.
 - .3 Housing: Fire rated V-0, 80 degrees C.

- .4 Zero crossing circuitry to protect relay contacts from damaging effects of inrush current generated by switching electronic ballast loads.
- .5 UL94 V-O plenum rated with compression wire terminals.
- .6 UL, cUL listed Emergency Lighting and Equipment; five year warranty.

2.10 DAYLIGHT HARVESTING PHOTO SENSORS

- .1 General:
 - .1 Class 2, low voltage.
 - .2 Ambient light sensor designed to interface directly with the analog input of the Lighting Control System.
 - .3 Supply an analog signal to the Lighting Control System proportional to the light measured.
 - .4 Sensor output shall provide for zero or offset based signal.
 - .5 Capable of a fully adjustable response in the range between 0 and 10,000 foot candles with a +/- 1 per cent accuracy at 21 degrees C.
 - .6 Input: 10 VDC.
 - .7 Output: 0 VDC to 10 VDC.
 - .8 Flame retardant housing and meet UL 94 HB standards.
 - .9 Operating temperature: -10 degrees C to 60 degrees C.
- .2 Interior sensors: Fresnel lens, with a 60 degree cone of response. Range between 0 fc and 750 fc.
- .3 Exterior sensors: Complete with hood over the aperture to shield the sensor from direct sunlight. Outdoor sensor circuitry completely encased in an optically clear epoxy resin. Sensor range between 0 fc and 750 fc.
- .4 Atrium sensors: Translucent dome with a 180 degree field of view. Range from 2 fc to 2,500 fc.
- .5 Skylight sensors: Translucent dome with a 180 degree field of view. Range between 10 fc and 7,500 fc.

2.11 SEQUENCES OF OPERATION

- .1 To Section 26 06 50.19.
- .2 [Vacancy Sensor Operation: Manual On, Manual/Auto Off.]
- .3 [In accordance with ASHRAE 90.1-2013].

3 Execution

3.01 INSTALLATION

- .1 In accordance with manufacturer's instructions.
- .2 Minimum 14 AWG from the circuit control hardware relays.
- .3 It shall be the contractor's responsibility to locate and aim sensors in the correct location required for complete and proper volumetric coverage within the range of coverage(s) of controlled areas per the

manufacturer's recommendations. Rooms shall have 90 per cent to 100 per cent coverage to completely cover the controlled area to accommodate all occupancy habits of single or multiple occupants at any location within the room(s). The locations and quantities of sensors shown on the drawings are diagrammatic and indicate only the rooms which are to be provided with sensors. The contractor shall provide additional sensors if required to properly and completely cover the respective room.

- .4 It is the contractor's responsibility to arrange a pre-installation meeting with manufacturer's factory authorized representative, at Owner's facility, to verify placement of sensors and installation criteria.
- .5 Proper judgement must be exercised in executing the installation so as to ensure the best possible installation in the available space and to overcome local difficulties due to space limitations or interference of structural components.
- .6 Install manual control devices and sensors in accordance with manufacturer's instructions for Vacancy Operation.

3.02 SYSTEM STARTUP

- .1 The lighting controls manufacturer's representative shall conduct system startup and submit startup report.

3.03 SITE TESTS AND INSPECTIONS

- .1 The lighting controls manufacturer's representative and Contractor shall conduct functional testing and provide report as described in ASHRAE 90.1-2013:
 - .1 Lighting control devices and control systems shall be tested to ensure that control hardware and software are calibrated, adjusted, programmed, and in proper working condition in accordance with the construction documents and manufacturer's installation instructions.
 - .2 When occupant sensors, time switches, programmable schedule controls, or photosensors are installed, at a minimum, the following procedures shall be performed:
 - .1 Occupant Sensors
 - .1 Certify that the sensor has been located and aimed in accordance with manufacturer recommendations.
 - .2 For projects with up to seven (7) occupancy sensors, all occupancy sensors shall be tested.
 - .3 For projects with more than seven (7) occupancy sensors, testing shall be done for each unique combination of sensor type and space geometry.
 - .4 For each sensor to be tested, verify the following:
 - .1 Status indicator (as applicable) operates correctly.
 - .2 Controlled lights turn off or dim down to the specified level within the required time (20 minutes, or as noted), as applicable to the space type.
 - .3 For auto-on occupant sensors (occupancy mode), the lights turn on to the permitted level when someone enters the space.
 - .4 For manual-on sensors (vacancy mode), the lights turn on only when manually activated.
 - .5 The lights are not incorrectly turned on by movement in nearby areas or by HVAC operation.

- .2 Automatic Time Switches
 - .1 Confirm that the automatic time switch control is programmed with appropriate weekday, weekend, and holiday (as applicable) schedules.
 - .2 Document for the owner automatic time switch programming, including weekday, weekend, and holiday schedules, as well as all setup and preference program settings.
 - .3 Verify that correct time and date are properly set in the time switch.
 - .4 Verify that any battery backup (as applicable) is installed and energized.
 - .5 Verify that the override time limit is set to no more than two (2) hours.
 - .6 Simulate occupied condition. Verify and document the following:
 - .1 All lights can be turned on and off by their respective area control switch.
 - .2 The switch only operates lighting in the enclosed space in which the switch is located.
 - .7 Simulate unoccupied condition. Verify and document the following:
 - .1 All non-exempt lighting turns off.
 - .2 Manual override switch allows only the lights in the enclosed space where the override switch is located to turn on or remain on until the next scheduled shut off occurs.
- .3 Daylight Controls
 - .1 All control devices (photocontrols) have been properly located, field-calibrated, and set for appropriate set points and threshold light levels.
 - .2 Daylight controlled lighting loads adjust to appropriate light levels in response to available daylight.
 - .3 The location where calibration adjustments are made is readily accessible only to authorized personnel.
- .3 The individual(s) responsible for the functional testing shall not be directly involved in either the design or construction of the project and shall provide documentation certifying that the installed lighting controls meet or exceed all documented performance criteria.
- .2 Test lighting controls with fire alarm system in accordance with Section 28 08 46 and Section 28 46 51.
- .3 Commissioning:
 - .1 [Upon completion of the installation, the system shall be completely commissioned to verify all adjustments and sensor placement to ensure a trouble-free lighting control system.]
 - .2 [Submit commissioning report to the Consultant and the commissioning authority for review.]
 - .3 [Provide the Consultant and Commissioning Authority with ten working days written notice of the scheduled commissioning date.]

3.04 TRAINING

- .1 Provide training session of minimum 4 hours duration in accordance with Section 01 79 00.

End of Section

1 General

1.01 SECTION INCLUDES

- .1 Power distribution panelboards – Circuit breaker type.
- .2 Lighting and Appliance Branch Circuit Panelboards.
- .3 [Suite panelboards (loadcentres).]

1.02 RELATED REQUIREMENTS

- .1 Section 26 28 16.02 – Molded Case Circuit Breakers.
- .2 Section 26 43 13 – Surge Protective Devices for Low-Voltage Electrical Power Circuits.

1.03 REFERENCES

- .1 CSA Group:
 - .1 CSA C22.1-18, Canadian Electrical Code, Part 1 (24th Edition), Safety Standard for Electrical Installations.
 - .2 Ontario Electrical Safety Code (27th edition/2018).
 - .3 CSA C22.2 No. 5-16 – Molded Case Circuit Breakers, molded-case switches, and circuit-breaker enclosures.
 - .4 CSA C22.2 No. 29-15 – Panelboards and Enclosed Panelboards.
- .2 NEMA:
 - .1 NEMA ICS 2-2000 (R2020) – Industrial Control and Systems: Controllers, Contactors, and Overload Relays Rated 600 Volts.
 - .2 NEMA KS 1-2013 – Heavy Duty Enclosed and Dead-Front Switches (600 Volts Maximum).
 - .3 NEMA PB 1-2011 – Panelboards.
 - .4 NEMA PB 1.1-2013 – General Instructions for Proper Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less.
- .3 NETA ATS – Acceptance Testing Specifications for Electrical Power Distribution Equipment (published by the International Electrical Testing Association).

1.04 SUBMITTALS

- .1 Submit in accordance with Section 01 33 00.
- .2 Shop drawings shall contain overall panelboard dimensions, interior mounting dimensions, and wiring gutter dimensions. The location of the main, branches, and solid neutral shall be clearly shown. In addition, the drawing shall illustrate one line diagrams with applicable voltage systems.
- .3 Shop drawings
 - .1 Indicate the following:
 - .1 Outline and support point dimensions
 - .2 Voltage

- .3 Main bus ampacity
- .4 Integrated short circuit ampere rating
- .5 Circuit breaker arrangement, types and sizes.
- .2 The following information shall be submitted to the Consultant:
 - .1 Breaker layout drawing with dimensions indicated and nameplate designation
 - .2 Component list
 - .3 Conduit entry/exit locations
 - .4 Assembly ratings including:
 - .1 Short-circuit rating
 - .2 Voltage
 - .3 Continuous current
 - .5 Cable terminal sizes
 - .6 Product data sheets
- .3 Where applicable, the following additional information shall be submitted to the Consultant:
 - .1 Key interlock scheme drawing and sequence of operations
- .4 Submittals for Construction
 - .1 The following information shall be submitted for record purposes:
 - .1 Installation information

1.05 CLOSEOUT SUBMITTALS

- .1 Refer to Section 01 78 00.
- .2 Record actual locations of panelboards and record actual circuiting arrangements in project record documents.
- .3 Maintenance Data: Include spare parts listing; source and current prices of replacement parts and supplies; and recommended maintenance procedures and intervals.
- .4 Final as-built drawings and information shall incorporate all changes made during the manufacturing and installation process.
- .5 Include a copy of each panelboard schedule in the Operation and Maintenance manual.

1.06 MAINTENANCE MATERIAL SUBMITTALS

- .1 Manufacturer shall provide installation instructions and NEMA Standards Publication PB 1.1 - Instructions for Safe Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less.
- .2 Equipment operation and maintenance manuals shall be provided with each assembly shipped and shall include instruction leaflets, instruction bulletins and renewal parts lists where applicable, for the complete assembly and each major component.

- .3 Provide two of each panelboard key.
- .4 Provide final panelboard schedules indicating panelboard data, phasing, breaker sizes, and loads served.

1.07 QUALITY ASSURANCE

- .1 Regulatory Requirements
 - .1 Products: Listed and classified by CSA (Canadian Standards Association).
- .2 Qualifications
 - .1 Company specializing in manufacturing of panelboard products with a minimum of 20 years' experience.
 - .2 The manufacturer of the assembly shall be the manufacturer of the major components within the assembly.
 - .3 For the equipment specified herein, the manufacturer shall be ISO 9001 or 9002 certified.
 - .4 The manufacturer of this equipment shall have produced similar electrical equipment for a minimum period of five (5) years. When requested by the Consultant, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.

1.08 DELIVERY, STORAGE, AND HANDLING

- .1 Inspect and report concealed damage to carrier within their required time period.
- .2 Handle carefully to avoid damage to panelboard internal components, enclosure, and finish.
- .3 Store in a clean, dry environment. Maintain factory packaging and, if required, provide an additional heavy canvas or heavy plastic cover to protect enclosure(s) from dirt, water, construction debris, and traffic.
- .4 Equipment shall be handled and stored in accordance with manufacturer's instructions. One copy of these instructions shall be included with the equipment at time of shipment.

1.09 MANUFACTURER WARRANTY

- .1 Warrant specified equipment to be free from defects in materials and workmanship for eighteen (18) months from the date of purchase.

2 Products

2.01 GENERAL

- .1 Description: CSA C22.2 No.29, circuit breaker type.

2.02 DISTRIBUTION PANELBOARDS – CIRCUIT BREAKER TYPE

- .1 Manufacturers:
 - .1 Square D by Schneider Electric, I-LINE Series.
 - .2 Eaton Cutler-Hammer, PRL 3 and PRL4 Series.
 - .3 Equal by Siemens.

- .2 The listing of specific manufacturers above does not imply acceptance of their products that do not meet the specified ratings, features and functions. Manufacturers listed above are not relieved from meeting these specifications in their entirety. Products in compliance with the specification and manufactured by others not named will be considered only if pre-approved by the Consultant ten days prior to bid date.
- .3 Panelboard Bus:
 - .1 Copper, ratings as indicated.
 - .2 Provide copper neutral bus for panelboards indicated for 4-wire systems.
 - .3 Provide copper ground bus in each panelboard.
- .4 Short Circuit Ratings:
 - .1 Panelboards rated 600 V shall have minimum integrated short-circuit ratings as shown on the drawings or as herein scheduled, but not less than 65 000 amperes RMS symmetrical.
 - .2 Distribution panelboards with bolt-on devices contained therein shall have interrupting ratings as specified herein or indicated on the drawings.
 - .3 Panelboards shall be fully rated.
 - .4 Where indicated, provide circuit breakers ULC listed for application at 100 per cent of their continuous ampere rating in their intended enclosure.
- .5 Minimum integrated short circuit rating: Panelboards rated 240 V shall have minimum integrated short-circuit ratings as shown on the drawings or as herein scheduled, but not less than 10 000 amperes RMS symmetrical.
- .6 Molded Case Circuit Breakers: To Section 26 28 16.02.
- .7 Circuit Breaker Accessories: Trip units and auxiliary switches as indicated.
- .8 Cabinet Front: Surface type, fastened hinge and latch, metal directory frame, finished in manufacturer's standard gray enamel.
- .9 Enclosures: CSA type 2 sprinklerproof complete with drip hood, or as noted.
- .10 Trims shall be equipped with a flush lock.
- .11 Breaker positions labeled as "Spare" or "Space" shall constitute no less than 20 per cent of available breaker positions, whether indicated or not in panelboard schedules.
- .12 Each panel shall be complete with a directory which shall be mounted inside door in a metal frame with clear plastic cover and copy in each Data Book. Use final Room Numbers for directories.

2.03 BRANCH CIRCUIT PANELBOARDS

- .1 Manufacturers:
 - .1 Square D by Schneider Electric, NQ or NQOD Series.
 - .2 Eaton Cutler-Hammer, POW-R-LINE 1, POW-R-LINE 2, POW-R-LINE 3 Series.
 - .3 Equal by Siemens.
- .2 Description: CSA C22.2 No.29, circuit breaker type, lighting and appliance branch circuit panelboard.
- .3 Panelboard Bus:

- .1 Copper, ratings as indicated.
- .2 Provide copper neutral bus in each panelboard.
- .3 Provide copper ground bus in each panelboard.
- .4 Provide insulated ground bus where scheduled.
- .4 Minimum Integrated Short Circuit Rating: 10 000 amperes RMS symmetrical for 240 volt panelboards, or as indicated.
- .5 Molded Case Circuit Breakers: NEMA AB 1, plug-on type thermal magnetic trip circuit breakers, with common trip handle for all poles, listed as Type SWD for lighting circuits, Type HACR for air conditioning equipment circuits, Class A ground fault interrupter circuit breakers where scheduled. Do not use tandem circuit breakers.
- .6 Current Limiting Molded Case Circuit Breakers where indicated: NEMA AB 1, circuit breakers with integral thermal and instantaneous magnetic trip in each pole, coordinated with automatically resetting current limiting elements in each pole. Interrupting rating 100,000 symmetrical amperes, let-through current and energy level less than permitted for same size Class RK-5 fuse.
- .7 Cabinet Front: Surface cabinet front with concealed trim clamps, concealed hinge, metal directory frame, and flush lock all keyed alike. Finish in manufacturer's standard gray enamel.
- .8 Enclosure shall be CSA type 2 sprinklerproof complete with drip hood, or as noted.
- .9 Trims shall be equipped with a flush lock
- .10 Breaker positions labeled as "Spare" or "Space" shall constitute no less than 20 per cent of available breaker positions, whether indicated or not in panelboard schedules.
- .11 Panelboards: to CSA C22.2 No.29 and product of one manufacturer.
 - .1 Install circuit breakers in panelboards before shipment.
 - .2 In addition to CSA requirements manufacturer's nameplate must show fault current that panel including breakers has been built to withstand.
- .12 Panelboards rated 240 Vac or less shall have short-circuit ratings as shown on the drawings or as herein scheduled, but not less than 10,000 amperes RMS symmetrical.
- .13 Bus and breakers rated for symmetrical interrupting capacity, as indicated.
- .14 Sequence phase bussing with odd numbered breakers on left and even on right, with each breaker identified by permanent number identification as to circuit number and phase.
- .15 Panelboards: mains, number of circuits, and number and size of branch circuit breakers as indicated.
- .16 Two keys for each panelboard and key panelboards alike.
- .17 Copper bus with neutral of same ampere rating as mains.
- .18 Mains: suitable for bolt-on breakers.
- .19 Trim with concealed front bolts and hinges.
- .20 Trim and door finish: baked grey enamel.
- .21 The minimum short-circuit rating for branch circuit panelboards shall be as specified herein or as indicated on the drawings. Panelboards shall be fully rated.

- .22 Bolt-on type, heavy-duty, quick-make, quick-break, single- and multi-pole circuit breakers of the types specified herein, shall be provided for each circuit with toggle handles that indicate when unit has tripped.
- .23 Circuit breakers shall be thermal-magnetic type with common type handle for all multiple pole circuit breakers. Circuit breakers shall be minimum 100-ampere frame and through 100-ampere trip sizes shall take up the same pole spacing. Circuit breakers shall be ULC listed as type SWD for lighting circuits.
 - .1 Circuit breaker handle locks shall be provided for all circuits that supply exit signs, emergency lights, energy management, and control system (EMCS) panels and fire alarm panels.
- .24 Circuit breakers shall have a minimum interrupting rating of 10 000 amperes symmetrical at 240 volts, and 14 000 amperes symmetrical at 480 volts, unless otherwise noted on the drawings.
- .25 Each panel shall be complete with a directory which shall be mounted inside door in a metal frame with clear plastic cover and copy in each Data Book. Use final Room Numbers for directories.
- .26 Lighting and receptacle panels shall be surface or flush-mounting type, as shown.
- .27 Panels shall be dead front type in code gauge steel enclosures. All panels shall be sprinkler proof c/w drip hoods as required.
- .28 Panels shall have mains of voltage and capacity, and main and branch breakers, as shown on the drawings. Spaces shall include necessary bus work such that Owners, at a later date, need buy only the breakers.
- .29 Where branch circuit metering is used on a panelboard, provide 762 mm (30”) tub width to accommodate the metering devices within the panelboard.
- .30 Where panels exceed 42 circuits, use multi-section panel with main cross-over solid bus bars unless noted otherwise on drawings. Main bus capacity of each section shall be full size to match cross-over bus.
- .31 Breakers shall have bolted type connections. Multi-pole breakers shall be common trip type with a single handle, suitable for voltage applied and of same manufacture as single pole breakers.
- .32 Panels for 120/208 volt, 3-phase, 4-wire systems shall be complete with full size breakers.
- .33 Where shown on drawings or required by code, certain breakers shall include ground fault interrupter.
- .34 Provide lighting and receptacle panels, surface or flush-mounting type, as shown.
- .35 Provide locking bars on non-switched circuits where panels are used for switching lighting circuits.
- .36 Panels for non-linear loads shall be complete with lugs for double neutrals.
- .37 Panels shall be given a rust-resistant treatment to both tub and trim.
- .38 Flush panels shall have concealed hinges and flush type combination lock latch. Locks shall be chrome plated. Doors shall open minimum 135 degrees. Trims shall have fasteners concealed and shall be prime coated to receive room finish paint.
- .39 Surface mounted panels shall have manufacturer's standard surface door trim complete with lock and latch. Finish shall be grey.
- .40 Recessed panels shall have standard flush trims.
- .41 Co-ordinate panel finish with Room Finish Schedule.

2.04 [RESIDENTIAL SUITE PANELS (LOADCENTRES)]

- .1 Manufacturers:
 - .1 Schneider Electric Homeline series.
 - .2 Eaton BR series.
 - .3 Siemens EQL series.
- .2 Description:
 - .1 120/240 volt, 1-phase 3-wire, 125 amp rating.
 - .2 Panelboards suitable for recessed or surface mounted applications.
 - .3 3.75 inch nominal depth.
 - .4 Tin-plated aluminum bus.
 - .5 Suitable for plug-on circuit breakers.
 - .6 CSA certified.
 - .7 White cover colour.
 - .8 CSA Type 1 enclosure.
 - .9 Minimum number of branch circuit positions in accordance with 2018 OESC Rule 8-108.

2.05 MOLDED CASE CIRCUIT BREAKERS

- .1 Breakers: to Section 26 28 16.02.
- .2 Breakers with thermal and magnetic tripping in panelboards except as indicated otherwise.
- .3 Main breaker: separately mounted on top or bottom of panel to suit cable entry. When mounted vertically, down position should open breaker.
- .4 Lock-on devices for 10 per cent of 15 A to 30 A breakers installed as indicated. Turn over unused lock-on devices to Owner.
- .5 Lock-on devices for fire alarm, security, and sprinkler circuits.
- .6 Provide shunt trips, bell alarms, and auxiliary switches as shown on the contract drawings.
- .7 Provide breakers for externally mounted Surge Protective Devices in accordance with Section 26 43 13.

2.06 CONSTRUCTION

- .1 General:
 - .1 Interiors shall be completely factory assembled. They shall be designed such that switching and protective devices can be replaced without disturbing adjacent units and without removing the main bus connectors.
 - .2 Surface trims shall be same height and width as box. Flush trims shall overlap the box by 3/4 of an inch on all sides.

- .3 A temporary directory card with a clear plastic cover shall be supplied and mounted on the inside of each door.
- .4 All locks shall be keyed alike. Key same as existing.
- .2 Branch Circuit Panelboards:
 - .1 Trims for branch circuit panelboards shall be supplied with a hinged door over all circuit breaker handles. Doors in panelboard trims shall not uncover any live parts. Doors shall have a semi flush cylinder lock and catch assembly. Door-in-door trim shall be provided. Both hinged trim and trim door shall utilize three point latching. No tools shall be required to install or remove trim. Trim shall be equipped with a door-actuated trim locking tab. Equip locking tab with provision for a screw such that removal of trim requires a tool, at the owner's option. Installation shall be tamper resistant with no exposed hardware on the panelboard trim.
- .3 Distribution Panelboards:
 - .1 Distribution panelboard trims shall cover all live parts. Switching device handles shall be accessible.

2.07 BUS

- .1 Lugs: Copper and listed by CSA, or cUL, for use with copper conductors and sized to accept copper conductors of the ampacity specified.
- .2 Main bus bars shall be copper sized in accordance with CSA standards to limit temperature rise on any current carrying part to a maximum of 65 degrees C above an ambient of 40 degrees C maximum.
- .3 A copper system ground bus shall be included in all panelboards.
- .4 Full-size (100 per cent rated) insulated copper neutral bars shall be included for panelboards shown with neutral. Bus bar taps for panels with single-pole branches shall be arranged for sequence phasing of the branch circuit devices. Neutral busing shall have a suitable lug for each outgoing feeder requiring a neutral connection. 200 per cent rated neutrals shall be supplied for panels designated on drawings with oversized neutral conductors.

2.08 EQUIPMENT IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 05 53.
- .2 Nameplate for each panelboard size 4 engraved.
- .3 Nameplate for each branch circuit in distribution panelboards size 2 engraved.
- .4 Complete circuit directory with typewritten legend showing location and load of each circuit.
- .5 Provide an engraved nameplate for each panelboard section.
- .6 Provide copies of all circuit directories in Manuals.

2.09 SOURCE QUALITY CONTROL

- .1 The following standard factory tests shall be performed on the equipment provided under this section. All tests shall be in accordance with the latest version of NEMA and CSA standards.

3 Execution

3.01 INSTALLATION

- .1 Install panelboards to CSA C22.1.
- .2 Install panelboards plumb.
- .3 Height: 1800 mm to top of panelboard; install panelboards taller than 1800 mm with bottom no more than 100 mm above floor.
- .4 Provide filler plates for unused spaces in panelboards.
- .5 Provide typed circuit directory for each branch circuit panelboard. Revise directory to reflect circuiting changes required to balance phase loads.
- .6 Provide engraved plastic nameplates under the provisions of Section 26 05 53.
- .7 Ground and bond panelboard enclosure according to Section 26 05 26.
- .8 Locate panelboards as indicated and mount securely, plumb, true and square, to adjoining surfaces.
- .9 Install surface mounted panelboards on fire rated plywood backboards in accordance with Section 06 10 00. Where practical, group panelboards on common backboard.
- .10 Connect loads to circuits.
- .11 Connect neutral conductors to common neutral bus with respective neutral identified.
- .12 Deliver five (5) duplicate keys for each panel lock to Owner.
- .13 Mount electrical panels, where possible, with top of trim at uniform height of 2000 mm.
- .14 Cap ends of conduits in accessible locations in ceiling spaces above panels, to allow for future wiring.
- .15 The Contractors shall install all equipment per the manufacturer's recommendations and the contract drawings.
- .16 Install panelboards in accordance with manufacturer's written instructions, NEMA PB 1.1 and Electrical Code requirements.
- .17 After completion of wiring, type directory showing a clear description of each circuit being controlled from panel and place in metal frame inside door.
- .18 Provide revised directories for existing panels if revised.
- .19 Provide circuit breaker handle locks for all circuits that supply exit signs, emergency lights, energy management, and control system (EMCS) panels and fire alarm panels.
- .20 [Provide three 27 mm empty conduits from top of lighting, receptacle, telephone, signal and communication panels recessed in walls, to ceiling space.]

3.02 FIELD QUALITY CONTROL

- .1 Perform inspections and tests listed in NETA ATS, Section 7.4 for switches, Section 7.5 for circuit breakers.
- .2 Inspect complete installation for physical damage, proper alignment, anchorage, and grounding.

- .3 Measure steady state load currents at each panelboard feeder; rearrange circuits in the panelboard to balance the phase loads within 20 per cent of each other. Maintain proper phasing for multi-wire branch circuits.
- .4 Check tightness of bolted connections and circuit breaker connections using calibrated torque wrench or torque screwdriver per manufacturer's written specifications.

3.03 ADJUSTING

- .1 Measure steady state load currents at each panelboard feeder; rearrange circuits in the panelboard to balance the phase loads to within 20 percent of each other.
- .2 Maintain proper phasing for multi-wire branch circuits.

End of Section

1 General

1.01 SECTION INCLUDES

- .1 Switches, receptacles, wiring devices, cover plates and their installation.

1.02 RELATED REQUIREMENTS

- .1 Section 26 09 23 – Lighting Control Devices.
- .2 Section 26 27 26.13 – Floor Box Assemblies.

1.03 UNIT PRICES

- .1 [Refer to Document 00 43 00.26.]
- .2 Submit with Tender unit prices to provide the following. Include installation in the unit price:
 - .1 5-15R [specification grade] duplex receptacle complete with wiring and conduit, based on 10 metre distance from the local panelboard.
 - .2 5-20R [specification grade] duplex receptacle complete with wiring and conduit, based on 10 metre distance from the local panelboard.
- .3 Unit cost of additional conduit and wire for the above items.

1.04 REFERENCES

- .1 CSA Group:
 - .1 CSA C22.1-18, Canadian Electrical Code, Part 1 (24th Edition), Safety Standard for Electrical Installations.
 - .2 Ontario Electrical Safety Code (27th edition/2018).
 - .3 CSA C22.2 No. 14-13, Industrial control equipment
 - .4 CSA C22.2 No. 42-10 (R2015), General use receptacles, attachment plugs, and similar devices.
 - .5 CSA C22.2 No. 42.1-13, Cover plates for flush-mounted wiring devices.
 - .6 CSA C22.2 No. 55-15 (R2020), Special use switches.
 - .7 CSA C22.2 No.111-10 (R2015), General-use snap switches.
 - .8 CSA C22.2 No. 182.1-17, Plugs, receptacles, and cable connectors of the pin and sleeve type

1.05 INFORMATIONAL SUBMITTALS

- .1 Submit shop drawings and product data in accordance with Section 01 33 00.
- .2 Product Data: Provide manufacturer's catalogue information showing dimensions, colours, and configurations.
- .3 Submit manufacturer's installation instructions.

2 Products

2.01 MANUFACTURERS

- .1 Eaton.
- .2 Hubbell Bryant.
- .3 Leviton.
- .4 Molex.
- .5 Pass & Seymour (Legrand).

2.02 WALL SWITCHES

- .1 Single pole, double pole, three-way, four-way switches to: CSA C22.2 No.55 and CSA C22.2 No.111.
- .2 Description: CSA-C22.2 No.111, Commercial Spec Grade, AC only general-use snap switch.
- .3 Local switches shall be 20 ampere, silent, brown coloured, AC type and CSA certified, specification grade. Provide switches rated to suit system voltage 120 V or 347 V.
- .4 Manually-operated general purpose AC switches with following features:
 - .1 Terminal holes approved for 10 AWG wire.
 - .2 Silver alloy contacts.
 - .3 Urea or melamine moulding for parts subject to carbon tracking.
 - .4 Suitable for back and side wiring.
- .5 Voltage: 120 volt or 347 volt, AC as indicated.
- .6 Current: 20 amperes.
- .7 Body and Handle: white plastic with toggle handle. Confirm finish colour prior to ordering.
- .8 Toggle operated fully rated for tungsten filament and fluorescent lamps, and up to 80% of rated capacity of motor loads.
- .9 Example Products (Decorator style):
 - .1 120 volt:
 - .1 Hubbell HBL2121 series.
 - .2 347 volt:
 - .1 Pass & Seymour 2601-347 series.
- .10 Example Products (Toggle style):
 - .1 120 volt:
 - .1 Hubbell HBL1221 (single pole).
 - .2 Hubbell HBL1222 (double pole).
 - .3 Hubbell HBL1223 (three-way).

- .4 Hubbell HBL1224 (four-way).
- .2 347 volt:
 - .1 Hubbell HBL18221 (single pole).
 - .2 Hubbell HBL18223 (three-way).
 - .3 Pass & Seymour PS372030I.
- .11 Local switches and receptacles shall be of the same manufacturer throughout except where a specified item is not made by that manufacturer.

2.03 RECEPTACLES

- .1 General
 - .1 Description: CSA C22.2 No. 42, Commercial Spec Grade general use receptacles.
 - .2 Device Body: white plastic.
 - .3 Configuration: Type as specified and indicated.
 - .4 Convenience Receptacle: Type 5-15, 5-20 where indicated.
 - .5 GFCI Receptacle: Convenience receptacle with integral ground fault circuit interrupter to meet regulatory requirements.
 - .6 Data Room Receptacle Types: As indicated on drawings.
 - .7 Receptacles of one manufacturer throughout project.
- .2 Receptacles shall be white coloured, specification grade, unless noted otherwise.
- .3 Receptacles shall be as listed below:
 - .1 15 ampere, 120 volt, single phase grounded duplex receptacle shall be NEMA-U- ground type CSA Configuration 5-15R.
 - .2 20 ampere, 120 volt, single phase grounded duplex receptacle shall be NEMA-U-ground type CSA Configuration 5-20RA
 - .3 15 ampere, 120 volt, weatherproof receptacles shall be equal to those above but complete with gasketed cast plate and hinged covers.
- .4 Other types of receptacles shall be provided as shown on Drawings.
- .5 Duplex receptacles, CSA type 5-15 R, 125 V, 15 A, U ground, to: CSA-C22.2 No. 42 with following features:
 - .1 White urea moulded housing.
 - .2 Suitable for No. 10 AWG for back and side wiring.
 - .3 Break-off links for use as split receptacles.
 - .4 Eight back wired entrances, four side wiring screws.
 - .5 Triple wipe contacts and riveted grounding contacts.

- .6 Single receptacles CSA type 5-15 R, 125 V, 15 A, U ground with following features:
 - .1 White urea moulded housing.
 - .2 Suitable for No. 10 AWG for back and side wiring.
 - .3 Four back wired entrances, 2 side wiring screws.
- .7 Other receptacles with ampacity and voltage as indicated.
- .8 Example Products (Decorator style duplex 5-15R):
 - .1 Pass & Seymour 26252 Series.
 - .2 Hubbell HBL2152 Series.
- .9 Ground Fault Circuit Interrupter (GFCI or GFI) Receptacles
 - .1 Protected by a ground fault circuit interrupter of the Class A type.
 - .2 Any receptacle within 1.5 m of a sink must be GFCI protected.
 - .3 Any receptacle located outdoor must be GFCI protected.
- .10 Isolated Ground (IG) Receptacles:
 - .1 Marked as such (green triangle).
 - .2 Example Products:
 - .1 Hubbell IG2152 (15A duplex decorator style, orange faceplate).
- .11 Tamper-resistant receptacles.
 - .1 Marked as such (for example "TR").
 - .2 To be used in the following spaces:
 - .1 Child care facilities and kindergarten classrooms.
 - .2 Guest rooms and suites of hotels and motels.
 - .3 Preschools and elementary education facilities, including kindergarten facilities.
 - .4 Dwelling units.
 - .3 Example Products:
 - .1 Hubbell BR15WHITR (15A duplex decorator style).
 - .2 Hubbell BR20WHITR (20A duplex decorator style).
- .12 Wet location and weatherproof devices:
 - .1 Receptacles and cover plates suitable for wet locations, cover plates to provide shielding with and without a plug inserted into the receptacle in accordance with OESC rule 26-702. Cover plates to be marked "Extra Duty".
 - .2 Receptacles shall be 20 A rated, GFI.

2.04 COVER PLATES

- .1 Cover plates for wiring devices to: CSA C22.2 No. 42.1.
- .2 Cover plates from one manufacturer throughout project.
- .3 Sheet steel utility box cover for wiring devices installed in surface-mounted utility boxes.
- .4 Stainless steel, vertically brushed, cover plates, thickness 2.5 mm for wiring devices mounted in flush-mounted outlet box.
- .5 Cast cover plates for wiring devices mounted in surface-mounted FS or FD type conduit boxes.
- .6 Weatherproof double lift spring-loaded cast aluminum cover plates, complete with gaskets for duplex receptacles as indicated.
- .7 Weatherproof spring-loaded cast aluminum cover plates complete with gaskets for single receptacles or switches.
- .8 Decorative Cover Plate: Polycarbonate.
 - .1 Pass & Seymour TP26W series.
- .9 Switch, receptacle, telephone and other plates shall be stainless steel 18-8 chrome metal alloy, Type 302, non-metallic in finished areas and pressed steel in unfinished areas. Finish brush marks shall be run in a vertical direction.
- .10 Wet Location and weatherproof devices: receptacles and cover plates shall be suitable for wet locations, and provide shielding with and without a plug inserted into the receptacle in accordance with 2018 OESC rule 26-710.

2.05 PENDANT RECEPTACLES

- .1 Pendant cord mounted single receptacles complete with strain relief device.
- .2 Strain relief system: Hubbell Kellems Grips, Molex, or equal.

2.06 RECEPTACLE CORD REELS

- .1 Retractable cable reel, mounted to structure above. 125 V, 5-15R [5-20R] C/W [25] [40] feet of cabtire (or equal).
- .2 Provide framing bracket to support reel at underside of structure above.
- .3 Connect to GFCI breakers.
- .4 Manufacturers:
 - .1 Hubbell HBL-C40-123TT.
 - .2 Woodhead (Molex) 997 series.
 - .3 Approved equal.

2.07 SPECIAL WIRING DEVICES

- .1 Pilot lights as indicated, with neon type 0.04 W, 125 V lamp and red plastic jewel flush type.

2.08 PIN AND SLEEVE DEVICES

- .1 Manufacturers:
 - .1 Crouse-Hinds by Eaton.
 - .2 Hubbell.
 - .3 Meltric.
 - .4 Mennekes.
 - .5 Russellstoll (Thomas & Betts).
 - .6 Walther Electric.
- .2 Refer to equipment schedule and plans for locations and specific requirements.

2.09 REGULATORY REQUIREMENTS

- .1 Provide products listed and classified by CSA (Canadian Standards Association).

3 Execution

3.01 EXAMINATION

- .1 Verify that outlet boxes are installed at proper height.
- .2 Verify that wall openings are neatly cut and will be completely covered by wall plates.
- .3 Verify that branch circuit wiring installation is completed, tested, and ready for connection to wiring devices.

3.02 PREPARATION

- .1 Provide extension rings to bring outlet boxes flush with finished surface.
- .2 Clean debris from outlet boxes.

3.03 INSTALLATION

- .1 Install to CSA C22.1.
- .2 Mounting heights in accordance with Section 26 05 00.
- .3 Install devices plumb and level.
- .4 Install switches with OFF position down.
- .5 Install wall dimmers to achieve full rating specified and indicated after de-rating for ganging as instructed by manufacturer.
- .6 Do not share neutral conductor on load side of dimmers.
- .7 Install receptacles with grounding pole on bottom.
- .8 Connect wiring device grounding terminal to outlet box with bonding jumper.
- .9 Install decorative plates on switch, receptacle, and blank outlets in finished areas.

- .10 Connect wiring devices by wrapping conductor around screw terminal.
- .11 Use jumbo size plates for outlets installed in masonry walls.
- .12 Install galvanized steel plates on outlet boxes and junction boxes in unfinished areas, above accessible ceilings, and on surface mounted outlets.
- .13 Switches:
 - .1 Install single throw switches with handle in "UP" position when switch closed.
 - .2 Install switches in gang type outlet box when more than one switch is required in one location.
- .14 Receptacles:
 - .1 Install receptacles in gang type outlet box when more than one receptacle is required in one location.
 - .2 Where split receptacle has one portion switched, mount vertically and switch upper portion.
 - .3 Connect receptacle grounding terminal to the outlet box with an insulated green ground strap.
 - .4 [Provide a combination-type arc-fault circuit interrupter on all dwelling unit branch circuit breakers supplying 125 V receptacles rated 20 A or less except for receptacles serving kitchen counters, refrigerators, bathrooms, or sump pumps in accordance with OESC requirements.]
 - .5 Receptacles for maintenance of HVAC and similar equipment located on rooftops.
 - .1 Provide weatherproof GFI 5-20R receptacles on roof, installed at 750 mm (30 inches) above finished roof level, complete with wet location cover plate.
 - .2 Locate within 7500 mm (25 feet) of new HVAC equipment, and at least 2000 mm (6.5 feet) away from roof line.
 - .3 Refer to 2018 OESC rules 2-316, 26-708, and 26-710, and OESC bulletin 26-27-0, or latest edition.
- .15 Cover plates:
 - .1 Protect stainless steel cover plate finish with paper or plastic film until painting and other work is finished.
 - .2 Install suitable common cover plates where wiring devices are grouped.
 - .3 Do not use cover plates meant for flush outlet boxes on surface-mounted boxes.
 - .4 Do not install plates until final painting of room or area is completed. Remove protective covering.
- .16 Circuit identification: in accordance with Section 26 05 53.

3.04 FIELD QUALITY CONTROL

- .1 Inspect each wiring device for defects.
- .2 Operate each wall switch with circuit energized and verify proper operation.
- .3 Verify that each receptacle device is energized.
- .4 Test each receptacle device for proper polarity.

.5 Test each GFCI receptacle device for proper operation.

3.05 ADJUSTING

.1 Adjust devices and wall plates to be flush and level.

3.06 CLEANING

.1 Clean exposed surfaces to remove splatters and restore finish.

End of Section

1 General

1.01 SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00.
- .2 Product Data:
 - .1 Provide fuse performance data characteristics for each fuse type and size above 200 amps. Performance data to include: average melting time-current characteristics.
- .3 Shop Drawings:
 - .1 Provide shop drawings in accordance with Section 01 33 00.

1.02 DELIVERY, STORAGE, AND HANDLING

- .1 Ship fuses in original containers.
- .2 Do not ship fuses installed in switchboard.
- .3 Store fuses in original containers in storage cabinet.
- .4 Waste Management and Disposal:
 - .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 19.

1.03 MAINTENANCE MATERIAL SUBMITTALS

- .1 Provide maintenance materials in accordance with Section 01 78 00.
- .2 3 spare fuses of each type and size installed above 600 A.
- .3 6 spare fuses of each type and size installed up to and including 600 A.

2 Products

2.01 MANUFACTURERS

- .1 Bussman by Eaton.
- .2 GEC.
- .3 Littelfuse.
- .4 Mersen.
- .5 Substitutions: not permitted.

2.02 FUSES - GENERAL

- .1 Fuse type references L1, L2, J1, R1, etc. have been adopted for use in this specification.
- .2 Fuses: product of one manufacturer.
- .3 Fuses shall be sized as shown, time delay type, and of the same type throughout.
- .4 Fuses shall be CSA certified Class-J for 1-600A or Class-L for 650 Amps and above.

2.03 FUSE TYPES

- .1 Class J fuses.
 - .1 Type J1, time delay, capable of carrying 500 per cent of its rated current for 10 seconds minimum.
 - .2 Type J2, fast acting.
- .2 Class L fuses.
 - .1 Type L1, time delay, capable of carrying 500 per cent of its rated current for 10 seconds minimum.
 - .2 Type L2, fast acting.
- .3 Class R fuses.
 - .1 Type R1, (UL Class RK1), time delay, capable of carrying 500 per cent of its rated current for 10 seconds minimum, to meet UL Class RK1 maximum let-through limits.
 - .2 Type R2, time delay, capable of carrying 500 per cent of its rated current for 10 seconds minimum.
 - .3 Type R3, (UL Class RK1), fast acting Class R, to meet UL Class RK1 maximum let-through limits.

2.04 FUSE REQUIREMENTS

- .1 Dimensions and Performance: CSA C22.2 No. 248 Series, Class as specified or indicated.
- .2 Voltage: Provide fuses with voltage rating suitable for circuit phase-to-phase voltage.
- .3 Power Load Feeder Switches: HRC-1 Class J time delay type.
- .4 Other Feeder Switches: HRC-1 Class J time delay type.

2.05 SPARE FUSE CABINET

- .1 Description: Wall-mounted sheet metal cabinet, suitably sized to store spare fuses and fuse pullers specified.
- .2 Doors: Hinged, with hasp for Owner's padlock.
- .3 Finish: Prime finish for field painting.
- .4 Dimensions: Minimum 3 foot by 3 foot by 1 foot.

3 Execution

3.01 INSTALLATION

- .1 Install fuses to manufacturer's instructions.
- .2 Install fuse with label oriented such that manufacturer, type, and size are easily read.
- .3 Install spare fuse cabinet in electrical room.

- .4 Provide a complete set of fuses in each fusible device supplied under this Division and provide 3 spare fuses for each size used in spare fuse cabinet.

End of Section

1 General

1.01 SECTION INCLUDES

- .1 Fusible and non-fusible enclosed low-voltage disconnect switches from 30 to 800 amps.

1.02 RELATED REQUIREMENTS

- .1 Section 26 28 13 – Fuses.

1.03 REFERENCES

- .1 Canadian Standards Association
 - .1 CSA C22.1-18, Canadian Electrical Code, Part 1 (24th Edition), Safety Standard for Electrical Installations.
 - .2 Ontario Electrical Safety Code (27th Edition/2018).
 - .3 CAN/CSA-C22.2 No. 4-16 – Enclosed and Dead-Front Switches.
 - .4 CSA C22.2 No. 248 series – Low-voltage fuses.
- .2 NETA (International Electrical Testing Association) ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

1.04 SUBMITTALS

- .1 Product Data: Provide switch ratings, and enclosure dimensions.

1.05 CLOSEOUT SUBMITTALS

- .1 Record actual locations of enclosed switches in project record documents.

2 Products

2.01 MANUFACTURERS

- .1 Eaton Cutler-Hammer.
- .2 Siemens.
- .3 Square D by Schneider Electric.

2.02 REGULATORY REQUIREMENTS

- .1 Products: Listed and classified by CSA or testing firm acceptable to the authority having jurisdiction as suitable for the purpose specified and indicated.

2.03 DISCONNECT SWITCHES

- .1 Provide dedicated disconnect switches at electrical equipment.
- .2 Fused or un-fused disconnect or safety switches: Type "A", quick-make, quick-break construction with provision for padlocking switches in either "ON" or "OFF" position.
 - .1 Quick-make, quick-break.
 - .2 Heavy duty industrial type.

- .3 Lockable with up to 3 padlocks.
- .4 Cover interlocked with switch mechanism.
- .5 Viewing window for viewing blades.
- .3 Fused switches equipped with fuse clips designed for Class "J" fuses and designed to reject standard NEC fuses.
- .4 Enclosure: CSA Type 1 sprinkler-proof, or as noted.
- .5 Switches throughout project of same manufacturer.

3 Execution

3.01 INSTALLATION

- .1 Provide fused or un-fused safety or disconnect switches as shown and as required by Code.
- .2 Install disconnect switches complete with fuses, if applicable, to CSA C22.1.
- .3 Apply neatly typed adhesive tag on inside door of each fusible switch indicating NEMA fuse class and size installed.
- .4 Coordinate fuse ampere rating with installed equipment. Fuse ampere rating variance between original design information and installed equipment, size in accordance with Bussmann Fusetron 40 degree C recommendations. Do not provide fuses of lower ampere rating than motor starter thermal units.

End of Section

1 General

1.01 SECTION INCLUDES

- .1 Common requirements for all electric lighting, including interior, exterior, and emergency lighting.

1.02 RELATED REQUIREMENTS

- .1 Section 26 09 23 – Lighting Control Devices.
- .2 Section 26 09 26 – Lighting Control Panelboards.
- .3 Section 26 09 43 – Network Lighting Controls.
- .4 Section 26 51 00 – Interior Lighting.
- .5 Section 26 52 13.13 – Emergency Lighting.
- .6 Section 26 52 13.16 – Exit Signs.
- .7 Section 26 56 19 – LED Exterior Lighting.

1.03 REFERENCES

- .1 CSA Group
 - .1 CSA C22.1-18, Canadian Electrical Code, Part 1 (24th Edition), Safety Standard for Electrical Installations.
 - .2 Ontario Electrical Safety Code (27th edition/2018).
 - .3 CSA C22.2 No. 9.0 - General Requirements for Luminaires.
 - .4 CSA C22.2 No. 250.0 - Luminaires (Bi-National Standard, with UL 1598).
 - .5 CAN/CSA E920-98 (R2017) - Ballasts for Tubular Fluorescent Lamps - General and Safety Requirements (Adopted IEC 920:1990, first edition, including Amendment 1:1993 and Amendment 2:1995, with Canadian deviations).
 - .6 CAN/CSA-E61347-2-3:03 (R2013) - Lamp controlgear - Part 2-3: Particular Requirements for A.C. supplied electronic ballasts for fluorescent lamps (Adopted CEI/IEC 61347-2-3:2000, first edition, 2000-10, with Canadian deviations).
- .2 Illumination Engineering Society (IES)
 - .1 IES HB-10-11 – The Lighting Handbook, 10th Edition.
 - .2 IES LM-79-08 – Approved Method: Electrical and Photometric Measurements of Solid-State Lighting Products.
 - .3 IES LM-80-08 – IES Approved Method for Measuring Lumen Maintenance of LED Light Sources.
- .3 NEMA WD 6 - Wiring Devices - Dimensional Requirements.

1.04 SUBMITTALS

- .1 Refer to Section 01 33 00.
- .2 General

- .1 The Contractor shall be responsible for supplying equipment product data, and as indicated in the specification, partial or complete working samples of the specified equipment in a timely fashion for design team approval, prior to releasing orders on equipment. Contractor shall be responsible for coordinating all aspects of order placement, deposits, shop drawing procurement, order release, order follow-up, delivery tracking, etc. with Distributor in a timely fashion. Some luminaires may require at least 12 to 16 weeks of lead time or more- the Contractor is responsible for allowing sufficient time for the order-and-deposit process, shop drawing procurement, submittal, and review process. Substitutions will not be accepted on the basis of the contractor's obligation to make any deadlines, contractual or otherwise, agreed by the contractor toward the completion of this project. Lamp submittals are as important and necessary as luminaire submittals and must be supplied by the Contractor to assure correct lamp wattage, color and efficacy.
- .2 All submittals shall be generated by respective factories with their seals or other authentication marks and each submittal sheet shall be clearly labeled with respective luminaire type, complete catalog number relevant to submitted luminaire, date of submittal generation and name, phone number, and email address of submittal author in order to track provenance of information. The Consultant may contact respective factory submittal source.
- .3 The lighting equipment specified herein has been carefully chosen for its ability to meet the luminous environment requirements of this project. Calculations were typically made to determine luminances, luminance ratios, and/or horizontal and vertical illuminances and uniformities. In some instances, virtual reality "images" were generated with lighting calculation software to assist the Design Team and/or the Client in assessing the lighting quality of the spaces or areas. Equipment and/or manufacturers which have been shown to comply with the established criteria, including ASHRAE/IES 90.1 or California Title 24 or other such energy code as applicable by ordinance, code, Federal law, or mandate, and/or intended LEED or other green-building certification, is specified herein. Substitutions in all likelihood will be unable to meet all or some of the salient criteria as the specified equipment.
- .4 Where permitted, substitution submittals shall consist of a physical description, detailed dimensioned drawing and complete photometric and electric data of the proposed lamp, ballast, driver, or transformer as required, and luminaire. Working samples of lamp and luminaire substitutions must also be supplied at time of substitution request for visual check of finish, operating and photometric characteristics, and functional and aesthetic design. Photometric reports must list the actual candela values of the luminaire's distribution with specified or similar lamp in at least five horizontal planes with elevation angles in increments not greater than 5° from nadir to zenith. If additional data is required to account for asymmetric distributions, then this shall also be supplied. Candela curves, lux or footcandle and lumen tables and iso-lux-or-footcandle contours are not acceptable. The Contractor shall be responsible for negotiation with the client, Consultant, Lighting Designer, and Electrical Engineer prior to substitution submittal to assure fees are available for: redesign project based on proposed substitution ; or review by Consultant, Lighting Designer and Electrical Engineer of all photometric, sample, design and calculation documentation and virtual reality renderings (provided by Contractor) for proposed substitutions. All substitutions must be identified and approved prior to bid date; and all contractor negotiations re: additional fees for redesign work due to substitutions must occur prior to bid date. A Substitution Request Form shall be completed, submitted, and postmarked along with all relevant documentation required on the Substitution Request Form two weeks prior to bid date. No substitutions will be considered without compliance with this paragraph. Contractor's bid value and/or schedule commitments shall not be based on substitutions in expectation of design team approval, nor on Contractor estimated value of specified equipment. If submitted substitution fails to comply with any specification requirements or is rejected for any or no reason whatsoever, Contractor will furnish specified equipment at no additional cost or delay to the Owner.
- .5 The Contractor shall be responsible for obtaining from his supplying lighting manufacturers, for each luminaire, a recommended maintenance manual including:
 - .1 Vendor and local representative's contact information

- .2 Tools required
 - .3 Instructions
 - .4 Types of cleaners to be used
 - .5 Replacement parts identification lists
 - .6 Equipment product data (high-quality reproducible copies)
 - .7 Warranty documentation
- .3 Shop Drawings:
- .1 Indicate dimensions and components for each luminaire that is not a standard product of the manufacturer.
 - .2 Wiring diagrams for power, signal and control wiring.
- .4 Product Data: For each type of lighting fixture, arranged in order of fixture designation. Include data on features, accessories, finishes and the following:
- .1 Provide manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 The product literature shall provide an explanation of all options and descriptors in the catalog number as submitted.
 - .3 Include luminaire weight.
 - .4 Provide complete photometric data prepared by independent testing laboratory for each luminaire, for approval by Engineer.
 - .5 Physical description of lighting fixtures including dimensions.
 - .6 Ballast, including BF.
 - .7 Energy-efficiency data, including ballast input wattage.
 - .8 Life, output (lumens, CCT and CRI), and energy efficiency data for lamps.
- .5 Photometric Data and Calculations
- .1 Provide Luminaire Data Photometric Testing performed by an independent agency complying with IESNA Lighting Measurement Testing and Calculation Guides.
 - .2 Submit photometric calculations for typical areas based on layouts as indicated on the drawings.
 - .1 Submit a photometric calculation for the typical areas based on the existing conditions.
 - .2 Submit a photometric calculation for the same typical areas based on the proposed new fixtures.
 - .3 Clearly indicate mounting heights, heights of calculation zones, light loss factors and surface reflectance values.
 - .4 Use the follow photometric parameters:
 - .1 Recoverable Light Loss Factors: 0.8

- .2 Ceiling reflectance values of 80 per cent.
- .3 Wall reflectance value of 50 per cent.
- .4 Floor reflectance value of 20 per cent.
- .3 Submittals shall be in PDF format, and the native file of the software used to make the photometric analysis.
- .4 Submit IES photometric data files for the existing and proposed luminaires.

1.05 CLOSEOUT SUBMITTALS

- .1 Section 01 33 00 and Section 01 78 00: Submittals for project closeout.
- .2 Submit manufacturer's operation and maintenance instructions for each product.
- .3 Provide a list of all lamp types used on the project, use ANSI and manufacturer's codes.

1.06 DEFINITIONS

- .1 BF: Ballast factor.
- .2 CCT: Correlated colour temperature.
- .3 CRI: Colour-rendering index.
- .4 HID: High-intensity discharge.
- .5 LER: Luminaire efficacy rating.
- .6 LED: Light Emitting Diode.
- .7 Lumen: Measured output of lamp and luminaire, or both.
- .8 Luminaire: Complete lighting fixture, including ballast housing if provided.

1.07 QUALIFICATIONS

- .1 Manufacturer: Company specializing in manufacturing the products specified in this section with minimum five years documented experience.

1.08 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00.
- .2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
- .3 Disposal and recycling of fluorescent lamps as per local regulations.

1.09 MAINTENANCE MATERIAL SUBMITTALS

- .1 Refer to Section 01 78 00.
- .2 Extra Stock Materials:
 - .1 Provide an additional 2 per cent spare luminaires of each new type to be provided.
- .3 Spare Parts:
 - .1 Provide 1 per cent of each plastic lens type.

- .2 Provide 2 per cent replacement lamps for each lamp type.
- .3 Provide 1 per cent of each ballast type.
- .4 Tools: Provide three of each type of any special tools required for system use and maintenance.

1.10 WARRANTY

- .1 Refer to Section 01 78 00 and Section 26 05 00.
- .2 LED Luminaires shall have a manufacturer's warranty for a period of not less than five years.

2 Products

2.01 LUMINAIRES

- .1 In accordance with related sections.

2.02 REGULATORY REQUIREMENTS

- .1 Products shall be listed and classified by CSA (Canadian Standards Association), ULC (Underwriter's Laboratories of Canada), or certified by recognized independent testing organizations that test to CSA standards.
- .2 All equipment and parts specified herein shall bear the "ULC Approved" label (or other NRTL label) indicating compliance with UL requirements or as otherwise allowed by the Authority Having Jurisdiction. All luminaires shall be ULC/ NRTL or CSA listed and labeled for installation in fireproof or non-fireproof construction, dry, damp, or wet locations as required.

2.03 LUMINAIRE DISCONNECT PLUGS

- .1 Shall be installed on all 120 V and 347 V luminaires before the ballast or LED driver inputs.
- .2 Shall be a bright colour to aid in identification as a safety device.
- .3 600V rated.
- .4 Types and application:
 - .1 3-wire disconnect plug to be used for all 3-wire ballasts, such as dimming ballasts using three-wire phase control.
 - .2 2-wire disconnect plug to be used on all other luminaires.
- .5 Code requirements:
 - .1 Listed to UL 2459.
 - .2 Listed to CSA 182.3.
- .6 Example Manufacturers:
 - .1 Thomas and Betts Marrette Series Luminaire Disconnect
 - .2 Ideal Industries Inc. PowerPlug Series Luminaire Disconnect

3 Execution

3.01 INSTALLATION

- .1 Install lighting equipment, including but not limited to luminaires, controls, auxiliary devices and the integration of same in strict conformance with all manufacturers' recommendations and instructions the securing of which shall be the responsibility of the Contractor.
- .2 Luminaires shall be integrated with controls in accordance with respective luminaire manufacturers' and controls manufacturers' recommendations and instructions and to provide a complete, trouble-free operation without compromising safety, code and UL/CSA/NOM requirements.
- .3 Contractor shall be responsible for sealing all outdoor luminaires for wet locations (i.e. all knock-outs, all pipe and wire entrances, etc.) as is standard industry practice to prevent water from entering luminaires.
- .4 The Contractor shall coordinate the lighting system installation with the relevant trades so as to eliminate interferences with hangers, mechanical ducts, sprinklers, pipes, steel, etc.
- .5 For installation in suspended ceilings, ensure that the luminaires are supported such that there is no resultant bowing or deflection of the ceiling system greater than 1/360 of the length of the total span of the ceiling member.
- .6 Mounting heights and configuration of the luminaires shall be as specified in the Luminaire Schedule portion of the Specification or indicated on the drawings, and where conflicts exist, as approved by the Consultant.
- .7 All luminaires shall be installed plumb and true and level as viewed from all directions unless specifically identified otherwise in the Luminaire Schedule. Luminaires shall remain plumb and true without continual adjustment or visibly obvious means beyond what is shown on luminaire submittal drawings.
- .8 Suspended luminaires shall be installed plumb and true and level unless specifically identified otherwise in the Luminaire Schedule portion of this Specification and at a height from finished floor as specified on the drawings, details and Luminaire Schedule. In cases where this is impractical, refer to the Consultant for a decision. All appurtenances shall be consistently organized for a neat, uniform appearance.
- .9 Luminaire finishes which are disturbed in any way during construction shall be touched up or refinished in a manner satisfactory to the Consultant.
- .10 Reflector cones, louvers, baffles, lenses, trims and other decorative elements shall be installed after completion of ceiling tile installation, plastering, painting and general cleanup.
- .11 Whenever a luminaire or its hanger canopy is installed directly to a surface mounted junction box, a finishing ring painted to match the ceiling, shall be used to conceal the junction box.
- .12 All lamps shall be seasoned for a minimum of 12 hours and a maximum of 100 hours in full-on mode without dimming. All lamps used for convenience lighting during construction shall be replaced with identical new lamps, which shall then be seasoned as described above, immediately prior to the date of substantial completion as determined by the Consultant.
- .13 All accessories shall be properly installed and adjusted by Contractor in accordance with specification and installation instructions. Any spare items shall be clearly labeled (indicate type of accessory and associated luminaire types).
- .14 Locate and install luminaires as indicated.
- .15 Provide adequate support to suit ceiling system.
- .16 For fluorescent lighting, provide instant start ballasts for all areas with no occupancy sensors and program rapid start in areas with occupancy sensors.

- .17 Install suspended luminaires and exit signs using pendants supported from swivel hangers. Provide pendant length required to suspend luminaire at indicated height.
- .18 Install recessed luminaires using accessories and firestopping materials to meet regulatory requirements for fire rating.
- .19 Install clips to secure recessed grid-supported luminaires in place.
- .20 Install wall mounted luminaires at height as indicated.
- .21 Install accessories provided with each luminaire.
- .22 Install specified lamps in luminaire.
- .23 Clean and re-lamp existing luminaires to be reused.
- .24 Check lighting luminaires and mountings for their electrical and physical characteristics in relation to conditions due to building construction and mechanical equipment. Make necessary adjustments to luminaires or hanging arrangement without expense to Owners. Give notification at time of shop drawings and before construction if decision on necessary changes is required.
- .25 Do not mount luminaires above pipes, ducts or equipment. In event of unavoidably tight locations, provide hangers to clear obstruction. Check layouts of other trades on job and plan co-operatively. Luminaires in any room shall hang at one height. Obtain approval before any changes are made to layouts shown.

3.02 TESTING AND ADJUSTMENT

- .1 As required, all adjustable luminaires shall be aimed, focused, locked, etc., by the Contractor under the observation of the Consultant. As aiming and adjusting is completed, locking setscrews and bolts and nuts shall be tightened securely by the Contractor.
- .2 All ladders, scaffolds, lifts, etc. required for aiming and adjusting luminaires shall be furnished by the Contractor.
- .3 The Contractor shall be responsible for notifying the Consultant of appropriate time for staking any outdoor luminaire locations which are called out as "to be field located" on drawings and Luminaire Schedule, and shall supply equipment and personnel for staking at the direction of the Consultant.
- .4 Where possible, units shall be focused during the normal working day. However, where daylight interferes with seeing lighting effects, aiming shall be accomplished at night.

3.03 WIRING

- .1 Install luminaire disconnect plugs on all new luminaires not provided as such from the manufacturer.
- .2 Connect luminaires to branch circuit outlets provided under Section 26 05 33.13 using flexible conduit.
- .3 Make wiring connections to branch circuit using building wire with insulation suitable for temperature conditions within luminaire.
- .4 Bond products and metal accessories to branch circuit equipment grounding conductor.

3.04 LUMINAIRE SUPPORTS

- .1 Support luminaires independently of ceiling framing, unless ceiling is certified by the manufacturer to support weight of installed devices. Confirm if T-bar ceilings are metric or imperial and provide luminaires to suit ceiling dimensions.
- .2 Provide chain hangers for new and existing luminaires.

3.05 LUMINAIRE ALIGNMENT

- .1 Locate recessed ceiling luminaires as indicated on reflected ceiling plan. Recessed luminaires shall be installed to permit removal from below. Include accessories and materials to meet applicable codes and regulatory requirements.
- .2 Align luminaires mounted in continuous rows to form straight uninterrupted line.
- .3 Align luminaires mounted individually parallel or perpendicular to building grid lines.
- .4 Install surface mounted luminaires plumb and adjust to align with building lines and with each other. Secure to prevent movement.

3.06 FIELD QUALITY CONTROL

- .1 Operate each luminaire after installation and connection. Inspect for proper connection and operation.
- .2 Wiring connections to the branch circuit shall be made using building wire with insulation suitable for temperature conditions within luminaire.
- .3 Fixtures supported by suspended ceiling systems shall be securely fastened to the ceiling framing member by mechanical means, such as bolts, screws, or rivets. Ceiling framing members must be securely attached to each other and to the building structure as required by all applicable codes and standards. Use of integral clips is not acceptable.
- .4 Occupancy Sensors
 - .1 Locate and aim sensors in the correct location required for complete and proper volumetric coverage within the range of coverage(s) of controlled areas.
 - .2 Rooms shall have 90 per cent to 100 per cent coverage to completely cover the controlled area to accommodate all occupancy habits of single or multiple occupants at any location within the room(s).
 - .3 Exercise proper judgment in executing the work to ensure the best possible installation in the available space and to overcome local difficulties due to space limitations or interference of structural components.

3.07 CLEANING

- .1 All luminaires and accessories shall be thoroughly cleaned after being installed. All fingerprints, dirt, tar, smudges, drywall mud and dust, etc. shall be removed by the Contractor from the luminaire bodies, reflectors, trims, and lens or louvers prior to final acceptance. All reflectors shall be free of paint other than factory-applied, if any. All reflectors, cones and lenses shall be cleaned only according to manufacturers' instructions.
- .2 Clean electrical parts to remove conductive and deleterious materials.
- .3 Remove dirt and debris from enclosures.
- .4 Clean photometric control surfaces as recommended by manufacturer.
- .5 Clean finishes and touch up damage.

3.08 PROTECTION OF FINISHED WORK

- .1 Re-lamp luminaires that have failed lamps.
- .2 Re-lamp luminaires used for temporary lighting at Substantial Completion.

3.09 COMMISSIONING

- .1 Measure samples of each new luminaire type to be replaced as described in PART 1 of this section for demonstration of energy savings.
- .2 Sensor placement and orientation for all sensor types.
- .3 Occupancy sensor function, sensitivity, and time delays.
- .4 Daylight harvesting sensor calibration.
- .5 Automated shade operation.
- .6 Manual control placement and operation.
- .7 Automated control operation, including scheduled on/off functions and dimming trims and presets.
- .8 Override operation, access, and functionality.
- .9 Centralized control interfaces and operation.
- .10 Client education of operations.
- .11 Documentation archived to client.

End of Section

1 General

1.01 SECTION INCLUDES

- .1 Common execution requirements for interior luminaires specified in related sections.

1.02 RELATED REQUIREMENTS

- .1 Section 26 08 50 – Commissioning of Lighting.
- .2 Section 26 09 23 – Lighting Control Devices.
- .3 Section 26 50 00 – Lighting.
- .4 Section 26 51 16 – Fluorescent Interior Lighting.
- .5 Section 26 51 19 – LED Interior Lighting.
- .6 Section 26 51 19.16 – LED Retrofit Lamps.

2 Products

2.01 LUMINAIRES - GENERAL

- .1 Sheet Metal:
 - .1 Shall be formed to prevent warping and sagging. Housing, trim and lens frame shall be true, straight (unless intentionally curved), and parallel to each other as designed.
 - .2 Sheet steel housings to be minimum 20 gauge.
 - .3 Wireways and fittings shall be free of burrs and sharp edges, and shall accommodate internal and branch circuit wiring without damage to the wiring.
 - .4 When installed, any exposed fixture housing surface, trim frame, door frame, and lens frame shall be free of light leaks.
 - .5 Hinged door frames shall operate smoothly without binding. Latches shall function easily by finger action without the use of tools.
- .2 Ballasts, drivers, and lamps shall be serviceable while the fixture is in its normally installed position. Ballasts shall not be mounted to removable reflectors or wireway covers unless so specified.
- .3 Recessed fixtures mounted in an insulated ceiling shall be listed for use in insulated ceilings.
- .4 Mechanical Safety: Lighting fixture closures (lens doors, trim frame, hinged housings, etc.) shall be retained in a secure manner by captive screws, chains, aircraft cable, captive hinges, or fasteners such that they cannot be accidentally dislodged during normal operation or routine maintenance.
- .5 Metal Finishes:
 - .1 The manufacturer shall apply standard finish (unless otherwise specified) over a corrosion-resistant primer, after cleaning to free the metal surfaces of rust, grease, dirt and other deposits. Edges of pre-finished sheet metal exposed during forming, stamping or shearing processes shall be finished in a similar corrosion resistant manner to match the adjacent surface(s). Fixture finish shall be free of stains or evidence of rusting, blistering, or flaking, and shall be applied after fabrication.

- .2 Interior light reflecting finishes shall be white with not less than 85 per cent reflectance, except where otherwise shown on the drawing.
- .3 Exterior finishes shall be as shown on the drawings.
- .6 Lighting fixtures shall have a specific means for grounding metallic wireways and housings to an equipment grounding conductor.

3 Execution

3.01 INSTALLATION

- .1 Install lighting equipment, including but not limited to luminaires, controls, auxiliary devices and the integration of same in strict conformance with all manufacturers' recommendations and instructions the securing of which shall be the responsibility of the Contractor.
- .2 Luminaires shall be integrated with controls in accordance with respective luminaire manufacturers' and controls manufacturers' recommendations and instructions and to provide a complete, trouble-free operation without compromising safety, code and UL/CSA/NOM requirements.
- .3 Contractor shall be responsible for sealing all outdoor luminaires for wet locations (i.e. all knock-outs, all pipe and wire entrances, etc.) as is standard industry practice to prevent water from entering luminaires.
- .4 The Contractor shall coordinate the lighting system installation with the relevant trades so as to eliminate interferences with hangers, mechanical ducts, sprinklers, pipes, steel, etc.
- .5 For installation in suspended ceilings, ensure that the luminaires are supported such that there is no resultant bowing or deflection of the ceiling system greater than 1/360 of the length of the total span of the ceiling member.
- .6 Mounting heights and configuration of the luminaires shall be as specified in the Luminaire Schedule portion of the Specification or indicated on the drawings, and where conflicts exist, as approved by the Consultant.
- .7 All luminaires shall be installed plumb and true and level as viewed from all directions unless specifically identified otherwise in the Lighting Fixture Schedule. Luminaires shall remain plumb and true without continual adjustment or visibly obvious means beyond what is shown on luminaire submittal drawings.
- .8 Suspended luminaires shall be installed plumb and true and level unless specifically identified otherwise in the Luminaire Schedule portion of this Specification and at a height from finished floor as specified on the drawings, details and Luminaire Schedule. In cases where this is impractical, refer to the Consultant for a decision. All appurtenances shall be consistently organized for a neat, uniform appearance.
- .9 Luminaire finishes which are disturbed in any way during construction shall be touched up or refinished in a manner satisfactory to the Consultant.
- .10 Reflector cones, louvers, baffles, lenses, trims and other decorative elements shall be installed after completion of ceiling tile installation, plastering, painting and general cleanup.
- .11 Whenever a luminaire or its hanger canopy is installed directly to a surface mounted junction box, a finishing ring painted to match the ceiling, shall be used to conceal the junction box.
- .12 All lamps shall be seasoned for a minimum of 12 hours and a maximum of 100 hours in full-on mode without dimming. All lamps used for convenience lighting during construction shall be replaced with identical new lamps, which shall then be seasoned as described above, immediately prior to the date of substantial completion as determined by the Consultant.

- .13 All accessories shall be properly installed and adjusted by Contractor in accordance with specification and installation instructions. Any spare items shall be clearly labeled (indicate type of accessory and associated luminaire types).
- .14 Locate and install luminaires as indicated.
- .15 Provide adequate support to suit ceiling system.
- .16 For fluorescent lighting, provide instant start ballasts for all areas with no occupancy sensors and program rapid start in areas with occupancy sensors.
- .17 Install suspended luminaires and exit signs using pendants supported from swivel hangers. Provide pendant length required to suspend luminaire at indicated height.
- .18 Install recessed luminaires using accessories and firestopping materials to meet regulatory requirements for fire rating.
- .19 Install clips to secure recessed grid-supported luminaires in place.
- .20 Install wall mounted luminaires at height as indicated.
- .21 Install accessories provided with each luminaire.
- .22 Install specified lamps in luminaire.
- .23 Clean and re-lamp existing luminaires to be reused.

3.02 TESTING AND ADJUSTMENT

- .1 As required, all adjustable luminaires shall be aimed, focused, locked, etc., by the Contractor under the observation of the Consultant. As aiming and adjusting is completed, locking setscrews and bolts and nuts shall be tightened securely by the Contractor.
- .2 All ladders, scaffolds, lifts, etc. required for aiming and adjusting luminaires shall be furnished by the Contractor.
- .3 The Contractor shall be responsible for notifying the Consultant of appropriate time for staking any outdoor luminaire locations which are called out as "to be field located" on drawings and Luminaire Schedule, and shall supply equipment and personnel for staking at the direction of the Consultant.
- .4 Where possible, units shall be focused during the normal working day. However, where daylight interferes with seeing lighting effects, aiming shall be accomplished at night.

3.03 WIRING

- .1 Install luminaire disconnect plugs on all new luminaires not provided as such from the manufacturer.
- .2 Connect luminaires to branch circuit outlets provided under Section 26 05 33.13 using flexible conduit.
- .3 Make wiring connections to branch circuit using building wire with insulation suitable for temperature conditions within luminaire.
- .4 Bond products and metal accessories to branch circuit equipment grounding conductor.

3.04 LUMINAIRE SUPPORTS

- .1 Support luminaires independently of ceiling framing, unless ceiling is certified by the manufacturer to support weight of installed devices. Confirm if T-bar ceilings are metric or imperial and provide luminaires to suit ceiling dimensions.

- .2 Provide chain hangers for new and existing luminaires.

3.05 LUMINAIRE ALIGNMENT

- .1 Locate recessed ceiling luminaires as indicated on reflected ceiling plan. Recessed luminaires shall be installed to permit removal from below. Include accessories and materials to meet applicable codes and regulatory requirements.
- .2 Align luminaires mounted in continuous rows to form straight uninterrupted line.
- .3 Align luminaires mounted individually parallel or perpendicular to building grid lines.
- .4 Install surface mounted luminaires plumb and adjust to align with building lines and with each other. Secure to prevent movement.

3.06 FIELD QUALITY CONTROL

- .1 Operate each luminaire after installation and connection. Inspect for proper connection and operation.
- .2 Wiring connections to the branch circuit shall be made using building wire with insulation suitable for temperature conditions within luminaire.
- .3 Fixtures supported by suspended ceiling systems shall be securely fastened to the ceiling framing member by mechanical means, such as bolts, screws, or rivets. Ceiling framing members must be securely attached to each other and to the building structure as required by all applicable codes and standards. Use of integral clips is not acceptable.
- .4 Occupancy Sensors
 - .1 Locate and aim sensors in the correct location required for complete and proper volumetric coverage within the range of coverage(s) of controlled areas.
 - .2 Rooms shall have 90 per cent to 100 per cent coverage to completely cover the controlled area to accommodate all occupancy habits of single or multiple occupants at any location within the room(s).
 - .3 Exercise proper judgment in executing the work to ensure the best possible installation in the available space and to overcome local difficulties due to space limitations or interference of structural components.

3.07 CLEANING

- .1 All luminaires and accessories shall be thoroughly cleaned after being installed. All fingerprints, dirt, tar, smudges, drywall mud and dust, etc. shall be removed by the Contractor from the luminaire bodies, reflectors, trims, and lens or louvers prior to final acceptance. All reflectors shall be free of paint other than factory-applied, if any. All reflectors, cones and lenses shall be cleaned only according to manufacturers' instructions.
- .2 Clean electrical parts to remove conductive and deleterious materials.
- .3 Remove dirt and debris from enclosures.
- .4 Clean photometric control surfaces as recommended by manufacturer.
- .5 Clean finishes and touch up damage.

3.08 PROTECTION OF FINISHED WORK

- .1 Re-lamp luminaires that have failed lamps.

.2 Re-lamp luminaires used for temporary lighting at Substantial Completion.

3.09 COMMISSIONING

.1 In accordance with Section 26 08 50.

End of Section

1 General

1.01 SECTION INCLUDES

- .1 Solid state, light emitting diode (LED) source interior luminaires.
- .2 New, fully integrated luminaires for indoor applications.

1.02 RELATED REQUIREMENTS

- .1 Section 26 09 23 – Lighting Control Devices.
- .2 Section 26 52 13.13 – Emergency Lighting.

1.03 REFERENCES

- .1 Canadian Standards Association (CSA)
 - .1 CSA C22.1-18, Canadian Electrical Code, Part 1 (24th Edition), Safety Standard for Electrical Installations.
 - .2 Ontario Electrical Safety Code (27th edition/2018).
 - .3 CSA C22.2 No. 250.0 - Luminaires (Bi-National Standard, with UL 1598).
- .2 DesignLights Consortium (DLC).
 - .1 Technical Requirements Table v4.4, or latest edition.
 - .2 Where the specifications do not explicitly call for DLC qualified LED luminaires, the technical criteria provided in the DLC Technical Requirements provide the basis of the requirements for this section of the Specification.
- .3 Energy Star
 - .1 Program Requirements for Luminaires - Eligibility Criteria, Version 1.2, or latest edition.
- .4 Illuminating Engineering Society (IES)
 - .1 IES HB-10-11 – The Lighting Handbook, 10th Edition.
 - .2 IES LM-79-08 – Approved Method: Electrical and Photometric Measurements of Solid-State Lighting Products.
 - .3 IES LM-80-08 – IES Approved Method for Measuring Lumen Maintenance of LED Light Sources.
 - .4 IES TM-21-11 – IES Technical Memorandum on Projecting Long Term Lumen Maintenance of LED Light Sources.
- .5 National Electrical Manufacturer's Association (NEMA)
 - .1 SSL-1-10 – Electronic Drivers for LED Devices, Arrays, or Systems.
 - .2 WD 6 - Wiring Devices - Dimensional Requirements.

1.04 DEFINITIONS

- .1 CCT: Correlated colour temperature.
- .2 CRI: Colour-rendering index.

- .3 LED: Light Emitting Diode.
- .4 Lumen: Measured output of lamp and luminaire, or both.
- .5 Luminaire: Complete lighting fixture, including ballast housing if provided.

1.05 ACTION SUBMITTALS

- .1 Refer to Section 01 33 00.
- .2 Product submittals shall be accompanied by product specification sheets or other documentation that includes the designed parameters as detailed in this specification. These parameters include (but not limited to):
 - .1 Maximum power in Watts.
 - .1 If a transformer is used in conjunction with a driver (for example on some 347 volt lighting circuits), the maximum power shall include the transformer losses.
 - .2 L70 in hours, when extrapolated for the worse case operating temperature. TM-21 report shall be submitted to demonstrate this.
 - .3 Product submittals shall be accompanied by performance data that is derived in accordance with appropriate IESNA testing standards and tested in a laboratory that is NVLAP accredited for Energy Efficient Lighting Products.

1.06 INFORMATIONAL SUBMITTALS

- .1 Installation instructions.

1.07 CLOSEOUT SUBMITTALS

- .1 Section 01 78 00: Submittals for project closeout.
- .2 Submit manufacturer's operation and maintenance instructions for each product.
- .3 Warranty information.

1.08 QUALIFICATIONS

- .1 Manufacturer: Company specializing in manufacturing the products specified in this section with minimum five years documented experience.

1.09 REGULATORY REQUIREMENTS

- .1 Products shall be listed and classified by CSA (Canadian Standards Association), ULC (Underwriter's Laboratories of Canada), or certified by recognized independent testing organizations that test to CSA standards.
- .2 Products shall be certified by a recognized testing agency accredited by the Standards Council of Canada and bear a certification mark from that agency.
- .3 All luminaires shall be listed and labeled for installation in fireproof or non-fireproof construction, dry, damp, or wet locations as required.
- .4 Recessed fixtures mounted in an insulated ceiling shall be listed for use in insulated ceilings.

1.10 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00.

- .2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.

1.11 EXTRA STOCK MATERIALS

- .1 Refer to Section 01 78 00.
- .2 Provide the following additional equipment as listed herein.
 - .1 Provide an additional 2 per cent spare luminaires of each new type to be provided.
 - .2 Provide 1 per cent of each plastic lens type.
 - .3 Provide three of each type of any special tools required for system use and maintenance.

1.12 WARRANTY

- .1 Refer to Section 01 78 00 and Section 26 05 00.
- .2 The manufacturer shall provide a warranty against loss of performance and defects in materials and workmanship for the luminaires for a period of 5 years after acceptance of the luminaires. Warranty shall cover all components comprising the luminaire.
- .3 All warranty documentation shall be provided to customer prior to the first shipment.
- .4 LED Luminaires shall have a manufacturer's warranty for a period of not less than five years.
- .5 LED boards, drivers and associated components shall have a warranty of 5 years on the LEDs, 5 years on the driver, 10 years on the paint finish.

2 Products

2.01 MANUFACTURERS

- .1 [As noted on Lighting Fixture Schedule.]
- .2 Approved equal.

2.02 INDOOR LED LUMINAIRES, GENERAL

- .1 Initial delivered lumens – thermal losses should be less than 10 per cent when operated at a steady state at an average ambient operating temperature of 25 degrees C, and optical losses should be less than 15 per cent.
- .2 Average Delivered Lumens – Average delivered lumens over 50 000 hours should be minimum of 85 per cent of initial delivered lumens.
- .3 All luminaires shall be tested per LM79/80 and published L70 data.
- .4 Available in 3500 K correlated colour temperature, CRI greater than or equal to 80, or as indicated.
- .5 Accessibility and Maintenance:
 - .1 All LED luminaires shall be field serviceable, with LED arrays, LED modules, drivers, etc. fully serviceable and easily accessible. In the case of recessed ceiling mounted, and in the case of surface mounted ceiling fixtures, these components must be accessible from below. Luminaires in which any of these components are accessible only from above are not acceptable.
 - .2 Ballasts, drivers, LED arrays, LED modules, and lamps shall be serviceable while the fixture is in its normally installed position. Ballasts or drivers shall not be mounted to removable reflectors or

wireway covers unless so specified. In the case of ceiling mounted luminaires, the serviceable components must be accessible from below.

- .6 Housings:
 - .1 Formed to prevent warping and sagging. Housing, trim and lens frame shall be true, straight (unless intentionally curved), and parallel to each other as designed.
 - .2 Sheet steel housings to be minimum 20 gauge.
 - .3 Wireways and fittings: free of burrs and sharp edges, and shall accommodate internal and branch circuit wiring without damage to the wiring.
 - .4 When installed, any exposed fixture housing surface, trim frame, door frame, and lens frame shall be free of light leaks.
 - .5 Hinged door frames shall operate smoothly without binding. Latches shall function easily by finger action without the use of tools.
 - .6 Drivers shall not be mounted to removable reflectors or wireway covers unless so specified.
- .7 Mechanical Safety: Lighting fixture closures (lens doors, trim frame, hinged housings, etc.) shall be retained in a secure manner by captive screws, chains, aircraft cable, captive hinges, or fasteners such that they cannot be accidentally dislodged during normal operation or routine maintenance.
- .8 Metal Finishes:
 - .1 Fixture finish and construction to meet ULC listings and CSA certifications related to intended installation.
 - .2 All metal components of fixtures shall be painted after fabrication to mitigate raw metal edges, and thus prevent premature corrosion.
 - .3 The manufacturer shall apply standard finish (unless otherwise specified) over a corrosion-resistant primer, after cleaning to free the metal surfaces of rust, grease, dirt and other deposits. Edges of pre-finished sheet metal exposed during forming, stamping or shearing processes shall be finished in a similar corrosion resistant manner to match the adjacent surface(s). Fixture finish shall be free of stains or evidence of rusting, blistering, or flaking, and shall be applied after fabrication.
 - .4 Interior light reflecting finishes shall be white with not less than 85 per cent reflectance, except where otherwise shown on the drawing.
- .9 Wiring:
 - .1 Lighting fixtures shall have a specific means for grounding metallic wireways and housings to an equipment grounding conductor.
 - .2 Supplied complete with a luminaire disconnect plug.

2.03 DRIVERS, GENERAL

- .1 Electronic LED drivers shall be integral to the luminaire, and be designed to be accessible in the field for replacement and servicing.
- .2 Input Voltage:
 - .1 Driver with a voltage range of (120-277) +/- 10% or (347-480) +/- 10%.
 - .2 Refer to lighting fixture schedule.

- .3 For luminaires connected to a 347 volt circuit and utilizing a natively 120-277 volt driver, provide an appropriately sized step down transformer.
- .3 Input frequency 60 Hz.
- .4 Load regulation: +/- 1 per cent from no load to full load.
- .5 Output ripple less than 10 per cent.
- .6 Output should be isolated.
- .7 Case temperature: rated for -40 degrees C through +80 degrees C.
- .8 Overheat protection, self-limited short circuit protection and overload protected.
- .9 Primary fused.
- .10 Driver life rating not less than 50 000 hours
- .11 Power Factor and Total Harmonic Distortion
 - .1 Power factor of greater than or equal to 0.9 at full load.
 - .2 THD of less than or equal to 20 per cent at full load.
- .12 Dimming Control:
 - .1 Coordinate with Section 26 09 23.
 - .2 0-10 V dimming control typical for all fixtures unless otherwise noted.
 - .3 Control range: 10 per cent to 100 per cent typical, unless noted otherwise.
 - .4 Provide a mock-up to demonstrate the luminaire is free of flicker throughout the dimming range when used with the dimming controllers described in related sections.

2.04 INTERIOR WALL-WASH LED LUMINAIRES

- .1 Minimum Light Output: 575 lm.
- .2 Zonal lumen density:
 - .1 Minimum 60 per cent between 0 degrees and 90 degrees from nadir.
 - .2 Minimum 60 per cent of the lumens must be produced in the “forward” hemisphere, towards the wall.
- .3 Minimum luminaire efficacy: 45 lumens per watt.
- .4 Correlated Colour Temperature (CCT): 3500 K
- .5 Colour Rendition Index (CRI): 80 CRI minimum.
- .6 Minimum L70 lumen maintenance to occur at 50 000 hours in accordance with LM-80 testing data and TM-21 extrapolation.

2.05 TRACK OR MONO-POINT DIRECTIONAL LED LUMINAIRES

- .1 Minimum Light Output: 250 lm.
- .2 Zonal lumen density:

- .1 Minimum 85 per cent between 0 degrees and 90 degrees from nadir.
- .3 Minimum luminaire efficacy: 45 lumens per watt.
- .4 Correlated Colour Temperature (CCT): 3500 K
- .5 Colour Rendition Index (CRI): 80 CRI minimum.
- .6 Minimum L70 lumen maintenance to occur at 50 000 hours in accordance with LM-80 testing data and TM-21 extrapolation.

2.06 DOWNLIGHT LUMINAIRES

- .1 Minimum Light Output: 500 lm.
- .2 Zonal lumen density: Minimum 75 per cent between 0 degrees and 60 degrees from nadir.
- .3 Minimum luminaire efficacy: 45 lumens per watt.
- .4 Correlated Colour Temperature (CCT): 3500 K
- .5 Colour Rendition Index (CRI): 80 CRI minimum.
- .6 Minimum L70 lumen maintenance to occur at 50 000 hours in accordance with LM-80 testing data and TM-21 extrapolation.

2.07 NOMINAL 610 MM BY 610 MM (2 FOOT BY 2 FOOT) LUMINAIRES FOR AMBIENT LIGHTING OF INTERIOR SPACES

- .1 Minimum Light Output: 2 000 lm.
- .2 Zonal lumen density:
 - .1 Minimum 75 per cent between 0 degrees and 60 degrees from nadir.
- .3 Spacing Criteria:
 - .1 0 degrees to 180 degrees: 1.0 to 2.0
 - .2 90 degrees to 270 degrees: 1.0 to 2.0
- .4 Minimum luminaire efficacy: 85 lumens per watt.
- .5 Correlated Colour Temperature (CCT): 3500 K
- .6 Colour Rendition Index (CRI): 80 CRI minimum.
- .7 Minimum L70 lumen maintenance to occur at 50 000 hours in accordance with LM-80 testing data and TM-21 extrapolation.

2.08 NOMINAL 305 MM BY 1220 MM (1 FOOT BY 4 FOOT) LUMINAIRES FOR AMBIENT LIGHTING OF INTERIOR SPACES

- .1 Minimum Light Output: 1 500 lm.
- .2 Zonal lumen density:
 - .1 Minimum 75 per cent between 0 degrees and 60 degrees from nadir.
- .3 Spacing Criteria:

- .1 0 degrees to 180 degrees: 1.0 – 2.0
- .2 90 degrees to 270 degrees: 1.0 – 2.0
- .4 Minimum luminaire efficacy: 85 lumens per watt.
- .5 Correlated Colour Temperature (CCT): 3500 K
- .6 Colour Rendition Index (CRI): 80 CRI minimum.
- .7 Minimum L70 lumen maintenance to occur at 50 000 hours in accordance with LM-80 testing data and TM-21 extrapolation.

2.09 NOMINAL 610 MM BY 1220 MM (2 FOOT BY 4 FOOT) LUMINAIRES FOR AMBIENT LIGHTING OF INTERIOR SPACES

- .1 Minimum Light Output: 3 000 lm.
- .2 Zonal lumen density:
 - .1 Minimum 75 per cent between 0 degrees and 60 degrees from nadir.
- .3 Spacing Criteria:
 - .1 0 degrees to 180 degrees: 1.0 – 2.0
 - .2 90 degrees to 270 degrees: 1.0 – 2.0
- .4 Minimum luminaire efficacy: 85 lumens per watt.
- .5 Correlated Colour Temperature (CCT): 3500 K
- .6 Colour Rendition Index (CRI): 80 CRI minimum.
- .7 Minimum L70 lumen maintenance to occur at 50 000 hours in accordance with LM-80 testing data and TM-21 extrapolation.

2.10 LINEAR AMBIENT LUMINAIRES: INDIRECT

- .1 Minimum Light Output: 500 lm per foot.
- .2 Zonal lumen density:
 - .1 Minimum 50 per cent between 90 degrees and 150 degrees from nadir.
- .3 Minimum luminaire efficacy: 85 lumens per watt.
- .4 Correlated Colour Temperature (CCT): 3500 K
- .5 Colour Rendition Index (CRI): 80 CRI minimum.
- .6 Minimum L70 lumen maintenance to occur at 50 000 hours in accordance with LM-80 testing data and TM-21 extrapolation.

2.11 LINEAR AMBIENT LUMINAIRES: INDIRECT/DIRECT

- .1 Minimum Light Output: 500 lm per foot.
- .2 Zonal lumen density:
 - .1 Minimum 25 per cent between 0 degrees and 60 degrees from nadir.

- .2 Minimum 50 per cent between 90 degrees and 150 degrees from nadir.
- .3 Minimum luminaire efficacy: 85 lumens per watt.
- .4 Correlated Colour Temperature (CCT): 3500 K
- .5 Colour Rendition Index (CRI): 80 CRI minimum.
- .6 Minimum L70 lumen maintenance to occur at 50 000 hours in accordance with LM-80 testing data and TM-21 extrapolation.

2.12 LINEAR AMBIENT LUMINAIRES: DIRECT/INDIRECT

- .1 Minimum Light Output: 500 lm per foot.
- .2 Zonal lumen density:
 - .1 Minimum 40 per cent between 0 degrees and 60 degrees from nadir.
 - .2 Minimum 35 per cent between 90 degrees and 150 degrees from nadir.
- .3 Minimum luminaire efficacy: 85 lumens per watt.
- .4 Correlated Colour Temperature (CCT): 3500 K
- .5 Colour Rendition Index (CRI): 80 CRI minimum.
- .6 Minimum L70 lumen maintenance to occur at 50 000 hours in accordance with LM-80 testing data and TM-21 extrapolation.

2.13 LINEAR AMBIENT LUMINAIRES: DIRECT

- .1 Minimum Light Output: 375 lm per foot.
- .2 Zonal lumen density:
 - .1 Minimum 40 per cent between 0 degrees and 60 degrees from nadir.
- .3 Minimum luminaire efficacy: 85 lumens per watt.
- .4 Correlated Colour Temperature (CCT): 3500 K
- .5 Colour Rendition Index (CRI): 80 CRI minimum.
- .6 Minimum L70 lumen maintenance to occur at 50 000 hours in accordance with LM-80 testing data and TM-21 extrapolation.

2.14 HIGH-BAY LUMINAIRES FOR COMMERCIAL AND INDUSTRIAL BUILDINGS

- .1 Minimum Light Output: 10 000 lm.
- .2 Zonal lumen density:
 - .1 Minimum 30 per cent between 20 degrees and 50 degrees from nadir.
- .3 Minimum luminaire efficacy: 80 lumens per watt.
- .4 Correlated Colour Temperature (CCT): 4000 K
- .5 Colour Rendition Index (CRI): 70 CRI minimum.

- .6 Minimum L70 lumen maintenance to occur at 35 000 hours in accordance with LM-80 testing data and TM-21 extrapolation.

2.15 LOW-BAY LUMINAIRES FOR COMMERCIAL AND INDUSTRIAL BUILDINGS

- .1 Minimum Light Output: 5 000 lm.
- .2 Zonal lumen density:
 - .1 Minimum 30 per cent between 20 degrees and 50 degrees from nadir.
- .3 Minimum luminaire efficacy: 80 lumens per watt.
- .4 Correlated Colour Temperature (CCT): 4000 K
- .5 Colour Rendition Index (CRI): 70 CRI minimum.
- .6 Minimum L70 lumen maintenance to occur at 35 000 hours in accordance with LM-80 testing data and TM-21 extrapolation.

2.16 HIGH-BAY AISLE LUMINAIRES

- .1 Minimum Light Output: 10 000 lm.
- .2 Zonal lumen density:
 - .1 Minimum 30 per cent between 0 degrees and 20 degrees from nadir.
 - .2 Minimum 50 per cent between 20 degrees and 50 degrees from nadir.
- .3 Minimum luminaire efficacy: 80 lumens per watt.
- .4 Correlated Colour Temperature (CCT): 4000 K
- .5 Colour Rendition Index (CRI): 70 CRI minimum.
- .6 Minimum L70 lumen maintenance to occur at 35 000 hours in accordance with LM-80 testing data and TM-21 extrapolation.

3 Execution

3.01 VERIFICATION OF CONDITIONS

- .1 Coordinate the lighting system installation with the relevant trades so as to eliminate interferences with hangers, mechanical ducts, sprinklers, piping, steel, etc.

3.02 INSTALLATION

- .1 Install lighting equipment, including but not limited to luminaires, controls, auxiliary devices and the integration of same in strict conformance with all manufacturers' recommendations and instructions the securing of which shall be the responsibility of the Contractor.
- .2 Integrate luminaires with controls in accordance with respective luminaire manufacturers' and controls manufacturers' recommendations and instructions and to provide a complete, trouble-free operation without compromising safety, code and CSA requirements.
- .3 Seal all luminaires for wet locations (i.e. all knock-outs, all pipe and wire entrances, etc.) as is standard industry practice to prevent water from entering luminaires.

- .4 Luminaire Alignment
 - .1 Locate recessed ceiling luminaires as indicated on reflected ceiling plan. Install recessed luminaires to permit removal from below. Include accessories and materials to meet applicable codes and regulatory requirements.
 - .2 Align luminaires mounted in continuous rows to form straight uninterrupted line.
 - .3 Align luminaires mounted individually parallel or perpendicular to building grid lines.
 - .4 Install surface mounted luminaires plumb and adjust to align with building lines and with each other. Secure to prevent movement.
 - .5 Locate and install luminaires as indicated. Mounting heights and configuration of the luminaires shall be as specified in the Luminaire Schedule portion of the Specification or indicated on the drawings, and where conflicts exist, as approved by the Consultant.
 - .6 Installed all luminaires plumb and true and level as viewed from all directions unless specifically identified otherwise in the Lighting Fixture Schedule. Luminaires shall remain plumb and true without continual adjustment or visibly obvious means beyond what is shown on luminaire submittal drawings.
 - .7 For installation in suspended ceilings, ensure that the luminaires are supported such that there is no resultant bowing or deflection of the ceiling system greater than 1/360 of the length of the total span of the ceiling member.
- .5 Install recessed luminaires using accessories and firestopping materials to meet regulatory requirements for fire rating.
- .6 Whenever a luminaire or its hanger canopy is installed directly to a surface mounted junction box, use a finishing ring painted to match the ceiling to conceal the junction box.
- .7 Suspended Luminaires:
 - .1 Install suspended luminaires and exit signs using pendants supported from swivel hangers. Provide pendant length required to suspend luminaire at indicated height.
 - .2 Suspended luminaires shall be installed plumb and true and level unless specifically identified otherwise in the Luminaire Schedule portion of this Specification and at a height from finished floor as specified on the drawings, details and Luminaire Schedule. In cases where this is impractical, refer to the Consultant for a decision. All appurtenances shall be consistently organized for a neat, uniform appearance.
- .8 Install wall mounted luminaires at height as indicated.
- .9 Accessories:
 - .1 Reflector cones, louvers, baffles, lenses, trims and other decorative elements shall be installed after completion of ceiling tile installation, plastering, painting and general cleanup.
 - .2 Install accessories provided with each luminaire.
 - .3 All accessories shall be properly installed and adjusted by Contractor in accordance with specification and installation instructions. Any spare items shall be clearly labeled (indicate type of accessory and associated luminaire types).

3.03 TESTING AND ADJUSTMENT

- .1 As required, all adjustable luminaires shall be aimed, focused, locked, etc., by the Contractor under the observation of the Consultant. As aiming and adjusting is completed, locking setscrews and bolts and nuts shall be tightened securely by the Contractor.
- .2 All ladders, scaffolds, lifts, etc. required for aiming and adjusting luminaires shall be furnished by the Contractor.
- .3 Where possible, units shall be focused during the normal working day. However, where daylight interferes with seeing lighting effects, aiming shall be accomplished at night.

3.04 LUMINAIRE SUPPORTS

- .1 Provide adequate support to suit ceiling system.
- .2 Support luminaires independently of ceiling framing, unless ceiling is certified by the manufacturer to support weight of installed devices. Confirm if T-bar ceilings are metric or imperial and provide luminaires to suit ceiling dimensions.
- .3 Provide chain hangers for new and existing luminaires.
- .4 Install clips to secure recessed grid-supported luminaires in place.
- .5 Fixtures supported by suspended ceiling systems shall be securely fastened to the ceiling framing member by mechanical means, such as bolts, screws, or rivets. Ceiling framing members must be securely attached to each other and to the building structure as required by all applicable codes and standards. Use of integral clips is not acceptable.

3.05 WIRING

- .1 Use SPC90 conductors for final connections to luminaires (including 0-10 V dimming conductors for applicable luminaires).
- .2 Install luminaire disconnect plugs on all new luminaires not provided as such from the manufacturer.
- .3 Connect luminaires to branch circuit outlets provided under Section 26 05 33.13 using flexible conduit.
- .4 Make wiring connections to branch circuit using building wire with insulation suitable for temperature conditions within luminaire.
- .5 Bond products and metal accessories to branch circuit equipment grounding conductor.

3.06 FIELD QUALITY CONTROL

- .1 Operate each luminaire after installation and connection. Inspect for proper connection and operation.
- .2 Make wiring connections to the branch circuit using building wire with insulation suitable for temperature conditions within luminaire.
- .3 Occupancy Sensors.
 - .1 Locate and aim sensors in the correct location required for complete and proper volumetric coverage within the range of coverage(s) of controlled areas.
 - .2 Rooms shall have 90 per cent to 100 per cent coverage to completely cover the controlled area to accommodate all occupancy habits of single or multiple occupants at any location within the room.

- .3 Exercise proper judgment in executing the work to ensure the best possible installation in the available space and to overcome local difficulties due to space limitations or interference of structural components.

3.07 CLEANING

- .1 Thoroughly clean all luminaires and accessories after installation. All fingerprints, dirt, tar, smudges, drywall mud, dust, etc. shall be removed by the Contractor from the luminaire bodies, reflectors, trims, and lens or louvers prior to final acceptance. All reflectors shall be free of paint other than factory-applied, if any. All reflectors, cones and lenses shall be cleaned only according to manufacturers' instructions.
- .2 Clean electrical parts to remove conductive and deleterious materials.
- .3 Remove dirt and debris from enclosures.
- .4 Clean photometric control surfaces as recommended by manufacturer.
- .5 Clean finishes and touch up damage.
- .6 Luminaire finishes which are disturbed in any way during construction shall be touched up or refinished in a manner satisfactory to the Consultant.

3.08 COMMISSIONING

- .1 In accordance with Section 26 08 50.

End of Section

1 General

1.01 SECTION INCLUDES

- .1 Emergency lighting units with battery back-up for emergency illumination of remote emergency fixtures and internally illuminated exit signs.
- .2 Remote emergency fixtures.

1.02 RELATED REQUIREMENTS

- .1 Section 26 51 19 – LED Interior Lighting.
- .2 Section 26 52 13.16 – Exit Signs.

1.03 REFERENCES

- .1 CSA Group:
 - .1 CSA C22.2 No. 141-15 (R2020), Emergency lighting equipment.
 - .2 CSA C22.1-18, Canadian Electrical Code, Part 1 (24th Edition), Safety Standard for Electrical Installations.
 - .3 Ontario Electrical Safety Code (27th edition/2018).
- .2 Ontario Building Code.
- .3 National Building Code of Canada.
- .4 Underwriters Laboratories, Inc. (UL):
 - .1 UL 924 – Standard for Safety of Emergency Lighting and Power Equipment.

1.04 SUBMITTALS

- .1 Submit in accordance with Section 01 33 00.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for emergency lighting and include product characteristics, performance criteria, physical size, finish and limitations.

1.05 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00.
- .2 Operation and Maintenance Data: submit operation and maintenance data for emergency lighting for incorporation into manual.

1.06 EXTRA MATERIALS

- .1 Allow the cost for material and for installation of the following to be installed as directed by the Consultant during construction:
 - .1 An additional [five] single head emergency remote units.
 - .2 An additional [five] dual head emergency remote units.

- .3 An additional [one] battery unit, based on the maximum battery capacity as specified.

1.07 QUALITY ASSURANCE

- .1 Manufacturer Qualifications: Products shall be free of defects in material and workmanship.
- .2 Furnished products are listed and/or certified by third party agencies as suitable for the intended purpose.
- .3 All units will be certified that they have been tested prior to shipping.

1.08 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver, store, and handle materials in accordance with Section 01 61 00 and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect emergency lighting from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.
- .4 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding and packaging materials as specified in Construction Waste Management Plan in accordance with Section 01 74 19.

1.09 WARRANTY

- .1 Product is warranted free of defects in material and workmanship.
- .2 Product is warranted to perform the intended function within design limits.
- .3 For batteries in this Section, 12 month warranty period is extended to 24 months.

2 Products

2.01 EMERGENCY BATTERY UNITS

- .1 Manufacturers:
 - .1 Lumacell RG12S series.
 - .2 Aimlite.
 - .3 Emergi-Lite.
 - .4 Stanpro.
 - .5 Beghelli.
- .2 Battery Unit Features:
 - .1 Self-contained unit equipment for LED emergency lighting shall be manufactured and labeled as certified to meet CSA C22.2 No 141.

- .2 Housing: Constructed of formed and welded 18 gauge cold rolled steel with knockouts for conduit, finished in baked white enamel. Cabinet suitable for direct or shelf mounting to wall. Removable or hinged front panel for easy access to batteries.
- .3 Charger:
 - .1 Solid-state micro-controller PCB, Pulse-Guard charger, features include; auto-equalized, temperature compensated, current limited, short circuit and reverse polarity protected.
 - .2 Recharges battery within 24 hours in accordance with CSA requirements.
- .4 Transfer: Upon failure of the power supply, or voltage dip below 75 per cent of nominal, a sealed relay automatically and instantaneously connects the battery to the emergency lighting load and disconnects when battery discharge reaches 87.5 per cent expectancy.
- .5 Batteries: seal lead calcium, maintenance free, and 10 year pro-rated service life.
- .6 Auto-test: Unit to perform self-test for 1 minute ever 30 days, 10 minutes on the 6th month and 30 minutes ever 12 months.
- .3 Battery Electrical Features:
 - .1 Input Voltage: 120-347 VAC universal input:
 - .1 Provided with plug and receptacle when connected to 120 volt source panelboard.
 - .2 direct connected to 347 volt source panelboard.
 - .2 Output Voltage: 12 VDC; balance loads to battery unit terminals.
 - .1 Normally "Off" output: wattage capacity as indicated for emergency remotes and internally illuminated exit signs.
 - .2 Battery Run Time at full load: must meet OBC minimum, [30] [60] [120] minutes.
 - .3 Voltage regulation: ± 5 per cent of nominal maximum.
 - .3 Signal lights: solid state, for 'AC Power ON' and 'High Charge'.
- .4 Lamp heads:
 - .1 Integral on unit, 345 degrees horizontal and 180 degrees vertical adjustment.
 - .2 Lamp type:
 - .1 Two 12 V, 6 W MR16 LED lamps mounted on top of the battery cabinet, shall be injection molded thermoplastic, white finish.
 - .2 Average lamp lumens: 170 lm.
 - .3 Centre Beam Candlepower: 440 cd.
 - .4 Beam angle: 30 degrees.
 - .5 Lamp efficacy: 42.5 lm/W.
- .5 Auxiliary equipment:
 - .1 Ammeter.

- .2 Voltmeter.
- .3 Test switch.
- .4 Time delay relay.
- .5 Battery disconnect device.
- .6 AC input and DC output terminal blocks inside cabinet.
- .7 Shelf Bracket.
- .8 Cord and single twist-lock plug connection for AC.
- .9 RFI suppressors.
- .10 Voltage Sensing Relay:
 - .1 Up to six inputs for line voltage detection from different normal lighting zone. The wire connection from each zone circuit shall be made with terminal blocks.
 - .2 Operation Sequence: In the case of power failure of one or several circuits feeding normal lighting, the output circuit will open and transfer the battery unit(s) in emergency lighting mode.
 - .3 Provide “push to test” push button and a pilot light for each zone circuit for manual testing and service.

2.02 VOLTAGE SENSING RELAY (VSR) ZONE CONTROL STAND-ALONE EXTENSION MODULE

- .1 Manufacturers: Lumacell VSR series (basis of design).
- .2 The equipment shall have an adequate quantity of inputs (up to 24 inputs) for line voltage detection from different building zones. The wire connection from each zone circuit shall be made with terminal blocks. The output circuit shall be a dry-contact relay, normally closed and shall be accessible for connection on a terminal block. The output circuit shall be connected at installation in series with the AC line supplying the battery unit equipment.
- .3 Operation Sequence: In the case of power failure of one or several circuits feeding normal lighting, the output circuit will open and transfer the battery unit(s) in emergency lighting mode.
- .4 Include a “push to test” push button and a pilot light for each zone circuit for manual testing and service.

2.03 EMERGENCY LIGHTING EMERGENCY REMOTE HEADS

- .1 Refer to drawings and lighting schedule.
- .2 One or two lamps, shall be injection molded thermoplastic, white finish, lamps shall be MR16 LED 12 V , 540 lumen, 25 degree beam angle, 6 watt.
- .3 Remote heads to be mounted not less than 2100 mm (6'-10") AFF.
- .4 LED MR16 lamps:
 - .1 Lumacell MQM-x-12V4W-LD10 series.
 - .2 Approved equal by Emergi-Lite.
 - .3 Approved equal by Stanpro.

- .4 Approved equal by Beghelli.

3 Execution

3.01 EXAMINATION

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

3.02 INSTALLATION

- .1 Install emergency lighting in compliance with local inspection authorities.
- .2 Wiring:
 - .1 Connect battery input to source panelboard. Balance the emergency lighting loads connected to battery output terminal blocks. Provide and connect remote fixtures and internally illuminated exit signs as specified and as required for system performance in compliance with OBC minimum egress illumination requirements. Install remotes in locations as shown on the drawings. Connect all remotes to normally "Off" output from battery units.
 - .2 Contractor is responsible for revisions to system, including relocations, aiming and additional remote heads as determined by testing results. All wiring shall be in accordance with manufacturer's recommendations.
 - .3 Use minimum #10 gauge or heavier if needed to provide a maximum voltage drop of 5 per cent. Consult manufacturer's table for sizing the minimum gage and length of wire runs permitted for connected loads to ensure a maximum voltage drop of 5 per cent from the battery unit to the farthest emergency remote, in accordance with OBC and local inspection authorities.
- .3 Mounting: Suitable for wall mounting, complete with bracket from manufacturer lighting heads, test switch and diagnostic LED indicator shall be visible.
- .4 Provide Voltage Sensing Relays internal or external to battery units to meet the intent of OESC Rule 46-304 (4). Unit equipment shall be installed in such a manner that it will be automatically actuated upon failure of the power supply to the normal lighting in the area covered by that unit equipment.

3.03 TESTING AND COMMISSIONING

- .1 When installation of emergency lighting equipment is complete, contractor shall commission and test the entire system and adjust if necessary.
- .2 Contractor is responsible for arranging and cost of a verification test of emergency illumination levels by the manufacturer's representative.
 - .1 Verification test shall be performed with a lux/footcandle meter at 1 m intervals along all paths of egress throughout the space, and record light level readings on floor plans provided by the consultant.
 - .2 The contractor shall also provide consultant with a letter stating the recorded emergency lighting levels meet the OBC requirements of 10 lx (1 fc) average with minimum readings not less than 1 lx (0.1 fc) on the path of egress.

- .3 The manufacturer is to provide a letter of verification confirming testing and operation of all emergency lighting as well as installation to all applicable codes.
- .3 Contractor is to indicate in the letter the duration of emergency lighting run time that was observed.
- .4 Testing shall be performed during non-daylight hours. Contractor shall aim all remotes to optimise illumination on the floor and stair.
- .5 Contractor shall certify in writing to the consultant that the system is complete, installed per CSA C22.2 No. 141, has been tested, and operates for the specified battery run time.
- .6 Contractor shall notify Owner and consultant at least ten days prior to proposed testing date and schedule testing at time and date acceptable to the Owner.
- .7 Installation shall be in accordance to the electrical code and manufacturer's instructions.
- .8 The Contractor is to submit a letter on Contractor's letterhead confirming the criteria specified above is met, including light levels, and run time, and include a copy of the plans with light levels recorded.
- .9 Provide breaker lock on emergency lighting circuit at source panelboard.

3.04 PROTECTION

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by emergency lighting installation.

3.05 TESTING, MAINTENANCE, AND WARRANTY SERVICE

- .1 Provide complete instructions for the operation and care of the emergency power supply or unit equipment that shall specify testing at least once every month to ensure security of operation. Instructions to be framed under glass.
- .2 OBC testing obligations: Owner's facility maintenance personnel are required to document one manual test of the battery units each month, and conduct one full discharge test once a year per OBC and CSA C22.2 No.141 requirements.
- .3 Annual Maintenance: The manufacturer recommends maintenance to be performed by a qualified service provider. Contact the manufacturer for any warranty service.

End of Section

1 General

1.01 SECTION INCLUDES

- .1 Internally illuminated “Running Man” exit sign units for ordinary location use.

1.02 RELATED REQUIREMENTS

- .1 Section 26 52 13.13 – Emergency Lighting: Emergency Battery Units.

1.03 REFERENCES

- .1 CSA Group:
 - .1 CSA C22.1-18, Canadian Electrical Code, Part 1 (24th Edition), Safety Standard for Electrical Installations.
 - .2 Ontario Electrical Safety Code (27th edition/2018).
 - .3 CSA C22.2 No. 141-15 (R2020), Emergency lighting equipment.
 - .4 CAN/CSA-C860-11 (R2020), Performance of Internally Lighted Exit Signs.
- .2 International Organization for Standardization (ISO)
 - .1 ISO 7010:2011 – Graphical symbols – Safety colours and safety signs.
 - .2 ISO 3864-1:2011 – Graphical symbols -- Safety colours and safety signs -- Part 1: Design principles for safety signs and safety markings
- .3 Ontario Building Code.
- .4 Underwriters Laboratories of Canada (ULC)
 - .1 ULC/ORD-924-02, Standard for Emergency Lighting and Power Equipment.
 - .2 CAN/ULC-S572-10, First Edition Standard for Photoluminescent and Self-Luminous Exit Signs and Path Marking Systems.

1.04 SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00.
- .2 Product Data: Submit manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Instructions: submit manufacturer's installation instructions and special handling criteria, installation sequence, cleaning procedures and maintenance.

1.01 EXTRA MATERIALS

- .1 Allow the cost for material and for installation of an additional five exit signs, single face or dual face, to be installed as directed by the Consultant during construction. Include 15.24 m (50 feet) of wire and conduit per exit sign.

1.02 QUALITY ASSURANCE

- .1 Exit signs units shall be ULC Listed and/or CSA Certified to CSA C22.2 No 141 and C860.
- .2 Furnished products are listed and/or certified by third party agencies as suitable for the intended purpose.

- .3 Manufacturer Qualifications: Products shall be free of defects in material and workmanship.
- .4 All units will be certified that they have been tested prior to shipping.

1.03 DELIVERY, STORAGE, AND HANDLING

- .1 In accordance with Section 01 61 00.

1.04 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 00.

1.05 WARRANTY

- .1 Product is warranted free of defects in material and workmanship for a minimum of one year from substantial completion.

2 Products

2.01 EXIT SIGNS, GENERAL

- .1 Manufacturers
 - .1 Aimlite.
 - .2 Beghelli.
 - .3 Emergi-Lite
 - .4 Lumacell.
 - .5 Stanpro.
 - .6 Other manufacturers as indicated in Section 26 52 13.13.
- .2 Substitution Limitations:
 - .1 Manufacturer of exit signs to be the same as manufacturer of emergency lighting battery units and remote heads specified in Section 26 52 13.13.
 - .2 No manufacturer substitutions.
- .3 Description
 - .1 Green and White LED Pictogram “Running Man” exit sign.
 - .2 The pictogram sign shall be certified as CSA 22.2 No. 141, and meet ISO 3864-1 and ISO 7010.
 - .3 The pictogram legend shall have a minimum illuminated dimension of 5.9" high and 11.13" with ISO 3864-1 and ISO 7010 pictogram printed on a pure-acrylic panel.
 - .4 The sign shall include a standard single face with optional double-faceplate included.
 - .5 Not acceptable:
 - .1 Red LED EXIT signs.
 - .2 Externally illuminated photoluminescent, or non-electrical radioluminescent type of pictogram signs are unacceptable.

- .4 Mounting
 - .1 The canopy shall universal to allow for wall, end, or ceiling mount.
- .5 Electrical
 - .1 The LED light source shall be long-life white Light-Emitting Diodes and shall provide uniform illumination of the pictogram in normal and emergency operation.
 - .2 The sign shall operate with universal 2-wire AC input voltage of 120 to 347 Vac at less than 3 Watts, and universal 2-wire DC input voltage from 6 to 24 Vdc at less than 2.5 Watts for single and double face legends with a single arrow either left or right.
 - .3 If arrow left and arrow right is required for T intersection, the contractor shall supply and install two separate pictogram signs.
 - .4 The pictogram edge-lit exit sign in a self-powered configuration shall use a sealed Nickel-Cadmium battery of 2.4 V nominal voltage and shall stay illuminated during emergency operation for at least two hours upon AC failure.

2.02 ALL-PLASTIC PICTOGRAM EXIT SIGN, COMMERCIAL GRADE

- .1 Manufacturers
 - .1 Lumacell LP Series
 - .2 Equivalent products from manufacturers as described in Article 2.01 of this section.
- .2 Materials
 - .1 The sign shall come standard with a canopy and shall be suitable for wall, end, or ceiling mounting. The frame, faceplates, back plate and canopy shall each be constructed of a one-piece UV-stabilized thermoplastic material colored factory white.

2.03 STEEL PICTOGRAM EXIT SIGNS

- .1 Manufacturers
 - .1 Lumacell LS series.
 - .2 Equivalent products from manufacturers as described in Article 2.01 of this section.
- .2 Materials
 - .1 The housing assembly shall be constructed of steel in [factory white] [black] [grey] colour.
 - .2 The frame and back plate shall each be of a one-piece steel construction.
 - .3 The faceplate(s) shall be constructed of robust clear poly-carbonate panels with an opaque border coloured factory-white.
 - .4 Each face plate shall come standard with two legend films for pictogram and directional indicators.

2.04 EXTRUDED ALUMINUM PICTOGRAM EXIT SIGNS

- .1 Manufacturers
 - .1 Lumacell LA series.

.2 Equivalent products from manufacturers as described in Article 2.01 of this specification.

.2 Materials

- .1 The housing assembly shall be constructed of extruded aluminum in [factory white] [black] [grey] [brushed aluminum] colour.
- .2 The housing shall be constructed of rugged extruded aluminum and have a maximum depth of 2-1/2".
- .3 The faceplate(s) shall be constructed of extruded aluminum and shall incorporate a protective clear poly-carbonate panel.
- .4 Each face plate shall come standard with two legend films for pictogram and directional indicators.

2.05 SLIM PROFILE EDGE-LIT PICTOGRAM EXIT SIGNS FOR SURFACE MOUNTED APPLICATIONS

.1 Manufacturers

- .1 Lumacell LAE series.
- .2 Equivalent products from manufacturers as described in Article 2.01 of this specification.

.2 Materials

- .1 The housing assembly shall be constructed of extruded aluminum with textured finish and [textured aluminum] [off-white] colour.
- .2 The canopy shall be of die-cast aluminum and allow for wall, end, or ceiling mount.
- .3 The legend shall be printed on a pure-acrylic panel.
- .4 The panel shall come standard with double-face legend, for single-face and double-face applications.

2.06 DIE-CAST EDGE-LIT PICTOGRAM EXIT SIGNS FOR SURFACE OR RECESSED MOUNTING APPLICATIONS

.1 Manufacturers

- .1 Lumacell LDE series.
- .2 Equivalent products from manufacturers as described in Article 2.01 of this specification.

.2 Materials

.1 Surface mount:

- .1 When specified for surface mount, the unit shall come standard with a trim plate, trim ring, back box and canopy made of die-cast aluminum with [brushed aluminum] [black] [chrome] [polished brass] [factory white] [bronze] finish.
- .2 The trim plate shall have a [angular] [circular] [flat (fully recessed)] profile and allow for wall or ceiling mount installation.

.2 Recessed ceiling mount:

- .1 When specified for recessed ceiling-mount, the unit shall come standard with a flat trim plate of die-cast aluminum with [brushed aluminum] [black] [chrome] [polished brass] [factory white] [bronze] finish, a back box of galvanized steel, and a hardware kit for back

box installation between ceiling joists. The back box shall be provided with conduit knock-outs at the top, back and end.

- .3 The legend shall be printed on a pure-acrylic panel.
- .4 The panel shall come standard with double-face legend, for single-face and double-face applications.

2.07 ALL-CLIMATE, HARSH ENVIRONMENT PICTOGRAM EXIT SIGN

- .1 Manufacturers
 - .1 Lumacell LN Series
 - .2 Equivalent products from manufacturers as described in Article 2.01 of this specification.
- .2 Materials
 - .1 The equipment shall be certified for NEMA- 4X and designed specifically for high abuse areas, wet location, and cold weather applications.
 - .2 The equipment frame shall be of industrial grade polyvinyl chloride with a gasket around lenses and canopy. The faceplate(s) shall be constructed of heavy-duty vandal resistant polycarbonate and feature an even illuminated legend.
 - .3 Finish colour: [black] [white].

3 Execution

3.01 INSTALLATION

- .1 Install exit lights to manufacturer's recommendations, listing requirements, CSA standard and local regulatory requirements.
- .2 Ensure exit signs are not obscured. Where an exit sign is to be installed in an area with no ceiling, provide a suitable pendant mount.
- .3 [Connect fixtures to exit light circuits normal power supply and emergency battery units specified in Section 26 52 13.13.]

[OR]

- .4 [Connect fixtures to exit light emergency power supply circuits.]
- .5 Ensure that emergency lighting circuit breaker is locked in ON position.
- .6 If arrow left and arrow right is required for T intersection, the contractor shall supply and install two separate pictogram signs.

3.02 FIELD QUALITY CONTROL

- .1 Comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.03 CLEANING

- .1 Proceed in accordance with Section 01 74 00.
- .2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

3.04 TESTING AND COMMISSIONING

- .1 When installation of emergency lighting equipment is complete, contractor shall commission and test the entire system and adjust if necessary.
- .2 Contractor shall certify in writing to the consultant that the system is complete, installed per CSA C22.2 No. 141, has been tested, and operates for the specified battery run time.
- .3 Contractor shall notify owner and consultant at least ten days prior to proposed testing date and schedule testing at time and date acceptable to the owner.
- .4 Installation shall be in accordance to the electrical code and manufacturer's instructions.
- .5 Provide breaker lock on emergency lighting circuit at source panelboard.

3.05 PROTECTION

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by exit sign installation.

End of Section

1 General

1.01 SECTION INCLUDES

- .1 Provide a complete system of conduits, pull boxes, outlets, sleeves and all components for a complete working system.
- .2 Existing PA System is Carehawk/Dukane MCS350 series public address system.

1.02 RELATED REQUIREMENTS

- .1 Section 26 05 33.13 – Conduit for Electrical Systems.
- .2 Section 26 05 33.16 – Boxes for Electrical Systems.
- .3 Section 10 25 19 – Classroom Control Panels.

1.03 REFERENCES

- .1 CSA C22.1:21, Canadian Electrical Code, Part 1 (25th Edition), Safety Standard for Electrical Installations.
- .2 Ontario Electrical Safety Code (28th edition/2021).
- .3 CAN/CSA-C22 No. 214 M90 Communications Cables.
- .4 CAN/CSA-T530 Commercial Building Standards for Telecommunications Pathways and Spaces.
- .5 CAN/CSA-T529-95 Commercial Buildings Telecommunications Standards.
- .6 CAN/CSA-T527 Grounding and Bonding Requirements for Telecommunications in Commercial Buildings.
- .7 CAN/CSA-T528 Administration Standard for the Telecommunications Infrastructure of Commercial Buildings.
- .8 Ontario Building Code.

1.04 SUBMITTALS

- .1 Product Data.

2 Products

2.01 OUTLET BOXES

- .1 Wall outlets shall be 115 mm square boxes with plaster rings to suit single gang devices unless otherwise noted.

2.02 CONDUIT

- .1 Conduit size shall be in accordance with recommended standard for conduits in Building as published by BICSI.
- .2 Minimum conduit size shall be 21 mm (3/4") diameter.
- .3 Plywood backboards shall be minimum 1200 x 2400 mm, 19 mm thick, painted with 2 coats of fire retardant light grey enamel.

2.03 CABLING

- .1 Provide twisted pair shielded cabling by Belden to building standard for each device.
- .2 Plenum cables are permitted in accessible ceilings. Provide 'J' hooks in these locations for cable installation.

2.04 EQUIPMENT

- .1 Handset: Dukane model PCS821, black cyclac, dynamic transmitter, standard magnetic receiver, 6'(1.8m) coiled cord, c/w two-gang stainless steel face plate, chromed steel two-pole hookswitch/cradle, rocker (PVCY and CALL) switch, and standard two-gang electrical back box.
- .2 Speakers: McBride series 8224 (recess mounted in Modular Control Panel (MCP)), pre-assembled "call-in" speaker complete with 8" dual cone speaker with magnet, 12.5" square steel baffle (MC25A), 24 or 70 Volt to match existing, 4 watt transformer and suitable back box.

3 Execution

3.01 INSTALLATION

- .1 Vertically mount outlet boxes, unless noted otherwise, 300 mm to centre above floor, or 150 mm above counter top where shown at counters or benches.
- .2 Fish conduit, clear blockages and outlet and clean out pull boxes at completion of installation. Leave conduit free of water or excess moisture. Install No. 12 gauge galvanized soft iron pull wire, or 1/8" nylon pull cord continuously from outlet to outlet, through conduit and fasten at each box.
- .3 Conduit bonds shall have a bending radius of not less than nine times conduit diameter. Ream out conduit and identify ends with green paint.
- .4 Install additional steel pull boxes in such a manner that, throughout entire system, there shall be not more than two 90 degree or equivalent bends or more than 30 000 mm in each run, so that wire or cables may be pulled in or withdrawn with reasonable ease. Minimum space requirements in pull boxes having one conduit each in opposite ends of the box, shall be as follows:

Maximum conduit size	Size of pull boxes in millimetres			For each additional conduit size increase width by:
	Width	Length	Depth	
21 mm	150 mm	300 mm	100 mm	50 mm
27 mm	200 mm	400 mm	150 mm	75 mm
35 mm	250 mm	450 mm	200 mm	75 mm
41 mm	300 mm	600 mm	250 mm	100 mm
53 mm	350 mm	750 mm	300 mm	125 mm

- .5 Show as-installed conduit routing and location of all pull boxes on the record drawings, prior to project completion. Include above noted information on final record drawings at project completion.
- .6 Install new devices in modular control panels.

3.02 TERMINATIONS

- .1 Connections at main PA rack to be performed by the Electrical Contractor.

End of Section

1 General

1.01 CONDITIONS AND REQUIREMENTS

- .1 Refer to the General Conditions, Supplementary General Conditions, and General Requirements.
- .2 Provisions of this Section shall apply to all Sections of Division 27.
- .3 Refer to Consultant's drawings for exact location of electrical equipment and devices. Refer to Designer drawings for additional notes which complement these specifications.
- .4 The Division 26 specification documents shall be followed in conjunction with the specification in this section.
- .5 Coordinate with the Division 26 contractor (hereafter referred to as the "electrical contractor").

1.02 RELATED DIVISIONS

- .1 Division 25 – Integrated Automation.
- .2 Division 26 – Electrical.
- .3 Division 28 – Electronic Safety and Security.

1.03 INTENT

- .1 Include all material, labour, equipment, and plant construction as necessary to make a complete installation as shown and specified hereinafter. Sections of this specification are not intended to delegate functions nor to delegate work and supply to any specific Trade. It shall be your responsibility to ensure that the systems specified hereafter are complete and operative.

1.04 CODES AND STANDARDS

- .1 The equipment, material and installation shall conform to the latest version of the applicable Codes, Standards (including technical service bulletins and addenda) and regulations of authorities having jurisdiction.
- .2 BICSI
 - .1 Telecommunications Distribution Methods Manual
 - .2 Cabling Installation Manual
 - .3 Outside Plant Manual
- .3 Canadian Standards Association (CSA)
 - .1 CSA C22.1 – Canadian Electrical Code, Part 1
 - .2 CSA T529 – Commercial Building Telecommunications Cabling Standard (ANSI/EIA/TIA-568-B).
 - .3 CSA T530 – Commercial Building Standard For Telecommunications Pathways And Spaces (TIA/EIA 569-A).
 - .4 CSA T528 – Administration Standard For The Telecommunications Infrastructure Of Commercial Buildings (ANSI/EIA/TIA-606).
 - .5 CSA T527 – Commercial Building Grounding And Bonding Requirements For Telecommunications (ANSI/EIA/TIA-607).

- .6 CSA C22.2 No. 214 – Communications Cables.
- .7 CSA C22.2 No. 232-M – Fibre Optic Cables.
- .8 CSA C22.2 No. 182.4-M90 – Plugs, Receptacles, and Connectors for Communication Systems.
- .4 TIA
 - .1 TIA/EIA-568-B.1 – Commercial Building Telecommunications Cabling Standard
 - .2 TIA/EIA-568-B.2 – Balanced Twisted Pair Cabling Components
 - .3 TIA/EIA-568-B.3 – Optical Fibre Cabling Components Standard
- .5 ISO
 - .1 ISO/IEC IS 11801A – Generic Cabling for Customer Premises.
- .6 CENELEC EN 50173 – Performance Requirements for Generic Cabling Schemes.
- .7 IEC
 - .1 IEC 603-7, PART 7 – Detailed Specification For Connectors, 8-Way, Including Fixed And Free Connectors With Common Mating Features.
 - .2 IEC 807-8 – Rectangular Connectors For Frequencies Below 3 MHz, Part 8: Detailed Specification For Connectors, Four-Signal Contacts And Earthing Contacts For Cable Screens, First Edition.
- .8 FIPS PUB 174 – Commercial Building Telecommunications Wiring Standard. Federal Information Standard Publication.
- .9 UL 444 and 13 – Adopted Test and Follow-Up Service Requirements For the Optional Qualification of 100Ω Twisted-Pair (Cables).
- .10 NEMA WC 63 – Performance Standard For Field Testing Of Unshielded Twisted-Pair Cabling System.
- .11 ANSI/EIA/TIA
 - .1 ANSI/EIA/TIA-492AAAA – Detailed Specification For 62.5µm Core Diameter / 125µm Cladding Diameter Class 1a Multimode, Graded-Index Optical Waveguide fibres.
 - .2 ANSI/EIA/TIA-492BAAA – Detailed Specifications For Class Iva Dispersion-Unshifted Singlemode Optical Waveguide Fibres Used In Communication Systems.
 - .3 ANSI/EIA/TIA-472CAAA – Detailed Specifications For All Dielectric (Construction 1) Fibre optic Communications Cable For Indoor Plenum Use, Containing Class 1a, 62.5µm Core Diameter / 125µm Cladding Diameter Fibre optic(s).
 - .4 ANSI/EIA/TIA-472DAAA – Detailed Specifications For All Dielectric Fibre optic Communications Cable For Outdoor Plant Use, Containing Class 1, 62.5µm Core Diameter / 250µm Cladding Diameter Fibre optic(s).
 - .5 ANSI/EIA/TIA-455 – Test Procedures For Fibre optics, Cables And Transistors.
 - .6 ANSI/EIA/TIA-598 – Colour Coding of Fibre Optic Cables.
 - .7 ANSI/EIA/TIA-604-3 – FOCIS 3 Fibre Optic Connector Intermateability Standard.

- .8 ANSI/EIA/TIA-606 – Administration Standard for the Telecommunications Infrastructure of Commercial Buildings.
- .9 ANSI/EIA/TIA-607 – Commercial Building Grounding and Bonding Requirements for Telecommunications.
- .12 ANSI Z136.2 – American Standards For The Safe Operation of Fibre optic Communication Systems Utilizing Laser Diode And LED Sources.
- .13 ANSI/CEA
 - .1 ANSI/ICEA S-83-640 – Fibre Optic Outside Plant Communications Cable.
 - .2 ANSI/ICEA S-83-596 – Fibre Optic Premises Distribution Cable.

1.05 WORK SEQUENCE

- .1 Prior to start of each work period in occupied area, temporary protection shall be installed to prevent damage to any personal property or furnishing. Coordinate with Owner's representative if any furniture must be relocated to facilitate work.
- .2 Owner's representative shall approve temporary protection plan prior to use.
- .3 Necessary steps shall be taken by contractor to ensure that required fire fighting apparatus is accessible at all times. Flammable materials shall be kept in suitable places outside the building.

1.06 INSPECTIONS

- .1 The Engineer and/or the Project Manager will carry out inspections and prepare deficiency list for action by the Contractor, during and on completion of project.

1.07 DRAWINGS AND SPECIFICATIONS

- .1 The drawings and specifications are complementary each to the other and what is called for by one to be binding as if called for by both. Should any discrepancy appear between the drawings and specifications which leaves the Contractor in doubt as to the true intent and meaning of plans and specifications, a ruling is to be obtained from the Engineer in writing before submitting Tender. If this is not done, the maximum, the most expensive alternate or option will be provided in base tender bid.
- .2 All drawings and all Divisions of these specifications shall be considered as a whole and work of this Division shown anywhere therein shall be furnished under this Division.
- .3 Drawings are diagrammatic and indicate the general arrangement of equipment and pathways. Most direct routing of cabling is not assured. Exact requirements shall be governed by architectural, structural, and mechanical conditions of the job. Consult all other drawings in preparation of the bid. Extra lengths of wiring or addition of pull and junction boxes, etc. necessitated by such conditions shall be included in the bid. Check all information and report and apparent discrepancies before submitting the bid.
- .4 Contractor shall determine the exact locations of equipment and rough-ins, and the exact routing of pathways so as to best fit the layout of the job.
- .5 Scaling off the drawings will not be sufficient or accurate for determining these locations. Where job conditions require reasonable changes in indicated arrangement and locations, such changes shall be made by the Contractor at no additional cost to the Owner.
- .6 Before ordering any conduit, cable tray, cables, fittings, etc., this Contractor shall verify all pertinent dimensions at the job site and be responsible for their accuracy.

1.08 MATERIAL

- .1 This contractor is responsible to ensure that all items submitted meet all requirements of the drawings and specification, and fits in the allocated space. The final determination of a product being acceptable shall be determined by the Engineer.

1.09 TESTING DATA

- .1 The contractor shall provide a complete testing report utilizing a testing device as specified in the applicable TIA/EIA standard with the correct adapter and test. All copper tests shall be compliant to the current TIA/EIA standards: Perm Link or Channel.
- .2 The Summary report shall provide be provided to the end user in a universal format so that there is no need to purchase any software to read and print the report.
 - .1 Utilizing Adobe Acrobat is an acceptable manner.

1.10 PAINTING AND FINISHES

- .1 Minor damages to finish on factory finished equipment shall be touched up to the Engineer's satisfaction. Items suffering major damage to finish shall be replaced at the direction of the Consultant. Protect work so that finishes will not be damaged or marred during construction. Maintain the necessary protection until completion of the work.

1.11 SAFETY

- .1 The Contractor shall be responsible for the safety of his workmen and the equipment on the project in accordance with all applicable safety legislation passed by Federal, Provincial, and local authorities governing construction safety. The more stringent regulations shall prevail.

1.12 WARRANTY

- .1 Submit a written performance warranty to the Owner for one year for the complete installation for a period of no less than five years from the date of testing and acceptance. The system warranty shall be based on industry standards.
- .2 The contractor shall also provide a one year labour warranty on the installation.

2 Products

2.01 MATERIAL APPROVAL

- .1 The design, manufacture and testing of electrical equipment and materials shall conform to or exceed the latest applicable CSA, IEEE, and ANSI standards.
- .2 All materials must be new and be ULC or CSA listed. Any materials not covered by the aforementioned listing standards shall be tested and approved by an independent testing laboratory, Technical Inspection Services, or other government agency.

2.02 SHOP DRAWINGS

- .1 Before delivery to site of any item of equipment, the electrical contractor shall submit 6 copies of shop drawings c/w all data, pre-checked and stamped accordingly, for approval to the Engineer. Indicate project name on each brochure or sheet. Submit shop drawings within 1 week after award of contract, for the following:
 - .1 Copper Cabling
 - .2 Fibre Optic Cabling

- .3 Fabric Innerduct
- .4 Racks, managers
- .5 Patch Panels
- .6 Telecommunications Outlets, Faceplates
- .7 Fibre Optic Routing System
- .8 Rack Power Distribution Units

2.03 AS-BUILT DRAWINGS

- .1 To Section 01 78 39.
- .2 Red lines, mark-ups by this contractor.

2.04 OPERATION AND MAINTENANCE MANUALS

- .1 Refer to Division 01.

3 Execution

3.01 WORKMANSHIP AND CONTRACTOR'S QUALIFICATIONS

- .1 Only first class workmanship will be accepted, not only in regards to durability, efficiency and safety, but also in regards to neatness of detail. Present a neat and clean appearance on completion to the satisfaction of the Engineer. Any unsatisfactory workmanship will be replaced at no extra cost.
- .2 Conform to the best practices applicable to this type of work. Install all equipment and systems in accordance with the manufacturer's recommendations, but consistent with the General Requirements of this Specification. This Contractor will be held responsible for all damage to the work of his own or any other trade, resulting from the execution of his work. Store all equipment and materials in dry locations.
- .3 Provide foreman in charge of this work at all times.
- .4 The contractor shall be fully liable to provide and maintain in force during the life of this Contract, such insurance, including Public Liability Insurance, Product Liability Insurance, Auto Liability Insurance, Worker's Compensation, and Employer's Liability Insurance.

3.02 COORDINATION

- .1 Coordinate work with other trades.
- .2 Verify equipment dimensions and requirements with provision specified under this Section. Check actual job conditions before fabricating work. Report all necessary changes in time to prevent needless work. Changes or additions subject to additional compensation, which are made without written authorization and an agreed price, shall be at Contractor's risk and expense.
- .3 Read specifications and drawings of other trades and conform with their requirements before proceeding with any work specified in this Division related to other trades. Cooperate with all other trades on the job, so that all equipment can be satisfactorily installed, and so that no delay is caused to any other Trades.

3.03 MANUFACTURERS' INSTRUCTIONS

- .1 Where the specifications call for an installation to be made in accordance with Manufacturer's recommendations, a copy of such recommendations shall be at all times be kept on the job site and be available to the Owner's Representative.

- .2 Follow manufacturer's instructions where they cover points now specifically indicated on the drawings and specifications. If they are in conflict with the drawings and specifications obtain clarification from the Consultant before starting work.

3.04 QUALITY ASSURANCE

- .1 See General Provisions of the Contract.
- .2 The specifications contained herein are set forth as the minimum acceptable requirements. This does not relieve the Contractor from executing other quality assurance measures to obtain a complete operating system within the scope of this project.
- .3 The Contractor shall ensure that all workmanship, all materials employed, all required equipment and the manner and method of installation conforms to accepted construction and engineering practices, and that each piece of equipment is in satisfactory working condition to satisfactorily perform its functional operation.
- .4 Provide quality assurance tests and operational check on all components of the electrical distribution system, all lighting fixtures, and communication systems.

3.05 LABELS AND SIGNS

- .1 Labelling shall be as per TIA/EIA-606.

3.06 ADJUST AND CLEAN-UP

- .1 The Contractor and associated sub trades, at all times during construction, to keep the site free of all debris, boxes, packing, etc., resulting from work of this Trade. At the completion of this work, the installation is to be left in a clean and finished condition to the satisfaction of the Engineer.

3.07 TESTS AND ACCEPTANCE

- .1 The operation of the equipment does not constitute an acceptance of the work by the Owner. The final acceptance is to be made after the Contractor has adjusted his equipment and demonstrated that it fulfils the requirements of the drawings and the specifications.
- .2 Testing of all systems shall be performed in the presence of the Owner's designated representative. The contractor shall give 72 hours advance notice to the Owner before beginning the tests.
- .3 Upon completion of the installation, the Contractor shall furnish certificates of approval from all authorities having jurisdiction, as applicable. Contractor shall demonstrate that work is complete and in perfect operating condition. In the presence of the Owner, the Contractor shall demonstration the proper operation of all miscellaneous systems.

End of Section

1 General

1.01 DESCRIPTION

- .1 This section specifies general grounding and bonding requirements of telecommunication installations for equipment operations.
- .2 “Grounding electrode system” refers to all electrodes required by Electrical Code, as well as including made, supplementary, telecommunications system grounding electrodes.
- .3 The terms “connect” and “bond” are used interchangeably in this specification and have the same meaning.

1.02 RELATED REQUIREMENTS

- .1 Section 26 05 26 – Grounding and Bonding for Electrical Systems.
- .2 Section 27 11 16 – Communications Cabinets, Racks, Frames, and Enclosures.

1.03 REFERENCES

- .1 Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by the basic designation only.
- .2 American Society for Testing and Materials (ASTM):
 - .1 B1-2001 - Standard Specification for Hard-Drawn Copper Wire
 - .2 B8-2004 - Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
- .3 Institute of Electrical and Electronics Engineers, Inc. (IEEE):
 - .1 81-1983 - IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System
- .4 Canadian Standards Association (CSA):
 - .1 CSA C22.1-12 - Canadian Electrical Code, Part I (22nd Edition), Safety Standard for Electrical Installations.
 - .2 Ontario Electrical Safety Code (25th Edition / 2012).
- .5 Telecommunications Industry Association, (TIA)
 - .1 J-STO-607-A - Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications
- .6 Underwriters Laboratories, Inc. (UL):
 - .1 44-2005 - Thermoset-Insulated Wires and Cables
 - .2 83-2003 - Thermoplastic-Insulated Wires and Cables
 - .3 467-2004 - Grounding and Bonding Equipment
 - .4 486A-486B-2003 - Wire Connectors

1.04 SUBMITTALS

- .1 Submit in accordance with Section 01 33 00.
- .2 Shop Drawings:
 - .1 Sufficient information, clearly presented, shall be included to determine compliance with drawings and specifications.
 - .2 Include the location of system grounding electrode connections and the routing of aboveground and underground grounding electrode conductors.
- .3 Test Reports: Provide certified test reports of ground resistance.
- .4 Certifications: Two weeks prior to substantial performance, submit four copies of the following:
 - .1 Certification that the materials and installation is in accordance with the drawings and specifications.
 - .2 Certification, by the Contractor, that the complete installation has been properly installed and tested.

2 Products

2.01 GROUNDING AND BONDING CONDUCTORS

- .1 Equipment grounding and bonding conductors shall be UL 83 insulated stranded copper, except that sizes 6 mm² (10 AWG) and smaller shall be solid copper. Insulation colour shall be continuous green for all equipment grounding conductors. Cable insulation shall be plenum rated (CMP).
 - .1 Example: American Insulated Wire Corp, Telcoflex III series.
- .2 Bonding conductors shall be ASTM B8 bare stranded copper, except that sizes 6 mm² (10 AWG) and smaller shall be ASTM B1 solid bare copper wire.
- .3 Telecom System Grounding Riser
 - .1 Telecom System Grounding Riser Conductor: Telecommunications Grounding Riser shall be in accordance with J STO-607A. Use a minimum 50mm² (1/0 AWG) insulated stranded copper grounding conductor unless indicated otherwise.

2.02 TELECOMMUNICATION AND EQUIPMENT GROUND BUSBARS

- .1 Provide solid copper busbar, pre-drilled from two-hole lug connections with a minimum thickness of 6 mm (1/4 inch) for wall and backboard mounting using standard insulators sized as per details on the electrical drawings.
- .2 Manufacturers:
 - .1 Newton Instrument Company
 - .2 Panduit
 - .3 Burndy
 - .4 Thomas and Betts.

2.03 SPLICES AND TERMINATION COMPONENTS

- .1 Components shall meet or exceed UL 467 and be clearly marked with the manufacturer, catalog number, and permitted conductor size(s).

2.04 GROUND CONNECTIONS

- .1 Above Grade:
 - .1 Bonding Jumpers: compression type connectors, using zinc-plated fasteners and external tooth lockwashers.
 - .2 Ground Busbars: Two-hole compression type lugs using tin-plated copper or copper alloy bolts and nuts.
 - .3 Rack and Cabinet Ground Bars: two-hole compression-type lugs using zinc-plated or copper alloy fasteners.

3 Execution

3.01 GENERAL

- .1 Ground in accordance with the Electrical Code, as shown on drawings, and as hereinafter specified.
- .2 Equipment Grounding: IT cabinets, and other conductive items in close proximity with electrical circuits shall be bonded and grounded.

3.02 SECONDARY EQUIPMENT AND CIRCUITS

- .1 Conduit Systems:
 - .1 Ground all metallic conduit systems. All metallic conduit systems shall contain an equipment grounding conductor.
 - .2 Non-metallic conduit systems shall contain an equipment grounding conductor, except that non-metallic feeder conduits which carry a grounded conductor from exterior transformers to interior or building-mounted service entrance equipment need not contain an equipment grounding conductor.
 - .3 Conduit containing only a grounding conductor, and which is provided for mechanical protection of the conductor, shall be bonded to that conductor at the entrance and exit from the conduit.
- .2 Feeders and Branch Circuits: Install equipment grounding conductors with all feeders and power and lighting branch circuits.
- .3 Boxes, Cabinets, Enclosures, and Panelboards:
 - .1 Bond the equipment grounding conductor to each pullbox, junction box, outlet box, device box, cabinets, and other enclosures through which the conductor passes (except for special grounding systems for intensive care units and other critical units shown).
 - .2 Provide lugs in each box and enclosure for equipment grounding conductor termination.
 - .3 Provide ground bars in panelboards, bolted to the housing, with sufficient lugs to terminate the equipment grounding conductors.
- .4 Receptacles shall not be grounded through their mounting screws. Ground with a jumper from the receptacle green ground terminal to the device box ground screw and the branch circuit equipment grounding conductor.

3.03 CORROSION INHIBITORS

- .1 When making ground and ground bonding connections, apply a corrosion inhibitor to all contact surfaces. Use corrosion inhibitor appropriate for protecting a connection between the metals used.

3.04 TELECOMMUNICATIONS SYSTEM

- .1 Bond telecommunications system grounding equipment to the electrical grounding electrode system.
- .2 Furnish and install all new wire and hardware required to properly ground, bond and connect communications raceway, cable tray, metallic cable shields, and equipment to a ground source.
- .3 Ground bonding jumpers shall be continuous with no splices. Use the shortest length of bonding jumper possible.
- .4 Provide ground paths that are permanent and continuous with a resistance of 1 ohm or less from raceway, cable tray, and equipment connections to the building grounding electrode. The resistance across individual bonding connections shall be 10 milliohms or less.
- .5 Above-Grade Grounding Connections: When making bolted or screwed connections to attach bonding jumpers, remove paint to expose the entire contact surface by grinding where necessary; thoroughly clean all connector, plate and other contact surfaces; and apply an appropriate corrosion inhibitor to all surfaces before joining.
- .6 Bonding Jumpers:
 - .1 Use insulated ground wire of the size and type shown on the Drawings or use a minimum of #6 AWG insulated copper wire.
 - .2 Assemble bonding jumpers using insulated ground wire terminated with compression connectors.
 - .3 Use compression connectors of proper size for conductors specified. Use connector manufacturer's compression tool.
- .7 Bonding Jumper Fasteners:
 - .1 Conduit: Fasten bonding jumpers using screw lugs on grounding bushings or conduit strut clamps, or the clamp pads on push-type conduit fasteners. When screw lug connection to a conduit strut clamp is not possible, fasten the plain end of a bonding jumper wire by slipping the plain end under the conduit strut clamp pad; tighten the clamp screw firmly. Where appropriate, use zinc-plated external tooth lockwashers.
 - .2 Wireway and Cable Tray: Fasten bonding jumpers using zinc-plated bolts, external tooth lockwashers, and nuts. Install protective cover, e.g., zinc-plated acorn nuts on any bolts extending into wireway or cable tray to prevent cable damage.
 - .3 Ground Plates and Busbars: Fasten bonding jumpers using two-hole compression lugs. Use tin-plated copper or copper alloy bolts, external tooth lockwashers, and nuts.
 - .4 Unistrut and Raised Floor Stringers: Fasten bonding jumpers using zinc-plated, self-drill screws and external tooth lockwashers.

3.05 COMMUNICATIONS RACEWAY GROUNDING

- .1 Conduit: Use insulated #6 AWG bonding jumpers to ground metallic conduit at each end and to bond at all intermediate metallic enclosures.

- .2 Wireway: use insulated #6 AWG bonding jumpers to ground or bond metallic wireway at each end at all intermediate metallic enclosures and across all section junctions.

End of Section

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1 General

1.01 SUMMARY

- .1 Provide a complete system of empty conduit, pull boxes, outlets, and sleeves for enclosure of wiring by communications cabling.

1.02 RELATED REQUIREMENTS

- .1 Section 26 05 33.13 – Conduit for Electrical Systems.
- .2 Section 26 05 33.16 – Boxes for Electrical Systems.

1.03 REFERENCES

- .1 BISC I Telecommunications Distribution Methods Manual, 13th Edition (2014).

2 Products

2.01 OUTLETS

- .1 Wall outlets shall be 115 mm square boxes with plaster rings to suit single gang devices unless otherwise noted.
- .2 Provide 53 mm conduit through walls as noted.

2.02 CONDUITS

- .1 Conduit size shall be in accordance with recommended standard for conduits in Building as published by BISC I.
- .2 Minimum conduit size shall be 21 mm diameter.
- .3 Minimum space requirements in pull boxes for 90 degree pulls, shall be as follows:

Maximum conduit size	Size of pull boxes in millimetres			For each additional conduit size increase width by:
	Width	Length	Depth	
21 mm	150 mm	300 mm	100 mm	50 mm
27 mm	200 mm	400 mm	150 mm	75 mm
35 mm	250 mm	450 mm	200 mm	75 mm
41 mm	300 mm	600 mm	250 mm	100 mm
53 mm	350 mm	750 mm	300 mm	125 mm

- .4 Plenum cables are permitted in accessible ceilings. Provide 'J' hooks in these locations for later cable installation under other sections of this Division.
- .5 Plywood backboards shall be minimum 1200 mm by 2400 mm, 19 mm thick, painted with 2 coats of fire retardant light grey enamel.
- .6 Provide a minimum of two 5-15R duplex receptacles on separate circuits at each backboard.

3 Execution

3.01 INSTALLATION

- .1 Vertically mount outlet boxes, unless noted otherwise, 300 mm to centre above floor, or 150 mm above counter top where shown at counters or benches.

- .2 Fish conduit, clear blockages and outlet and clean out pull boxes at completion of installation. Leave conduit free of water or excess moisture. Install No. 12 gauge galvanized soft iron pull wire, or 1/8 inch nylon pull cord continuously from outlet to outlet, through conduit and fasten at each box.
- .3 Conduit shall have a bending radius of not less than nine times conduit diameter. Ream out conduit and identify ends with green paint.
- .4 Install additional steel pull boxes in such a manner that, throughout entire system, there shall be not more than two 90 degree or equivalent bends or more than 30 000 mm in each run, so that wire or cables may be pulled in or withdrawn with reasonable ease. Minimum space requirements in pull boxes having one conduit each in opposite ends of the box, shall be as follows:

Maximum conduit size	Size of pull boxes in millimetres			For each additional conduit size increase width by:-
	Width	Length	Depth	
21 mm	150 mm	300 mm	100 mm	50 mm
27 mm	200 mm	400 mm	150 mm	75 mm
35 mm	250 mm	450 mm	200 mm	75 mm
41 mm	300 mm	600 mm	250 mm	100 mm
53 mm	350 mm	750 mm	300 mm	125 mm

- .5 Show as-installed conduit routing and location of all pull boxes on the record drawings, prior to project completion, for use by future installer to facilitate wiring and equipment installation. Include above noted information on final record drawings at project completion.

End of Section

1 General

1.01 SECTION INCLUDES

- .1 Provide a complete system of empty conduits, pull boxes, outlets, and sleeves for enclosure of wiring for this system. Refer to General Requirements.

1.02 RELATED REQUIREMENTS

- .1 Section 26 05 33.13 – Conduit for Electrical Systems.
- .2 Section 26 05 33.16 – Boxes for Electrical Systems.
- .3 Section 28 46 13 – Fire-Alarm Systems.

1.03 REFERENCES

- .1 BISCI Telecommunications Distribution Methods Manual, 13th Edition (2014).

2 Products

2.01 OUTLETS

- .1 Wall outlets shall be 115 mm square boxes with plaster rings to suit single gang devices unless otherwise noted.

2.02 CONDUITS

- .1 Conduit size shall be in accordance with recommended standard for conduits in Building as published by BICSI.
- .2 Minimum conduit size shall be 21 mm diameter.
- .3 Minimum space requirements in pull boxes for 90 degree pulls, shall be as follows:

Maximum conduit size	Size of pull boxes in millimetres			For each additional conduit size increase width by:-
	Width	Length	Depth	
21 mm	150 mm	300 mm	100 mm	50 mm
27 mm	200 mm	400 mm	150 mm	75 mm
35 mm	250 mm	450 mm	200 mm	75 mm
41 mm	300 mm	600 mm	250 mm	100 mm
53 mm	350 mm	750 mm	300 mm	125 mm

- .4 Plenum cables are permitted in accessible ceilings. Provide 'J' hooks in these locations for later cable installation by others.
- .5 Plywood backboards shall be minimum 1200 mm by 2400 mm, 19 mm thick, painted with two coats of fire retardant light grey enamel.
- .6 Provide a minimum of two duplex receptacles on separate circuits at each backboard.
- .7 Provide fire alarm over-ride feature at fire alarm control panel (FACP) to deactivate public address system when Fire Alarm System is in alarm.

3 Execution

3.01 INSTALLATION

- .1 Vertically mount outlet boxes, unless noted otherwise, 300 mm to centre above floor, or 150 mm above counter top where shown at counters or benches.
- .2 Fish conduit, clear blockages and outlet and clean out pull boxes at completion of installation. Leave conduit free of water or excess moisture. Install No. 12 gauge galvanized soft iron pull wire, or 1/8" nylon pull cord continuously from outlet to outlet, through conduit and fasten at each box.
- .3 Conduit bonds shall have a bending radius of not less than nine times conduit diameter. Ream out conduit and identify ends with green paint.
- .4 Install additional steel pull boxes in such a manner that, throughout entire system, there shall be not more than two 90 degree or equivalent bends or more than 30,000 mm in each run, so that wire or cables may be pulled in or withdrawn with reasonable ease. Minimum space requirements in pull boxes having one conduit each in opposite ends of the box, shall be as follows:

Maximum conduit size	Size of pull boxes in millimetres			For each additional conduit size increase width by:-
	Width	Length	Depth	
21 mm	150 mm	300 mm	100 mm	50 mm
27 mm	200 mm	400 mm	150 mm	75 mm
35 mm	250 mm	450 mm	200 mm	75 mm
41 mm	300 mm	600 mm	250 mm	100 mm
53 mm	350 mm	750 mm	300 mm	125 mm

- .5 Show as-installed conduit routing and location of all pull boxes on the record drawings, prior to project completion, for use by Cash Allowance installer to facilitate wiring and equipment installation. Include above noted information on final record drawings at project completion.

End of Section

1 General

1.01 SUMMARY

- .1 Provide a complete system of empty conduits, terminal cabinets, plywood backboards, pull boxes and outlets for enclosure of access control and intrusion detection system.

1.02 RELATED REQUIREMENTS

- .1 Section 26 05 33.13 – Conduit for Electrical Systems.
- .2 Section 26 05 33.16 – Boxes for Electrical Systems.

2 Products

2.01 OUTLETS

- .1 Wall and door outlets shall be single boxes, or 115 mm square boxes with plaster rings to suit single gang devices unless otherwise noted. Coordinate with Security Contractor.

2.02 CONDUITS

- .1 Provide conduit in all walls, exposed areas and inaccessible ceilings. All conduit work shall be concealed.
- .2 Minimum conduit size shall be 21 mm diameter.
- .3 Provide J hooks in accessible ceilings for plenum rated wiring.
- .4 Minimum space requirements in pull boxes for 90 degree pulls, shall be as follows:

Maximum conduit size	Size of pull boxes in millimetres			For each additional conduit size increase width by:
	Width	Length	Depth	
21 mm	150 mm	300 mm	100 mm	50 mm
27 mm	200 mm	400 mm	150 mm	75 mm
35 mm	250 mm	450 mm	200 mm	75 mm
41 mm	300 mm	600 mm	250 mm	100 mm
53 mm	350 mm	750 mm	300 mm	125 mm

- .5 Plywood backboards shall be minimum 1200 x 2400 mm, 19 mm thick, painted with 2 coats of fire retardant light grey enamel.
- .6 Provide a minimum of 2 duplex receptacles on separate circuits at each backboard.

3 Execution

3.01 INSTALLATION

- .1 Vertically mount outlet boxes, unless noted otherwise, 300 mm to centre above floor, or 150 mm above counter top where shown at counters or benches.
- .2 Fish conduit, clear blockages and outlet and clean out pull boxes at completion of installation. Leave conduit free of water or excess moisture. Install No. 12 gauge galvanized soft iron pull wire, or 1/8" nylon pull cord continuously from outlet to outlet, through conduit and fasten at each box.
- .3 Conduit bonds shall have a bending radius of not less than nine times conduit diameter. Ream out conduit and identify ends with green paint.

- .4 Install additional steel pull boxes in such a manner that, throughout entire system, there shall be not more than two 90 degree or equivalent bends or more than 30,000 mm in each run, so that wire or cables may be pulled in or withdrawn with reasonable ease. Minimum space requirements in pull boxes having one conduit each in opposite ends of the box, shall be as follows:

Maximum conduit size	Size of pull boxes in millimetres			For each additional conduit size increase width by:
	Width	Length	Depth	
21 mm	150 mm	300 mm	100 mm	50 mm
27 mm	200 mm	400 mm	150 mm	75 mm
35 mm	250 mm	450 mm	200 mm	75 mm
41 mm	300 mm	600 mm	250 mm	100 mm
53 mm	350 mm	750 mm	300 mm	125 mm

- .5 Show as-installed conduit routing and location of all pull boxes on the record drawings, prior to project completion, for use by Security installer to facilitate wiring and equipment installation. Include above noted information on final record drawings at project completion.

End of Section

1 General

1.01 SUMMARY

- .1 The work covered under this section consists of the furnishing of all necessary labor, supervision, materials, equipment, and services to completely execute the system of non-continuous cable supports (“J-Hooks”) as described in this specification.

1.02 SCOPE

- .1 Non-continuous cable supports.
- .2 Adjustable non-continuous cable support sling.
- .3 Multi-tiered non-continuous cable support assemblies.
- .4 Non-continuous cable support assemblies from tee bar.
- .5 Non-continuous cable support assemblies from drop wire/ceiling.
- .6 Non-continuous cable support assemblies from beam, flange.
- .7 Non-continuous cable support assemblies from C & Z Purlin.
- .8 Non-continuous cable support assemblies from wall, concrete, or joist.
- .9 Non-continuous cable support assemblies from threaded rod.
- .10 Raised floor non-continuous cable support assemblies.
- .11 Cantilever-Mounted Option for non-continuous cable supports.
- .12 Installation accessories for non-continuous cable supports.

1.03 DEFINITIONS

- .1 UTP: Unshielded twisted pair.
- .2 ANSI: American National Standards Institute
- .3 ASTM: American Society for Testing and Materials
- .4 EIA: Electronic Industries Alliance
- .5 TIA: Telecommunications Industry Association
- .6 cULus: Listed by Underwriters Laboratories based on both Canadian and US (United States) standards requirements.

1.04 SUBMITTALS

- .1 Submit product data on non-continuous cable support devices, including attachment methods. Product data to include, but not limited to materials, finishes, approvals, load ratings, and dimensional information.

1.05 QUALITY ASSURANCE

- .1 Non-continuous cable supports and cable support assemblies shall be listed by Underwriters Laboratories for both Canadian and US standards (cULus).

- .2 Non-continuous cable supports shall have the manufacturers name and part number stamped on the part for identification.
- .3 Manufacturer: Company specializing in manufacturing products specified in this section with a minimum of five years documented experience in the industry, and certified ISO 9000.

2 Products

2.01 ACCEPTABLE MANUFACTURERS

- .1 Subject to compliance with these specifications, non-continuous cable supports shall be as manufactured by ERICO, Inc or approved equal.

2.02 REFERENCES

- .1 ASTM B633 Standard Specification for Electro-deposited Coatings of Zinc on Iron and Steel
- .2 ASTM B 695-90 Standard Specification for coatings of Zinc Mechanically Deposited on Iron and Steel
- .3 ASTM A123 Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
- .4 ASTM A924/A924M Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process
- .5 ASTM A109 Standard Specification for Steel, Strip, Carbon, Cold-Rolled
- .6 ASTM A167 Standard Specification for Stainless and heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
- .7 ASTM A480/A480M Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip.
- .8 ASTM A568 Standard Specification for Steel, Sheet, Carbon, and High-Strength, Low-Alloy Hot-Rolled and Cold-Rolled
- .9 A653 G60-Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-coated (Galvannealed) by the Hot-Dip process
- .10 ASTM A666 Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar
- .11 ASTM A682 Standard Specification for Steel, Strip, High-Carbon, Cold-Rolled, Spring Quality
- .12 ASTM A879 Standard Specification for Steel Sheet, Zinc Coated by the Electrolytic Process for Applications Requiring Designation of the Coating Mass on Each Surface
- .13 ASTM B117 Standard Method of Salt Spray (Fog) Testing
- .14 ASTM D610 Standard test Method for Evaluating Degree of Rusting on Painted Steel Surfaces UL 2043 - Standard for Fire Test for Heat and Visible Smoke Release for Discrete Products and Their Accessories Installed in Air-Handling Spaces.
- .15 ANSI/ TIA/ EIA 568 Commercial Building Telecommunications Cabling Standard, current revision level.
- .16 ANSI/ TIA/ EIA 569 Commercial Building Standard for Telecommunications Pathways and Spaces, current revision level.
- .17 NFPA 70 National Electrical Code®

2.03 NON-CONTINUOUS CABLE SUPPORT SYSTEMS

- .1 Non-continuous cable supports
 - .1 Non-continuous cable supports shall provide a bearing surface of sufficient width to comply with required bend radii of high-performance cables; cULus Listed.
 - .2 Non-continuous cable supports shall have flared edges to prevent damage while installing cables.
 - .3 Non-continuous cable supports sized 1 5/16" and larger shall have a cable retainer strap to provide containment of cables within the hanger. The cable retainer strap shall be removable and reusable and be suitable for use in air handling spaces.
 - .4 Non-continuous cable supports shall have an electro-galvanized or G60 finish and shall be rated for indoor use in non-corrosive environments.
 - .5 Stainless Steel non-continuous cable supports are intended for indoor and outdoor use in non-corrosive environments or where only mildly corrosive conditions apply.
 - .6 Non-continuous cable supports shall be ERICO CableCat™ J-hook series CAT12, CAT21, CAT32, CAT64, CAT21SS, CAT32SS, CAT64SS; CAT-CMTM Double J-Hook CAT100CM; CAT-CMTM U-hook series CAT200CMLN, CAT300CMLN; and CAT-CMTM retainer CATRT200CM, CATRT300CM or approved equal.
- .2 Adjustable non-continuous cable support sling
 - .1 Constructed from steel and woven laminate; sling length can be adjusted to hold up to 425 4-pair UTP; rated for indoor use in non-corrosive environments. Rated to support Category 5 and higher cable, or optical fiber cable; cULus Listed.
 - .2 Adjustable non-continuous cable support sling shall have a static load limit of 100 lbs.
 - .3 Adjustable non-continuous cable support sling shall be suitable for use in air handling spaces.
 - .4 If required, assemble to manufacturer recommended specialty fasteners including beam clips, flange clips, C and Z purlin clips.
 - .5 Acceptable products: ERICO CADDY CableCat™ CAT425; or approved equal.
- .3 Multi-tiered non-continuous cable support assemblies
 - .1 Multi-tiered non-continuous cable support assemblies shall be used where separate cabling compartments are required. Assemblies may be factory assembled or assembled from pre-packaged kits. Assemblies shall consist of a steel angled hanger bracket holding up to six non-continuous cable supports, rated for indoor use in non-corrosive environments; cULus Listed.
 - .2 If required, the multi-tier support bracket may be assembled to manufacturer recommended specialty fasteners including beam clamps, flange clips, C and Z purlin clips.
 - .3 The multi-tiered support bracket shall consist of ERICO CADDY CATHBA and CableCat™ J-Hooks with screws; or approved equal.
- .4 Non-continuous cable support assemblies from tee bar
 - .1 Tee bar support bracket with one non-continuous cable support, factory or jobsite assembled; rated for indoor use in non-corrosive environments; cULus Listed.
 - .2 Acceptable products: ERICO CADDY CAT12TS, CAT21528, CAT32528; or approved equal.
- .5 Non-continuous cable support assemblies from drop wire/ceiling

- .1 Fastener to wire/rod with one non-continuous cable support, factory or jobsite assembled; rated for indoor use in non-corrosive environments; cULus Listed.
- .2 Acceptable products: ERICO CADDY CAT124Z34, CAT126Z34, CAT214Z34, CAT216Z34, CAT324Z34 or CAT326Z34; or approved equal.
- .6 Non-continuous cable support assemblies from beam, flange
 - .1 Fastener to beam or flange with one non-continuous cable support, factory or jobsite assembled; rated for indoor use in non-corrosive environments; cULus Listed.
 - .2 Acceptable products: ERICO CableCat™ J-hook series CAT12, CAT21, CAT32, CAT64 with CADDY beam clamps and CADDY flange clips; or approved equal.
- .7 Non-continuous cable support assemblies from C & Z Purlin
 - .1 Fastener to C or Z purlin with one non-continuous cable support, factory or jobsite assembled; rated for indoor use in non-corrosive environments, cULus Listed.
 - .2 Acceptable products: ERICO CableCat™ J-hook series CAT12, CAT21, CAT32, CAT64 with CADDY Purlin hangers; or approved equal.
- .8 Non-continuous cable support assemblies from wall, concrete, or joist
 - .1 Fastener to wall, concrete, or joist with one non-continuous cable support, factory or jobsite assembled; rated for indoor use in non-corrosive environments, cULus Listed.
 - .2 Acceptable products: ERICO CableCat™ J-hook series CAT12, CAT21, CAT32, CAT64, with CADDY angle bracket; or approved equal.
- .9 Non-continuous cable support assemblies from threaded rod
 - .1 Fastener to threaded rod with one non-continuous cable support, factory or jobsite assembled, rated for indoor use in non-corrosive environments, cULus Listed.
 - .2 The multi-tiered support bracket shall have a static load limit of 300 lbs.
 - .3 U-hooks and Double J-hook shall attach directly to threaded rod using standard nuts.
 - .4 Acceptable products: ERICO CableCat™ J-hook, CAT12, CAT21, CAT32, CAT64 with CADDY CATHBA series; CAT-CMTM Double J-hook CAT100CM, CAT-CMTM Direct mount U-hook CAT200CMLN, CAT300CMLN; or AFAB series; or approved equal.
- .10 Raised floor non-continuous cable support assemblies
 - .1 Fastener to raised (access) floor pedestal with one non-continuous cable support, factory or jobsite assembled, rated for indoor use in non-corrosive environments; cULus Listed.
 - .2 Acceptable products: ERICO CADDY CAT12CD1B, CAT21CD1B or CAT32CD1B; CAT64CD1B; or approved equal.
- .11 Cantilever-Mounted cable supports
 - .1 U-hook shall be able to be assembled to a wide variety of wall mount brackets.
 - .2 Spacing of individual U-hooks as needed, max of 4' to 5' apart.
 - .3 U-hooks may have the optional attachment of a cable roller for ease in pulling cables.

- .4 Acceptable products: ERICO CAT-CMTM U-hooks CAT200CMLN, CAT300CMLN; CAT-CM roller assemblies CATRL200CM, CATRL300CM; CATWMCM bracket; or approved equal.
- .12 Installation accessories for non-continuous cable supports
 - .1 Cable Pulley
 - .1 Non-continuous cable supports may be used as an installation tool when a removable pulley assembly is included. The pulley shall be made of plastic and be without sharp edges. The pin and bail assembly must be able to be secured to the J-Hook during cable installation. The pulley must remain secured while cables are being pulled.
 - .2 The pin and roller assembly must be removed after cables are installed.
 - .3 Acceptable products: ERICO CADDY CAT32PLR, CAT64PLR, or approved equal.
 - .2 Cable Protector
 - .1 The protective steel tube shall fit over threaded rod and be at least 4" in length.
 - .2 The tube shall prevent damage to cables placed in or pulled through CAT-CMTM U-hooks. The tube shall not inhibit the pulling of cables.
 - .3 Acceptable products: ERICO CAT-CMTM CATTBCM, or approved equal.

2.04 FINISHES

- .1 ASTM B633 Standard Specification for Electro-deposited Coatings of Zinc on Iron and Steel
- .2 ASTM B 695 Standard Specification for coatings of Zinc Mechanically Deposited on Iron and Steel
- .3 ASTM A123 Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
- .4 ASTM A924/A924M Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process
- .5 Non-continuous cable supports used where only mildly corrosive conditions apply shall be stainless steel, AISI type 304.

3 Execution

3.01 INSTALLATION

- .1 Installation and configuration shall conform to the requirements of the current revision levels of ANSI/EIA/TIA Standards 568 & 569, NFPA 70 (National Electrical Code), applicable local codes, and to the manufacturer's installation instructions.
- .2 Install cables using techniques, practices, and methods that are consistent with Category 5 or higher requirements and that supports Category 5 or higher performance of completed and linked signal paths, end to end.
- .3 Install cables without damaging conductors, shield, or jacket.
- .4 Do not bend cables, in handling or in installing, to smaller radii than minimums recommended by manufacturer.
- .5 Pull cables without exceeding cable manufacturer's recommended pulling tensions. Use pulling means that will not damage media.

- .6 Do not exceed load ratings specified by manufacturer.
- .7 Adjustable non-continuous support sling shall have a static load limit of 100 lbs.
- .8 Follow manufacturer's recommendations for allowable fill capacity for each size non-continuous cable support.

End of Section

1 General

1.01 SECTION INCLUDES

- .1 Cable trays, including ladder rack, wire mesh, optical fibre trough, and accessories.

1.02 RELATED REQUIREMENTS

- .1 Section 26 05 26 – Grounding and Bonding for Electrical Systems.
- .2 Section 26 05 29 – Hangers and Supports for Electrical Systems.

1.03 REFERENCES

- .1 CSA C22.1-12 - Canadian Electrical Code, Part I (22nd Edition), Safety Standard for Electrical Installations
- .2 Ontario Electrical Safety Code (25th Edition / 2012).
- .3 CSA C22.2 No. 126.1 (CSA/NEMA) - Metal Cable Tray Systems.

1.04 SUBMITTALS FOR REVIEW

- .1 Product Data: Provide data for fittings and accessories.
- .2 Shop Drawings: Indicate tray type, dimensions, support points, and finishes.

1.05 SUBMITTALS FOR INFORMATION

- .1 Manufacturer's Instructions:
 - .1 Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements.
 - .2 Include instructions for storage, handling, protection, examination, preparation, and installation of product.

1.06 SUBMITTALS FOR CLOSEOUT

- .1 Project Record Documents: Record actual routing of cable tray and locations of supports.

1.07 REGULATORY REQUIREMENTS

- .1 Products: Listed and classified by CSA (Canadian Standards Association as suitable for the purpose specified and indicated.

2 Products

2.01 LADDER RACK-TYPE CABLE TRAY

- .1 Description: CSA 22.2 No. 126.1, Class ladder type tray.
- .2 Material: Aluminum.
- .3 Inside width: As indicated.
- .4 Inside depth: As indicated.
- .5 Straight section rung spacing: 152 mm on centre.

- .6 Inside Radius of Fittings: As indicated.
- .7 Unless otherwise noted, provide manufacturer's standard clamps, hangers, brackets, splice plates, reducer plates, blind ends, barrier strips, connectors, and grounding straps.
- .8 Refer to drawings for details.
- .9 Manufacturers:
 - .1 Hubbell Nextframe Ladder Rack
 - .2 Canadian Electrical Raceways "Telecom Cable Rack"
 - .3 Approved Equal.

2.02 WIRE BASKET CABLE TRAY

- .1 Description: CSA 22.2 No. 126.1, Class Basket type tray.
- .2 Material: Carbon Steel, Hot Dipped Galvanized to ASTM A 123.
- .3 Inside Width: As indicated.
- .4 Inside Depth: As indicated.
- .5 Straight Section Rung Spacing: refer to drawings.
- .6 Inside Radius of Fittings: As indicated.
- .7 Unless otherwise noted, provide manufacturer's standard clamps, hangers, brackets, splice plates, reducer plates, blind ends, barrier strips, connectors, and grounding straps.
- .8 Refer to drawings for details.
- .9 Rung spacing 6 inch.
- .10 Radius for tees 12 inch minimum. Exact size to be verified on site.
- .11 Do not employ tray elbows. Use Tees to permit future extension of tray.
- .12 Radius for the dropouts 5 inch minimum. Exact size to be verified on site.
- .13 Manufacturers:
 - .1 Cablofil.
 - .2 Canadian Electrical Raceways Inc.
 - .3 Hubbell.
 - .4 Thomas & Betts

2.03 OPTICAL FIBRE ROUTING SYSTEM (FIBRE TRAY):

- .1 The optical fiber routing system shall be used to route, segregate and protect fiber optic communication cabling.
- .2 ULC Listed (UL2024A)
- .3 Size:

- .1 4" x 4"
- .2 As otherwise indicated on drawings.
- .4 2" minimum bend radius through-out pathway.
- .5 Impact Resistant and flame retardant material. (UL94-V0 Flammability).
- .6 Color: Black
- .7 Will include all mounting hardware, waterfalls, directional fittings and other accessories required for installation
- .8 Manufacturers:
 - .1 Panduit Fiberrunner series.
 - .2 ADC FiberGuide series.
 - .3 Commscope SpeedPRO series.

3 Execution

3.01 INSTALLATION

- .1 Trays to be sized to 40 per cent maximum capacity.
- .2 Install metallic cable tray to CSA C22.1 SB-02 and C22.2 No. 126.1.
- .3 Install fibreglass cable tray to CSA C22.1 SB-02 and C22.2 No. 126.2.
- .4 Support trays to Section 26 05 29. Provide supports at each connection point, at the end of each run, and at other points to maintain spacing between supports.
- .5 Use expansion connectors where required.

End of Section

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1 General

1.01 SECTION INCLUDES

- .1 Firestopping through penetrations in fire rated assemblies.

1.02 RELATED REQUIREMENTS

- .1 Section 07 85 00 – Firestopping and Smoke Seals.

1.03 REFERENCES

- .1 ASTM E 84, “Surface Burning Characteristics of Building Materials”.
- .2 ASTM E 119, “Fire Tests of Building Construction and Materials”.
- .3 ASTM E 814, “Fire Tests of Penetration Firestop Systems”.
- .4 ANSI/UL263, “Fire Tests of Building Construction and Materials”.
- .5 ANSI/UL723, “Surface Burning Characteristics of Building Materials”.
- .6 ANSI/UL1479, “Fire Tests of Through Penetration Firestops”.
- .7 Underwriters Laboratories Inc. (UL) – Fire Resistance Directory

1.04 PERFORMANCE REQUIREMENTS

- .1 Fire rated pathway devices shall be the preferred product and shall be installed in all locations where frequent cable moves, add-ons and changes will occur, such devices shall:
 - .1 Meet the hourly rating of the floor or wall penetrated.
 - .2 Permit the allowable cable load to range from 0% to 100% visual fill thereby eliminating the need to calculate allowable fill ratios.
 - .3 Not require any additional action on the part of the installer to open or close the pathway device or activate the internal smoke and fire seal, such as, but not limited to:
 - .1 Opening or closing of doors.
 - .2 Twisting an inner liner.
 - .3 Removal or replacement of any material such as, but not limited to, sealant, caulk, putty, pillows, bags, foam plugs, foam blocks, or any other material.
 - .4 Permit multiple devices to be ganged together to increase overall cable capacity.
 - .5 Allow for retrofit to install around existing cables.
 - .6 Include an optional means to lengthen the device to facilitate installation in thicker barriers without degrading fire or smoke sealing properties or inhibiting ability of device to permit cable moves, add-ons, or changes.
- .2 Where single cables (up to 0.27 in. (7 mm) diameter) penetrate gypsum board/stud wall assemblies, a fire-rated cable grommet may be substituted. Acceptable products shall be molded from plenum-grade polymer and conform to the outer diameter of the cable forming a tight seal for fire and smoke. Additionally, acceptable products shall lock into the barrier to secure cable penetration.

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- .3 Where non- mechanical products are utilized, provide products that upon curing do no re-emulsify, dissolve, leach, breakdown or otherwise deteriorate over time from exposure to atmospheric moisture, sweating pipes, ponding water or other forms of moisture characteristic during or after construction.
- .4 Where it is not practical to use a mechanical device, openings within floors and walls designed to accommodate telecommunications and data cabling shall be provided with re-enterable products that do not cure or dry.
- .5 Cable trays shall terminate at each barrier and resume on the opposite side such that cables pass independently through fire-rated pathway devices. Cable tray shall be rigidly supported independent from fire-rated pathway devices on each side of barrier.

1.05 SUBMITTALS

- .1 Submit under provisions of Section 01 33 00.
- .2 Product Data: Provide manufacturer's standard catalog data for specified products demonstrating compliance with referenced standards and listing numbers of systems in which each product is to be used.
- .3 Shop Drawings: Submit schedule of opening locations and sizes, penetrating items, and required listed design numbers to seal openings to maintain fire resistance ratings.
- .4 Certificates: Product certificates signed by firestop system manufacturer certifying material compliance with applicable code and specified performance characteristics.
- .5 Installation Instructions: Submit manufacturer's printed installation instructions.

1.06 QUALITY ASSURANCE

- .1 Products/Systems: Provide firestopping systems that comply with the following requirements:
 - .1 Firestopping tests are performed by a qualified, testing and inspection agency. A qualified testing and inspection agency is UL, or another agency performing testing and follow-up inspection services for firestop system acceptable to authorities having jurisdiction.
 - .2 Firestopping products bear the classification marking of qualified testing and inspection agency.
- .2 Installer Qualifications: Experience in performing work of this section who is qualified by the firestopping manufacturer as having been provided the necessary training to install firestop products in accordance with specified requirements.

1.07 DELIVERY, STORAGE, AND HANDLING

- .1 Delivery:
 - .1 Manufacturer's original, unopened, undamaged containers, identification labels intact identifying product and manufacturer, date of manufacture; lot number; shelf life, if applicable; qualified testing and inspection agency's classification marking; and mixing instruction for multicomponent products.
 - .2 Handle and store products according to manufacturer's recommendations published in technical materials. Leave products wrapped or otherwise protected and under clean and dry storage conditions until required for installation.
- .2 Storage and Protection:

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- .1 Store materials protected from exposure to harmful weather conditions and at temperature and humidity conditions recommended by manufacturer.

1.08 PROJECT CONDITIONS

- .1 Do not install firestopping products when ambient or substrate temperatures are outside limitations recommended by manufacturer.
- .2 Do not install firestopping products when substrates are wet due to rain, frost, condensation, or other causes.
- .3 Maintain minimum temperature before, during, and for a minimum 3 days after installation of materials.
- .4 Do not use materials that contain flammable solvents.
- .5 Coordinate construction of openings and penetrating items to ensure that through-penetration firestop systems are installed according to specified requirements.
- .6 Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate through-penetration firestop systems.
- .7 Schedule installation of firestopping after completion of penetrating item installation but prior to covering or concealing of openings.

2 Products

2.01 MANUFACTURERS

- .1 Specified Technologies Inc., 200 Evans Way, Somerville, NJ 08876. Tel: (800) 992-1180, Fax: (908) 526-9623, Email: specseal@stifirestop.com, Website: www.stifirestop.com.
- .2 Substitutions: as approved by the Engineer prior to tender closing.
- .3 Single Source: Obtain firestop systems for each type of penetration and construction condition indicated only from a single manufacturer.

2.02 MATERIALS

- .1 General: Use only firestopping products that have been tested for specific fire resistance rated construction conditions conforming to construction assembly type, penetrating item type, annular space requirements, and fire rating involved for each separate instance.

2.03 FIRE RATED CABLE PATHWAYS

- .1 Steel raceway with intumescent foam pads allowing 0 to 100 percent cable fill, the following products are acceptable:
 - .1 Specified Technologies Inc. (STI) EZ-PATH™ Fire Rated Pathway.

3 Execution

3.01 EXAMINATION

- .1 Before beginning installation, verify that substrate conditions previously installed under other sections are acceptable for installation of firestopping in accordance with manufacturer's installation instructions and technical information.

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- .2 Surfaces shall be free of dirt, grease, oil, scale, laitance, rust, release agents, water repellants, and any other substances that may inhibit optimum adhesion.
- .3 Provide masking and temporary covering to protect adjacent surfaces.
- .4 Do not proceed until unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- .1 General: Install through-penetration firestop systems in accordance with Performance Criteria and in accordance with the conditions of testing and classification as specified in the published design.
- .2 Manufacturer's Instructions: Comply with manufacturer's instructions for installation of firestopping products.

3.03 FIELD QUALITY CONTROL

- .1 Inspections: Engage qualified independent inspection agency to inspect through-penetration firestop systems.
- .2 Keep areas of work accessible until inspection by authorities having jurisdiction.
- .3 Where deficiencies are found, repair firestopping products so they comply with requirements.

3.04 ADJUSTING AND CLEANING

- .1 Remove equipment, materials, and debris, leaving area in undamaged, clean condition.
- .2 Clean all surfaces adjacent to sealed openings to be free of excess firestopping materials and soiling as work progresses.

End of Section

1 General

1.01 SECTION INCLUDES

- .1 Labelling and identification requirements for communications systems.

1.02 REFERENCES

- .1 ANSI/TIA/EIA-606-A – Administration Standard for Commercial Telecommunications Infrastructure.
- .2 UL 969 – Marking and Labeling Systems.

2 Products

2.01 SUMMARY

- .1 Adhesive cable labels to meet the legibility, defacement, and adhesion requirements specified in UL 969 (Ref. D-16). In addition, the labels shall meet the general exposure requirements in UL 969 for indoor use.
- .2 Self-laminating vinyl construction cable labels with a white printing area and a clear tail that self laminates the printed area when wrapped around a cable. The clear area should be of sufficient length to wrap around the cable at least one and one-half times.
- .3 ANSI/EIA/TIA-606 for colour codes shall be followed. Labels are to be mechanically printed using a laser printer. Hand written labels will not be acceptable.

2.02 LABEL PRINTER

- .1 Thermal Transfer Printer shall print high quality, industrial labels on a wide variety of materials for electrical and network applications such as wire/cable, components, safety and facility identification.
- .2 Laminated Adhesive Label Cassettes:
 - .1 For flat label applications.
 - .2 Polyester material.
- .3 Non-Laminated Adhesive Label Cassettes:
 - .1 For marking wire and cable and flat label applications.
 - .2 Polyester material
- .4 Example Products:
 - .1 Panduit LS7 series hand-held printer.
 - .2 Panduit LS8 series hand-held printer.

2.03 NAMEPLATES

- .1 Engraved three-layer laminated plastic, letters on contrasting background:
- .2 Rack and Cabinet ID labels: 25 mm (1”) high White Text on Black Background

3 Execution

3.01 INSTALLATION

- .1 Cable identification labels should appear at the following locations with the numbers indicated on the cable schedule and drawings:
 - .1 300 mm (12 inches) from each end of the cable – after termination.
 - .2 Front of patch panels.
 - .3 Front of IDC termination blocks.
 - .4 Front of workstation/communications outlet faceplates.
 - .5 Each end of each Telecommunications Conduit.
- .2 Fibre Optic safety labels shall appear at the following locations:
 - .1 Along the length of the conduit or innerduct at 3 m (10 foot) intervals.
 - .2 At all junction boxes
 - .3 At all pull boxes.
 - .4 On all fibre optic patch panels.
- .3 Provide 25 per cent additional labels to be left in each telecommunications room on site for future growth.
- .4 Provide two Rack/Cabinet nameplates. Mount one on the front, and one on the rear of the rack.

3.02 IDENTIFICATION CONVENTIONS

- .1 All cabling will be labelled with the closet letter, followed by a dash and the wire number (i.e. A-001 would be the first wire in closet A).
- .2 Labelling for backbone wiring will be preceded with BB followed by the wire number (i.e. BB-001 would be the first backbone).

End of Section

1 General

1.01 SECTION INCLUDES

- .1 Commissioning Requirements.

1.02 REFERENCES

- .1 Refer to Section 27 05 00 for references.

1.03 SUBMITTALS FOR REVIEW

- .1 Provide testing reports.

2 Products – Not Used

3 Execution

3.01 INSTALLATION

- .1 Testing of all horizontal copper cables are to be completed in accordance with the follow test criteria:
 - .1 Basic Link
 - .2 Grounds
 - .3 NEXT
 - .4 ELFEXT
 - .5 Continuity
 - .6 correct polarity
 - .7 PSNEXT
 - .8 PSELFEXT
 - .9 Shorts
 - .10 Length
 - .11 ACR
 - .12 Return Loss
 - .13 Opens
 - .14 Attenuation
 - .15 PSACR
 - .16 Resistance
- .2 Fibre strands in excess of 122m (400 ft) shall be tested with an Optical Time Domain Reflectometer for length and attenuation.
- .3 Test each stand of fibre, bi-directionally, with a Power Meter / Light Source combination operating at wavelengths of 850 nm and 1300 nm for multimode fibres.

- .4 Maximum multi-mode passive link loss (including patch cords) is not to exceed -2.35dB.
- .5 Maximum single-mode passive link loss (including patch cords) is not to exceed -1.0dB.

3.02 DOCUMENTATION

- .1 The Telecommunications Cabling Contractor is required to submit test results in native tester format or a format which can be read with a text reader (i.e. ".txt" extension). Paper results shall not be submitted for projects with 100 or more horizontal cable drops and/or fibre cables.
- .2 The Telecommunications Cabling Contractor is required to provide the software required to view the results.
- .3 The report should be divided into sections by Telecommunications Room.
- .4 The report should indicate for each cable when it was tested successfully, the result, and the length.
- .5 The Telecommunications Cabling Contractor shall sign off on the entire test report prior to submitting to the General Contractor/Construction Manager or The Consultant.
- .6 The test result documentation is to be submitted to the General Contractor/Construction Manager or The Consultant for review no later than 10 working days following the completion of the installation.
- .7 All deficiencies must be corrected before the General Contractor/Construction Manager or The Consultant will provide a certificate to release the Holdback on the project.

3.03 RECORD DRAWINGS

- .1 The Telecommunications Cabling Contractor is required to maintain one set of correct and accurate record drawings on-site at all times. These drawings are to be made available to the General Contractor/Construction Manager or the Consultant for review during the project.
- .2 The Telecommunications Cabling Contractor is required to provide record drawings of the telecommunication cabling installation in relation to the drawings provided in this specification.
- .3 The record drawings shall be updated electronically and include, but are not limited to;
 - .1 Horizontal cable numbers on the floor plans
 - .2 Horizontal Cable Routing on the floor plans
 - .3 Changes on the floor plans
 - .4 Backbone cable Routing between Telecommunications Rooms
 - .5 Paging Speaker Locations including daisy chain cable run
 - .6 Wireless Access Points and Cell coverage
 - .7 Cabinet/Rack Elevation drawings
 - .8 Backboard Elevation Drawing
- .4 The Telecommunications Cabling Contractor shall provide one soft copy in AutoCAD 2007 and one plotted copy for the Consultant to review prior to complete substantial performance and close-out documentation submission.
- .5 After approval, the Telecommunications Cabling Contractor shall submit one plotted copy of the drawings for;

- .1 The Main Computer Room
- .2 Each Telecommunications Room
- .3 The Consultant
- .6 All close-out documentation must be submitted to the General Contractor/Construction Manager or The Consultant within 10 working days of the completion of the project before the documentation holdback will be released.

End of Section

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1 General

1.01 SUMMARY

- .1 Supply, install and test complete data cabling system and accessories, based on physical star wiring topology, and as specified herein and indicated on drawings [for the new addition].
- .2 Include data cabling system the following sub-systems:
 - .1 Backbone Terminal Systems, located in Communications Closets, to serve as connection points between backbone cables and horizontal distribution cables.
 - .2 Horizontal distribution system links backbone terminal system to telecommunications outlets.
 - .3 Contractor is to submit details on equipment types and locations for review and approval prior to installation.

1.02 RELATED REQUIREMENTS

- .1 Active electronics, including servers, hubs, routers, switchers, and, PCs are by Owner and are not part of this contract.

1.03 ABBREVIATIONS AND ACRONYMS

- .1 MTER Main Telecommunication Equipment Room.
- .2 TC Telecommunications Closet.
- .3 TCs Telecommunications Closets.
- .4 RCDD Registered Communications Distribution Designer.
- .5 BICSI Building Industry Consulting Service International.
- .6 MDTS Main Distribution Terminal System.
- .7 IDC Insulation Displacement Connection.
- .8 OTDR Optical Time-Domain Reflectometer.
- .9 BCS Backbone Cabling System.
- .10 IDT Intermediate Distribution Terminal.
- .11 BTS Backbone Terminal System.

1.04 REFERENCE STANDARDS

- .1 Conform to CAN/CSA-T530 for new buildings and areas of substantial renovations of telecommunications, spaces, and pathways.
- .2 Ensure that cabling system shall conform to current issue of industry standard CAN/CSA-T529. This standard is currently being revised and is available as document EIA/TIA SP-2840A (future CAN/CSA-T529). All requirements of this new document must be followed including: Structural Return Loss (section 10.2.4.5), Power Sum Testing (section 10.3.4.7) and End to End Link Performance and continuity, attenuation, cable open and shorts, NEXT; mutual capacitance, pair polarity and cable impedance, S/N ratio, and Pass/Fail status. Tests are to be conducted and recorded using a Penta Scanner. Fibre optic cables shall be tested in conformance to ISO/IEC IS 11801 standards using an EXFO Optical Time Domain Reflectometer. Test results such as; dB loss, cable length and fibre deficiencies (if any) shall be conducted. Verification, documentation, and warranty shall be provided.

- .3 Where applicable, have performance of Category 5e cabling components used, verified by nationally recognized testing laboratory. Submit test results upon request.
- .4 Conform to applicable Building and Electrical Safety Codes.

1.05 SUBMITTALS

- .1 Shop Drawings
 - .1 Provide submittals in accordance with Section 01 33 00 prior to commencing installation.
 - .2 Submit complete cabling system layout for Consultant review for data, cable routing summary and cable outlet designation. Have cabling system layout performed by accredited RCDD (Registered Communications Distribution Designer) as defined by BICSI (Building Industry Consulting Service International). The Data Cabling system will not be accepted without this submission.
 - .3 Documentation proving compliance to End-to-End Link Performance test, as specified in Annex E of EIA/TIA SP-2840A shall be provided prior to structured cabling being installed.
 - .4 Submit detailed layout drawings, including termination racks prior to commencing this installation.
 - .5 Manufacturer's product information documents on all components of the cabling system, including horizontal and vertical cable management systems and all auxiliary components/devices and equipment prior to commencing this installation.
 - .6 The following documentation shall be submitted with a following cover letter listing attachments prior to commencement of work.
 - .1 A list of personnel for the project that will include the name of the Project Manager, Site Manager(s), Lead Hands, and Installers.
 - .2 Permits and notifications as may be required for the project.

1.06 CLOSEOUT SUBMITTALS

- .1 Provide manufacturer's certificate at completion of installation certifying the installation.
- .2 Prepare and submit "As-built" drawings reviewed by an RCDD.
- .3 "As-built" drawings are to detail the exact location of equipment indicating wiring runs and raceways, pull, junction and terminal boxes. Also to include outlet locations, cable numbers and equipment rack profiles.
- .4 Upon completion of work and prior to final acceptance, the contractor will submit to the Owner the required copies of Network Certification and Documentation in the form of manuals that will include the following:
 - .1 Detailed information on types of materials and equipment used and their locations including: distribution frame equipment (rack), equipment types and locations; a detailed listing of cable and outlet types and locations.
 - .2 Accurately and neatly recorded test results.
 - .3 Accurately and neatly record locations including room numbers, of all network components in list form for easy reference.
 - .4 Identify drawings as 'Project Record Copy' and maintain in new condition making available for inspection by Owner.

- .5 Bind all items listed above in a 3-ring hard covered binder suitably labelled with the names of each site/project.

1.07 QUALITY ASSURANCE

.1 Qualifications of Manufacturer

- .1 Supply equipment manufactured by experienced reputable manufacturer, whose installations have rendered satisfactory service for at least 2 years and who would provide factory trained technicians fully experienced in telecommunications wiring. Submit information regarding number of employees, and proof of VAR/CSV certification, including length of time Contractor or employee(s) have been certified to install Cable systems.
- .2 Provide certification that cabling solution offered will perform as a system as is defined in standards documents such as EIA-TIA SP-2840A and T568A configuration for Category 5E system standards. Provide certification supported by manufacturer of cabling components used.
- .3 In addition to certificate of assurance, evidence of support by manufacturer for above items shall be provided upon request in writing with bidding response.
- .4 Use components sourced completely from single manufacturer.

.2 Qualifications of Installer

- .1 Provide installation and supervision work supervised by telecommunications technicians qualified to install voice and data cabling system and to perform related tests as required by manufacturer. Installers/company must have valid certification.
- .2 Provide fully qualified telecommunications technicians, trained and certified by manufacturer in installation and testing of equipment specified. Provide evidence upon request in writing prior to work commencement of manufacturer's certification of supplier's ability to properly install structured cabling for building.
- .3 Submit proven track record in cabling projects of similar size. Include details of minimum 3 projects of similar size involving category 5E cabling, Multimode and Single-mode fibre optic cabling which have been completed in last 2 years. Include names, addresses, and phone numbers of references for 3 projects.

.3 Certifications

- .1 UTP network wiring shall conform to T568A configuration, Category 5e system standards. All UTP cables shall provide minimum signal impairment by preserving wire pair twists as closely as possible to the point of mechanical termination at each end. The following tests will be conducted and recorded using a Penta Scanner:
- .2 End to end continuity, attenuation, cable open and shorts; NEXT; mutual capacitance; pair polarity and cable impedance; S/N ratio and pass/fail status.

1.08 WARRANTY

- .1 The structured cabling systems shall be warranted for 25 years, covering all system products manufactured and provided by the single source supplier. The warrantor shall guarantee the following:
 - .1 All passive system components, e.g. patch panels, UTP cable and outlet jacks are free from manufacturing defects in material or workmanship
 - .2 Approved cabling systems exceed the specifications of the T1A-568A standards and ISO/IEC IS 11801, if applicable.

- .3 The installation exceeds attenuation and near end cross talk, loss and bandwidth requirements TIA Bulletin TIA TSB-67 and ISO/EIC IS 11801.
- .2 General workmanship and apparatus installed under this contract shall be warranted against defects of workmanship and material for a period of one year after final acceptance of work by the Owner, unless otherwise specified. The contractor will make good any defects developed as a result of their work during such time without expense to the Owner.

2 Products

2.01 MANUFACTURERS

- .1 Manufacturer List
 - .1 Commscope (Systimax) only.
- .2 Substitution Limitations
 - .1 Copper cabling installation shall be of one manufacturer.

2.02 UTP CABLING

- .1 100 ohm 4 pair UTP, compliant with TIA/EIA-568-C.2
- .2 Category 3 cabling for telephone communication.
- .3 Category 6 for data communication, security cameras.
 - .1 Unshielded twisted pair, 4 pair twisted, #24AWG, FT-6/CMP plenum rated, blue outer insulation,
- .4 CMP (FT6) Plenum rated.
- .5 No splicing of any data network cabling will be permitted.
- .6 Cable jacket colours shall be as follows:
 - .1 Workstation end data – MGS400-003 (Black);
 - .2 Patch panel end (workstation) – MGS400-003 (Black);
 - .3 Wireless Data – MGS400-123 (yellow);
 - .4 Security Camera Data – MGS400-318 (blue);
 - .5 Building Automation Data – MGS400-112 (orange);
 - .6 Patch panel cross data – MGS400-317 (red);
 - .7 Voice – MGS400-226 (green).

2.03 DATA OUTLETS

- .1 All data jacks must meet specifications.
- .2 Computer outlets complete with termination jacks shall be single, duplex or quad flush faceplates complete with Category 6, 8-position jacks.
- .3 Supply and install one – 4 pair cable to the single outlet, two – 4 pair cables to the duplex outlet, and three – 4 pair cables to quad outlet.

2.04 PATCH PANELS/EQUIPMENT RACKS

- .1 All data UTP, 4 pair, Category 6 horizontal cables are to be terminated on cabinet or rack mounted 24/48 port panels wired.
 - .1 PS5 HD-BIX Patch panel, 1U, 24 Port (Systimax M2000-24)
 - .2 PS5 HD-BIX Patch panel, 2U, 48 Port (Systimax M2000-48)
- .2 Network rack must have the following features:
 - .1 Wall mounting.
 - .2 Standard 19" module compatible.
 - .3 Lockable door.
 - .4 Maximum dimensions of 21"w x 26"d x 25" h.
 - .5 Acceptable products:
 - .1 Middle Atlantic Cat. #CWR-21-26XX c/w hinged lockable door.
- .3 In addition to the above, provide all necessary ancillary equipment such as cable management, label holders, and patch cords.

2.05 PATCH CORDS

- .1 Provide Category 6 patch cords, consisting of 4 pair stranded cable rated FT4 or higher and stamped accordingly. They must conform to EIA/TIA 568A and meet or exceed the EIA/TIA TSB-36 specifications for cordage.
- .2 Patch cords at the workstation end shall be 3050 mm in length, one per data cable.
- .3 Patch cords at the TC end shall be 2133 mm in length, one per data cable.
- .4 Cable jacket colours shall be as follows:
 - .1 Interconnection of networking equipment – red;
 - .2 Telephone/VOIP – green;
 - .3 BAS & Security – orange;
 - .4 Wireless Antenna – white;
 - .5 Security Cameras – blue;
 - .6 All other network requirements – yellow.

3 Execution

3.01 PATHWAYS FOR COMMUNICATIONS

- .1 Conduit to Section 26 05 33.13. J-Hooks: as described in Section 27 05 29.
- .2 Cabling between cable tray/j-hooks and data outlets to be enclosed in EMT conduit.
- .3 Cables/data outlets may be enclosed in pre-finished non-metallic raceways computer labs, classrooms, etc. where indicated.

- .4 Data network cables shall be installed in cable tray. Data network cables shall not be tie-wrapped to electrical conduits, mechanical piping, etc. and shall be run as far as possible from fluorescent lighting fixtures, transformers and electrical power service conduits.

3.02 INSTALLATION

- .1 Each equipment rack shall be anchored securely to the floor and grounded to the building ground with a #6 AWG Insulated Ground Wire in accordance with applicable code requirements (refer to CAN/CSA T5238).
- .2 Ground all data cables shields and associated equipment in Telecommunications rooms to meet applicable code requirements.
- .3 Supply vertical cables and backbone cabling using cable clamps or wiring harnesses.
- .4 Conform to Telecommunications Industry Standards (refer to EIA/TIA 568A) for all cable termination and pinning assignments.
- .5 Utilize cable trays in MTER and TCs to manage cable in orderly fashion.
- .6 All sleeves containing cable or unused shall be fire sealed. Coordinate with Section 07 84 00 for provision and installation of fire barriers.
- .7 Cabling is to be run at 90 degrees to the building grid except where the distance would exceed 90m in length if installed in this manner.
- .8 The maximum horizontal run length is not to exceed 90 metres. If the 90 metre constraint cannot be met, the Cabling Contractor is to notify the Owners Designee of any cables that exceed 90 metres, prior to the installation.
- .9 Ensure all grounding conductors are rated FT-6. Tie into bundles and support using j-hooks outside of tray or conduit and fasten to under-slab at intervals not to exceed 1500 mm.
- .10 Route all cable in such a way as to ensure minimum separations are maintained from sources of EMI as defined in EIA/TIA SP-2840A.
- .11 Place all exposed cabling in TC in neat and professional manner and route as per specifications and drawings. Cables are to be combed, bundled, and routed in a neat and organized manner. Tie-wrap all exposed cable bundles at maximum of every 200 mm using black 'hook-and-loop- fastening ties.
- .12 Securely mount voice outlets at all work area locations and locate so that cable required to reach work area equipment will be no more than 3 m long.
- .13 Ensure that optical fibre splices, fusion or mechanical, do not exceed maximum optical attenuation of 0.3 dB when measured in accordance with EIA/TIA 455-34 and CSA Standard C22.2 No. 232.
- .14 All cables must be properly handled and installed in accordance with the manufacturer's specification. Undue pulling tension, abrasion or rough handling must be avoided to ensure that the cables will permit transmission of the intended information with no impairment or degradation of signal quality. Cable runs between the wiring closets and wall plates must be performed with no splices or cuts to ensure the elimination of reflections, discontinuities, impedance, mismatches, and egress/ingress of undesired signals. Cables must be installed at a specified distance (shown below) from any electrical equipment such as radios, televisions, fluorescent lights or fixtures, motors, transformers, or other significant sources of RFI/EMI interference
- .15 Label all cables in accordance with Industry Standards and CAN/CSA T528 specifications. Number cables as per drawings.

- .16 In cases where the routing may bring the cable in close proximity to the above mentioned sources of disruption, the following minimum distances must be maintained:
 - .1 125 mm (5 inches) from power lines of 2 kVA or less.
 - .2 305 mm (12 inches) from lighting (including fluorescent).
 - .3 914 mm (36 inches) from power lines of 5 kVA or greater
 - .4 40 inches from transformers and motors
- .17 As well, cables must be routed to avoid direct contact with steam pipes or other heat sources so as to avoid thermal degradation of the cable insulation or other undesired effects.
- .18 Cables shall be located in ceiling spaces neatly, tied in bundles and installed in cable management “trays”, J-hooks, and conduit as indicated on the drawings.
- .19 All cables entering the wiring closets must be neatly dressed in bundles and run to the appropriate terminating location.
- .20 Each cable sheath must be clearly and permanently identified with a labelling scheme acceptable to the owner. Each patch panel port a must be clearly and indelibly marked with a structured, user friendly numbering scheme. This numbering scheme must be capable of accepting cable additions so as not to disrupt the logical flow of the scheme. All testing documentation is to reference this numbering scheme.
- .21 NOTE: The faceplate identification numbers/tags MUST be added to the electronic versions of the floor plans. This will be considered part of the As Built contract closeout submittals. The electronic version of the floor plan will be provided in ACAD 14 format by the consultant.
- .22 The wiring closets shall be labelled C1 etc.
- .23 Fibre optic cable installation procedures shall be as follows:
 - .1 All cables must be properly handled and installed in accordance with the manufacturer's specification. Undue pulling tension, abrasion or rough handling must be avoided to ensure that the cables will permit transmission of the intended information with no impairment or degradation of signal quality. Cable runs between the wiring closets and must be performed with no splices or cuts to ensure the elimination of reflections, discontinuities, excess signal loss, or other undesirable problems.
 - .2 All fibre cables shall be installed in conduits from end-to-end.
 - .3 If, during the course of cable installation, it is necessary to bore holes through a firewall, the holes must be sealed with an acceptable sealing material of compound once the cables are in place.
 - .4 All cables entering the computer room must be neatly dressed in bundles and run to the appropriate terminating location.
 - .5 Cable runs shall be free of tension at both ends as well as over the length of the run.
 - .6 Each cable sheath must be clearly and permanently identified at each end using an appropriate labelling scheme accepted by the Owner.

3.03 CABLE IDENTIFICATION AND LABELS

- .1 All adhesive cable labels shall meet the legibility, defacement, and adhesion requirements specified in UL 969 (Ref. D-16). In addition the labels shall meet the general exposure requirements in UL 969 for indoor use.

- .2 Cable labels shall be of self-laminating vinyl construction with a white printing area and a clear tail that self laminates the printed area when wrapped around a cable. The clear area should be of sufficient length to wrap around the cable at least one and one-half times.
- .3 All labels must be mechanically printed using a laser printer. Hand written labels are not permitted.
- .4 Labels are to be attached to:
 - .1 front of the IDC connector or communication outlet faceplate
 - .2 each patch panel jack
 - .3 each end of the horizontal cable at maximum distance of 50mm from the end of the sheath
- .5 Affix faceplate label printed with Workstation Identification number to faceplate cover of in-tile service box.

3.04 SITE TESTS AND INSPECTIONS

- .1 All UTP distribution cabling must be tested with a specialized UTP cable tester to measure the following characteristics:
 - .1 DC Resistance
 - .2 Characteristic Impedance
 - .3 Cable Length
 - .4 Pair Sequence Testing
 - .5 Hardcopy checklists indicating room number and faceplate ID, should be prepared, These results should be documented and form part of the Certification Report, Any documentation supplied in hardcopy form should also be supplied in electronic format (suitable word processing file, spread sheet, graphics file (e.g. AutoCAD, etc.).
 - .6 In addition to the above UTP testing, each cable and termination must be tested to 100 MBS standards.
 - .7 The specific tests to be performed, after all jack plates are mounted on boxes and labelled, are as follows,
 - .1 Mutual Capacitance
 - .2 Attenuation
 - .3 Near End Cross Talk
- .2 Fibre Optic Cable Testing Procedure
 - .1 System acceptance tests must be performed to verify that the cable plant can be certified fully operational. All optical fibre strands must be properly measured with approved optical fibre test equipment for the following characteristics:
 - .1 End to end attenuation loss in dB as measured by a calibrated optical power meter.
 - .2 Splice loss (if any)
 - .3 Cable length
 - .2 The above results are to be obtained by the following test procedures:

- .1 Power meter and light source.
 - .2 OTDR - provide hard copy of signature trace in report.
 - .3 Detailed results of these tests must be included as part of a Certification Report.
 - .4 No connector should exceed 0.5 dB loss. Splices shall not exceed 0-3 dB loss. Total attenuation of link including fibre cable, connectors and splices shall not exceed 5 dB.
- .3 These test results must be documented and form part of the Certification Report.

End of Section

1 General

1.01 SECTION INCLUDES

- .1 Termination Blocks, Patch Panels, and Connectors.

1.02 RELATED REQUIREMENTS

- .1 Section 27 13 13 – Communications Copper Backbone Cabling.

1.03 SUBMITTALS FOR REVIEW

- .1 Product Data: Provide manufacturers catalogue information.

2 Products

2.01 COPPER TERMINATION BLOCKS

- .1 Refer to Section 27 13 13.
- .2 Copper IDC termination block to be wall mounted BIX type, 300 Pair, c/w wire management and cross-connect jumper wires.

2.02 COPPER PATCH PANELS AND TERMINATION BLOCKS

- .1 Copper patch panels to be 19" rack mount, 24/48 port, Category 6, 8 pin modular jack (RJ45) with labels and icons, icon color to match field outlet color. Patch panel to have 2 types, angled type for the cabling rack and flat type for equipment cabinets and remote wall mounted telecom cabinets.

2.03 CATEGORY 6 1U-48 PORT FLAT PATCH PANELS

- .1 Suitable for mounting to any standard 19" or 23" EIA rack or cabinet.
- .2 Horizontal termination for data circuits shall consist of category 6 flat patch panels, which shall be 1U high and provide either 48 modular jack ports, as indicated on the drawings. Patch panels shall be configured with individually replaceable jacks.
- .3 Each modular jack shall be provided with a bend-limiting strain relief. The strain relief shall provide cylindrical support to limit the bend radius at the point of termination.
- .4 The front of each 6-port module shall be capable of accepting labels to TIA requirements.
- .5 Each port shall be capable of accepting an icon to indicate its function. Patch panels shall meet the Category 6 performance requirements of ANSI/TIA-568-C.2.
- .6 Commscope (Systimax) M2000 series.

2.04 FIBRE PATCH PANELS

- .1 Fiber patch panel to be 19" rack mount enclosure (in all 19" rack/cabinet) or wall mount enclosure, supporting optical fiber connector adapter panels (duplex LC Type), rear cable retention loops, entry cable strain relief supports, cable strength member clamps, D- grommets at cable entry, removable rear panel cover, accommodation and support for splice trays, removable front access cover, front space for patch cable storage, patch cable bend radius controls and identification labeling.

3 Execution

3.01 INSTALLATION

- .1 Refer to Section 27 13 13 Copper Backbone Cabling.
- .2 Refer to Section 27 15 13 Copper Horizontal Cabling.

End of Section

1 General

1.01 SECTION INCLUDES

- .1 Communications conductors and cables for fire detection, suppression, and alarm systems.
- .2 Conduit for fire detection, suppression, and alarm systems.

1.02 RELATED REQUIREMENTS

- .1 Section 28 46 13 – Fire-Alarm Systems.
- .2 Section 28 46 31 – Fire-Alarm Initiating Devices.

1.03 DEFINITIONS

- .1 ULC-S524: CLASS A CIRCUIT (Return Loop Circuit) – A circuit having one continuous path connecting all components on the circuit and terminating through an alternate connection path in the source enclosure.
- .2 ULC-S524: CLASS B CIRCUIT (Terminated Circuit) – A circuit having one continuous path connecting all devices on the circuit and terminating at an end-of-line device.

1.04 REFERENCES

- .1 CSA C22.1-18, Canadian Electrical Code, Part 1 (24th Edition), Safety Standard for Electrical Installations.
- .2 Ontario Electrical Safety Code (27th edition/2018).
- .3 CSA C22.2 No. 208-14 – Fire Alarm and Signal Cable.
- .4 CAN/ULC-S139:2017 – Standard for Fire Test for Circuit Integrity of Fire-Resistive Power, Instrumentation, Control, and Data Cables.
- .5 CAN/ULC-S524-14 – Standard for the Installation of Fire Alarm Systems.

1.05 DELIVERY, STORAGE, AND HANDLING

- .1 In accordance with Section 01 60 00.

1.06 WARRANTY

- .1 All work performed and all material and equipment furnished under this contract shall be free from defects and shall remain so for a period of at least one year from the date of acceptance.

2 Products

2.01 CONDUIT AND WIRE FOR FIRE ALARM SYSTEM

- .1 Conduit:
 - .1 In accordance with Section 26 05 33.13.
 - .2 All wiring shall be installed in conduit or raceway.
- .2 Terminal Boxes, Junction Boxes and Cabinets:
 - .1 All boxes and cabinets shall be listed for their purpose and use.

2.02 FIRE ALARM CABLE

- .1 Wiring shall be in accordance with local, provincial and national codes and as recommended by the manufacturer of the fire alarm system. Number and size of conductors shall be as outlined in the Ontario Electrical Safety Code, and as recommended by the fire alarm system manufacturer.
- .2 All wire and cable shall be listed and/or approved by a recognized testing agency for use with a protective signalling system, as outlined in the Ontario Electrical Safety Code.
- .3 Certified by CSA as fire alarm and signal cable type FAS 105 to CSA C22.2 No. 208.
- .4 Conductors:
 - .1 300 V rated multiconductor, insulated, colour coded, copper conductor.
 - .1 Use solid conductors unless noted otherwise.
 - .2 Use stranded conductors for connections between closest junction box and vibrating equipment i.e. generator set supervisory connection.
 - .2 Minimum #16 AWG for initiation circuits.
 - .3 Minimum #12 AWG for strobe signal circuits.
 - .4 Minimum #14 AWG for horn signal circuits.
 - .5 Minimum #12 AWG for bell signal circuits.
- .5 Non-Fire rated cable:
 - .1 Insulation: 105 degrees C flame retardant PVC.
 - .2 Outer Jacket: 105 degrees C flame retardant PVC Red.
 - .3 Armour: Interlocking aluminum without overall Jacket. For drops to devices in suspended ceilings from conduit system.
- .6 Fire rated fire alarm cable:
 - .1 Pentair Pyrotenax 1850 series mineral insulated (MI) cable with 2 hour fire rating to ULC S139 and to meet Ontario Building Code Rule 3.2.7.10.
 - .2 Substitution: VITALink CIC Type FAS105, manufactured by Comtran (listed by ULC under ULC category code 'FHIT7' and 'FHJR7', dated 19 May 2015), installed in EMT conduit.
 - .3 Substitutions such as "Lifeline" installed in conduit may only be considered if listed by ULC under ULC Category Code 'FHIT7'.

3 Execution

3.01 INSTALLATION

- .1 All conduit, junction boxes, conduit supports and hangers shall be concealed in finished areas and may be exposed in unfinished areas. Smoke detectors shall not be installed prior to the system programming and test period. If construction is ongoing during this period, measures shall be taken to protect smoke detectors from contamination and physical damage.
- .2 The entire system shall be installed in accordance with the latest edition of CAN/ULC-S524 and the approved manufacturer's manuals and wiring diagrams.

- .3 The contractor shall furnish all labour, conduit, wiring, outlet boxes, junction boxes, cabinets and similar devices necessary for installation of system devices.
- .4 Provide all necessary power supply, interconnecting and remote signal wire in dedicated conduit throughout and installed in accordance with the manufacturer's wiring diagrams and the requirements of the Ontario Electrical Safety Code and the Inspection Authority.
- .5 All penetration of floor slabs and fire walls shall be fire stopped in accordance with all local fire codes.
- .6 Install all wiring in metal raceways.
- .7 Provide wiring suitable for fire alarm circuits.
 - .1 Class A wiring for initiating circuits.
 - .2 Class B wiring for signalling circuits.
- .8 Fire rated conductors:
 - .1 Install fire rated conductors in accordance with the manufacturer's installation guidelines.
 - .2 Install 2 hour fire rated cables for fire alarm circuits as required by the building code where transponders (data gathering panels) or annunciators are installed in a separate fire compartment from the main FACP CPU.
 - .3 Install 2 hour fire rated cables for fire alarm system branch circuits where the transponder or DGP is not within the same storey as the first initiation, signalling, or voice communication device in the loop for that storey.
 - .4 In lieu of fire rated cables for the above noted cases, Contractor may, when reviewed beforehand by the Consultant, install non rated conductors in be located in a service space that is separated from the remainder of the building by a fire separation that has a fire resistance rating of not less than 2 hours.

3.02 SITE TESTS AND INSPECTIONS

- .1 The manufacturer's representative shall make an inspection of the fire alarm equipment. The inspection shall comprise an examination and test of such equipment for the following:
 - .1 That the type of conductors and cables installed are that designated by the specifications.
 - .2 That the specified equipment has been installed in accordance with the manufacturer's recommendations.
 - .3 That the supervisory wiring of all devices connected to a supervised circuit is operating and that the wiring has been met to the satisfaction of the inspecting officials.
- .2 Testing to be done in the presence of the local building inspector, and the local fire inspector.

End of Section

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1 General

1.01 SECTION INCLUDES

- .1 Category 6 copper unshielded twisted pair (UTP) communications cabling.

1.02 REFERENCES

- .1 Refer to Section 27 05 00 for references.

1.03 SUBMITTALS

- .1 Product Data: Provide manufacturers catalogue information.

2 Products

2.01 MANUFACTURERS

- .1 Commscope (Systimax).

2.02 TERMINATION EQUIPMENT

- .1 All termination mounts shall be fully loaded with the appropriate connectors.
- .2 Blank labelling strips are required for connectors that are not in use.
- .3 IDC block quantities shall accommodate the number of terminated cable pairs.
- .4 Material and equipment shall be new, and conform to grade, quality and standards specified.
- .5 Backboard layout will be as per manufacturer's recommendations unless expressly written otherwise by the General Contractor/Construction Manager or the Consultant.

3 Execution

3.01 INSTALLATION

- .1 The Telecommunications Cabling Contractor shall ensure ANSI/EIA/TIA-568-B installation practices are followed.
- .2 The Telecommunications Cabling Contractor shall terminate all pairs of cable. Terminate all spare cables at the Telecommunication Room end.
- .3 The Telecommunications Cabling Contractor shall run all horizontal cables parallel to building grid lines with no splices.
- .4 Provide 3 m (10'-0") of slack at the workstation end of the cable to permit future outlet relocation. Neatly coil slack in ceiling space or on the side of the cable tray.
- .5 Provide 1 m (3'-0") of slack at the Telecommunications Room end of the cable to permit future relocation. Neatly coil the cable in the cable tray or in the ceiling space.
- .6 Inform the Consultant immediately of any horizontal cable runs exceeding 90 m (295 feet).
- .7 When terminating copper cables remove cable jacket only enough to perform termination and untwist pairs a maximum of 13 mm (1/2") for Category 6 cables.

- .8 The Consultant shall determine the quality of workmanship during installation. Cables that have not been properly installed will be reinstalled by the Telecommunications Cabling Contractor at no additional expense to the client.
- .9 Maintain a minimum of four (4) times cable diameter as a bend radius if no bend radius is specified.
- .10 All horizontal cables shall be bundled on the Telecommunications Racks using “Hook & Loop” fastener straps. Bundles shall be wrapped at a maximum of 203 mm (8”) separation.
- .11 All exposed cabling at the workstation between wall/floor-input point locations and systems furniture are to be wrapped with Split Harness Wrap or Polyethylene Spiral Wrap, size and length as required to suit.
- .12 Provide blank filler plates for all unused modular jack positions on faceplates.
- .13 Supply and install Category 6 CMP cables to the outlets outlet indicated on the drawings. The Telecommunications Cabling Contractor shall refer to the legends on the drawing to determine the number of cables to each outlet location.
- .14 Terminate, test and label each Category 6 cables in accordance to the parameters stated in this specification document.

3.02 PATCH CABLES

- .1 Supply copper patch cords as per schedule in Section 27 16 19.

End of Section

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1 General

1.01 SECTION INCLUDES

- .1 Twisted Pair Patch Cords.
 - .1 Schedule of copper patch cords to be supplied.
- .2 Fibre Optic Patch Cords.
- .3 Related Cross-connect components.
- .4 Cross-connection and patching.

1.02 RELATED REQUIREMENTS

- .1 Section 27 13 23 – Communications Optical Fiber Backbone Cabling.
- .2 Section 27 13 13 – Communications Copper Backbone Cabling.
- .3 Section 27 11 19 – Communications Termination Blocks and Patch Panels.

1.03 SUBMITTALS

- .1 Product Data: For each type of product indicated.
 - .1 For Category-6 patch cords, include the following installation data for each type used:
 - .1 Nominal OD.
 - .2 Minimum bending radius.
 - .3 Maximum pulling tension.
 - .2 For Fiber Optic patch cords, include the following installation data for each type used:
 - .1 Nominal OD.
 - .2 Minimum bending radius.
 - .3 Maximum pulling tension.
- .2 Source quality-control reports.
- .3 Field quality-control reports.

1.04 QUALITY ASSURANCE

- .1 Electrical Components, Devices, and Accessories: Listed and labeled by a qualified testing agency, and marked for intended location and application.
- .2 Warranty: see Section 27 05 00.

1.05 DELIVERY, STORAGE, AND HANDLING

- .1 Test cables upon receipt at Project site.
 - .1 Test optical fiber cables to determine the continuity of the strand end to end. Use optical loss test set.

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- .2 Test each pair of UTP cable for open and short circuits.

1.06 PROJECT CONDITIONS

- .1 Environmental Limitations: Do not deliver or install cables and connecting materials until wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

2 Products

2.01 MANUFACTURERS

- .1 Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
 - .1 Commscope - Systimax.
 - .2 No alternative will be accepted.

2.02 PATCH CABLES

- .1 General Requirements: Comply with TIA/EIA-569-C.
- .2 Category 6 Copper Patch Cords:
 - .1 Factory-made, four-pair cables terminated with eight-position modular plug at each end in lengths as indicated in pricing sheet.
 - .2 Patch cords shall have bend-relief-compliant boots to ensure Category 6 performance.
- .3 Fibre Optic Patch Cords: Factor-made, dual-fibre cables with LC duplex connectors.
 - .1 Fibre patch cords will be available in the following lengths.
- .4 Estimated Quantities
 - .1 The estimate of cable counts and lengths is given for bid purposed only; the final count and lengths will be provided in the integration phase of the project.
 - .2 Pricing should include single cable pricing and quantity discount pricing.
- .5 Cable Connecting Hardware:
 - .1 Comply with Optical Fiber Connector Intermateability Standards (FOCIS) specifications of TIA/EIA-604-2, TIA/EIA-604-3-A, and TIA/EIA-604-12. Comply with TIA/EIA568-C.3.
 - .2 Quick-connect, simplex and duplex, Type LC connectors. Insertion loss not more than 0.75 dB.

2.03 IDENTIFICATION PRODUCTS

- .1 Comply with TIA/EIA-606-A and UL 969 for labeling materials, including label stocks, and inks used by label printers.
- .2 Comply with requirements in Section 26 05 53 "Identification for Electrical Systems."

2.04 SOURCE QUALITY CONTROL

- .1 Factory test UTP cables according to TIA/EIA-568-C.2.

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- .2 Factory test multimode optical fiber cables according to TIA/EIA-526-14-A and TIA/EIA-568-C.3.
- .3 Provide test and inspection reports.

3 Execution

3.01 FIELD QUALITY CONTROL

- .1 Perform tests and inspections.
 - .1 Visually inspect UTP and optical fiber cable jacket materials for NRTL certification markings. Inspect cabling connections for compliance with TIA/EIA-568-C.1.
 - .2 Visually confirm Category 6a, marking of patch cables.
 - .3 Visually confirm Fiber patch cable marking.
 - .4 Visually inspect cable placement, and patch cords, and labeling of all components

3.02 SUPPLY OF PATCH CORDS

- .1 Patch cords included in contract; all patch cords to be supply only, installation by the Owner.
 - .1 Supply two (2) copper patch cords per each telecom field outlet.
 - .1 7'-0" length at telecom room.
 - .2 10'-0" length at workstation.
 - .2 Supply one (1) duplex Fiber patch cord for every 12 strand fiber backbone cable.
 - .3 Supply one (1) duplex Fiber patch cord for every 2 strand fiber horizontal distribution cable.
- .2 Patch cord colour to match colour of system cabling.

End of Section

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1 General

1.01 SECTION INCLUDES

- .1 Wireless Access Points (WAPs) for WiFi network communications.

2 Products

2.01 OWNER-SUPPLIED PRODUCTS

- .1 WAP (Wireless Access Points).
 - .1 Free issued by Owner to this Contractor for installation at locations as indicated on the drawings.
 - .2 Power Over Ethernet (PoE) powered.

3 Execution

3.01 INSTALLATION

- .1 Refer to drawings for WAP locations and provide CAT 6 cabling for each WAP unit.
- .2 Allow for site wireless survey for the final locations of WAPs.
- .3 Allow for 5 m cable slack at WAP outlets end for final location adjustment.

End of Section

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1 General

1.01 SECTION INCLUDES

- .1 Modifications to existing fire alarm system, including provision of new zones as indicated, [relocating and] new fire alarm devices as indicated on the drawings, and system verification. Complete systems shall be left ready for continuous and efficient satisfactory operation.
- .2 Update annunciators / [passive] [active] graphic to include additions and renovated areas, as applicable.
- .3 New devices connected directly to the existing fire alarm system shall of the manufacturer's current product selection, and to match the existing system.

1.02 RELATED REQUIREMENTS

- .1 Section 21 12 00 – Fire-Suppression Standpipes.
- .2 Section 21 13 00 – Fire-Suppression Sprinkler Systems.
- .3 Section 26 05 33.13 – Conduit for Electrical Systems.
- .4 Section 26 05 33.16 – Boxes for Electrical Systems.
- .5 Section 26 05 33.23 – Surface Raceways for Electrical Systems.
- .6 Latest fire alarm verification or annual inspection report.

1.03 UNIT PRICES

- .1 Refer to Document 00 41 00 – Form of Tender.
- .2 Submit with Tender unit prices to provide the following:
 - .1 Provide manual pull station complete with wiring and conduit based on 10 metre distance.
 - .2 Provide fire alarm horn/strobe complete with wiring and conduit, based on 10 metre distance.
 - .3 Provide smoke detector complete with wiring and conduit, based on 10 metre distance.
 - .4 Provide duct type smoke detector complete with wiring and conduit on a separate zone, based on 30 metre distance.
 - .5 Provide unit rate cost of new conduit and wire for initiation or signal circuits based on 10 metre length.
 - .6 Provide unit rate cost to replace existing heat detector.
 - .7 Provide unit rate cost to replace existing manual pull station.
 - .8 Provide unit rate cost to replace existing end of line resistors.

1.04 ALTERNATES

- .1 Refer to Document 00 41 00 – Form of Tender.
- .2 Base bid design entails the provision of new fire alarm initiation and signal circuit wiring, unless noted otherwise on plans.

- .3 Submit with Tender as an alternate (separate) price to delete the removal of all existing fire alarm wiring, and delete the replacement of same with new wiring in existing conduits. This price will be actioned as a Change Order if it is determined during construction that the existing wiring can be re-used.

1.05 REFERENCES

- .1 The publications listed below form a part of this specification. The publications are referenced in text by the basic designation only. Comply with latest edition/amendment referenced Code/Publication.
 - .1 2012 Ontario Building Code.
 - .2 2007 Ontario Fire Code.
 - .3 CAN/ULC-S524-14, Standard for Installation of Fire Alarm Systems.
 - .4 CAN/ULC-S537-13, Standard for Verification of Fire Alarm Systems.
 - .5 CAN/ULC-S1001-11, Integrated Systems Testing of Fire Protection and Life Safety Systems.
 - .6 CSA C22.1-18, Canadian Electrical Code, Part 1 (24th Edition), Safety Standard for Electrical Installations.
 - .7 Ontario Electrical Safety Code (27th edition/2018).
 - .8 All requirements of the Authority Having Jurisdiction (AHJ).

1.06 SUBMITTALS

- .1 Provide submittals to the Consultant for review in accordance with Section 01 33 00.
- .2 Submit to the Fire Department, drawings showing bells, manual pull stations, complete wiring diagrams and annunciator details and obtain their approval.
- .3 Shop Drawings
 - .1 Include sufficient information, clearly presented, to determine compliance with drawings and specifications.
 - .2 Include manufacturer's name(s), model numbers, ratings, power requirements, equipment layout, and device arrangement.
 - .3 Show annunciator layout and main control panel module layout, configurations and terminations.
 - .4 Show device layout, complete riser diagram, and auxiliary functions.
 - .5 The supplier of the system shall prepare a complete zoning schedule and artwork layout for active graphic to be included with submittal package.
- .4 Manuals
 - .1 Submit complete operating and maintenance manuals listing the manufacturer's name(s) including technical data sheets (with model numbers to be used indicated).
 - .2 Wiring diagrams indicating terminals and the interconnections between the items of equipment.
 - .3 Provide a clear and concise description of operation which gives, in detail, the information required to properly operate the equipment.

1.07 CLOSEOUT SUBMITTALS

- .1 Fire Alarm Verification Report.
- .2 Operation and Maintenance Manual.
- .3 Training session attendance list.

1.08 QUALITY ASSURANCE

- .1 Approvals
 - .1 The system shall have proper listing and/or approval from the following nationally recognized agencies:
 - .1 ULC Underwriters Laboratories Canada.
 - .2 The fire alarm control, panel shall meet the modular listing requirements of ULC. Each subassembly of the FACP, including all printed circuit boards, shall include the appropriate ULC modular label.
 - .2 All devices/components shall be suitable for the locations, environment, temperatures in which they are to be installed.

1.09 WARRANTY

- .1 All work performed and all material and equipment furnished under this contract shall be free from defects and shall remain so for a period of at least one (1) year from the date of acceptance.

2 Products

2.01 EXISTING SYSTEM

- .1 The existing Fire Alarm System is Chubb-Edwards EST-3Xseries single-stagefire alarm system.
 - .1 The location of the Fire Alarm Control Panel is as indicated on the drawings.
 - .2 There is one passive graphic annunciator located at the main entrance.

2.02 MANUFACTURERS

- .1 The system components shall be selected so as to match and be compatible with the existing Fire Alarm system.

2.03 EQUIPMENT AND MATERIAL, GENERAL

- .1 Review latest verification report, and review existing system during tender walkthrough and note all required modifications.
- .2 All equipment and components shall be new, and the manufacturer's current model.
- .3 All equipment and components shall be installed in strict compliance with manufacturers' recommendations.
- .4 All Equipment shall be attached to walls and ceiling/floor assemblies and shall be held firmly in place. (e.g., detectors shall not be supported solely by suspended ceilings). Fasteners and supports shall be adequate to support the required load.

2.04 CONDUIT AND WIRE

- .1 Existing conventional zone wiring is existing to remain.
- .2 New conduit and wire for new zones and new devices to Section 27 15 01.19.
- .3 Conduit
 - .1 Conduit shall be in accordance with the Electrical Safety Authority (ESA), local and provincial requirements.
 - .2 All wiring shall be installed in conduit or raceway to Section 26 05 33.13 and Section 26 05 33.23.
- .4 Wire
 - .1 All fire alarm system wiring to suit new devices shall be new.
 - .2 Wiring shall be in accordance with local, provincial and national codes and as recommended by the manufacturer of the fire alarm system. Number and size of conductors shall be as outlined in the Ontario Electrical Safety Code and as recommended by the fire alarm system manufacturer.
 - .3 All wire and cable shall be listed and/or approved by a recognized testing agency for use with a protective signalling system, as outlined in the Ontario Electrical Safety Code.
- .5 Terminal Boxes, Junction Boxes and Cabinets:
 - .1 All boxes and cabinets shall be listed for their purpose and use.

2.05 MAIN FIRE ALARM CONTROL PANEL

- .1 Add new zones, zone modules, etc., for new work as required, and connect all new devices to Fire Alarm Control Panel.
- .2 Remote Annunciator and Passive Graphic
 - .1 Connect all new zones for the new work to annunciators.
 - .2 Provide new passive graphic, multicolour, under plexiglass with anodized frame and concealed tamperproof mounting.

2.06 COMPONENTS

- .1 Programmable Electronic Sounders:
 - .1 Electronic sounders shall match existing system.
 - .2 Shall be flush mounted as required.
 - .3 Mini horns shall be provided in all [Classroom] areas etc. and where shown.
- .2 Audible/Visual Combination Devices:
 - .1 Shall meet the applicable requirements of sounders listed above for audibility.
 - .2 Shall have a built-in strobe, 15 candela.
- .3 Strobe Synchronizing Modules:
 - .1 Synchronize strobes at 1 Hz and horns at temporal over single wire pan.

- .4 Manual Fire Alarm Stations
 - .1 Manual fire alarm stations shall be non-coded, non-breakable glass type.
 - .2 Stations must be designed such that after an actual activation, they cannot be restored to normal without the use of a special tool.
 - .3 An operated station shall automatically condition itself so as to be visually detected, as operated, at a minimum distance of 30.5 m (100 feet) front or side.
 - .4 Manual stations constructed of metal, with operating instructions provided on the cover. The word FIRE shall appear on the manual station in letters 12.7 mm (1/2 inch) in size or larger.
 - .5 Manual stations shall be c/w polycarbonate vandal covers.
- .5 Conventional Photoelectric Area Smoke Detectors
 - .1 Photoelectric smoke detectors shall be two wire, ceiling-mounted, light scattering type using an LED light source.
 - .2 Each detector shall contain a remote LED output and a built-in test switch.
 - .3 Detector shall be provided on a twist-lock base.
 - .4 It shall be possible to perform a calibrated sensitivity and performance test on the detector without the need for the generation of smoke. The test method shall test all detector circuits.
 - .5 A visual indication of an alarm shall be provided by dual latching Light Emitting Diodes (LEDs), on the detector, which may be seen from ground level over 360 degrees. These LEDs shall flash every 10 seconds, indicating that power is applied to the detector.
 - .6 The detector shall not go into alarm when exposed to air velocities of up to 914.4 m (3000 feet) per minute.
 - .7 The detector screen and cover assembly shall be easily removable for field cleaning of the detector chamber.
 - .8 All field wire connections shall be made to the base through the use of a clamping plate and screw.
- .6 Duct Smoke Detectors
 - .1 Duct smoke detectors shall be complete with visual alarm and power indicators, and a reset switch. Each detector shall be installed upon the with properly sized air sampling tubes.
- .7 Automatic Conventional Heat Detectors
 - .1 Automatic heat detectors shall have a combination rate of rise and fixed temperature rated at 135 degrees F (57.2 degrees C) for areas where ambient temperatures do not exceed 100 degrees F (37.7 degrees C), and 200 degrees F (93.33 degrees C) for areas where the temperature does not exceed 150 degrees F (65.5 degrees C).
 - .2 Automatic heat detectors shall be a low profile, ceiling mount type with positive indication of activation.
 - .3 The rate of rise element shall consist of an air chamber, a flexible metal diaphragm, and a factory calibrated, moisture-proof, trouble free vent, and shall operate when the rate of temperature rise exceeds 15 degrees F (9.4 degrees C) per minute.
 - .4 The fixed temperature element shall consist of a fusible alloy retainer and actuator shaft.

- .5 Automatic heat detectors shall have a smooth ceiling rating of 2 500 square feet (762 square metres).

2.07 OPERATION SEQUENCES

- .1 The fire alarm system shall be a [Zoned Single Stage Non-Coded System] as defined in the Ontario Building Code.
- .2 Basic Performance:
 - .1 Initiation Device Circuits (IDC) shall be wired Class A.
 - .2 Notification Appliance Circuits (NAC) shall be wired Class B (NFPA Style Y).
 - .3 Alarm signals arriving at the main FACP shall not be lost following a power failure (or outage) until the alarm signal is processed and recorded.
- .3 Basic System Functional Operation:
 - .1 An alarm is caused by actuation of any one of the following devices:
 - .1 Pulling a manual station
 - .2 Operation of an automatic fire alarm detector
 - .3 Operation of a sprinkler flow switch
 - .4 Operation of a smoke detector
 - .2 If, in any area of the building, an alarm is caused by actuation of the aforementioned devices, the following shall occur:
 - .1 Signals in the building shall sound.
 - .2 Annunciators shall indicate exact zone where alarm originated
 - .3 Fans shall be automatically turned off.
 - .3 Central station shall be automatically alerted via telephone lines connected for fire alarm system.
 - .4 If, in any area of the building, supervised valves of the sprinkler, systems are operated or exhibit short or open circuits, the following shall occur:
 - .1 The annunciator shall identify, as a separate zone, the item causing the trouble signal.
 - .2 The trouble buzzer on the annunciator(s) shall sound.
 - .3 The signals in the building shall not be sounded.

3 Execution

3.01 EXAMINATION

- .1 Do not disturb any existing devices unless absolutely necessary to facilitate installation of a new device. No existing devices are to be disturbed without specific authorization by the Project Manager.
- .2 [Conduct an impedance test of initiation and signal circuits, and submit report to the Consultant. Report any discrepancies in circuit loading.]

3.02 INSTALLATION

- .1 Maintain continuity of the existing fire alarm system at all times. In the event that a shutdown is required of the fire alarm system, provide a fire watch.
- .2 Install fire alarm system devices in accordance with applicable codes, and manufacturer's instructions.
- .3 Entire installation shall be done under supervision of manufacturer. Upon completion of installation, check entire system to approval and correct any malfunction immediately.
- .4 Standpipe System Connections.
 - .1 Refer to Section 21 12 00.
 - .2 Connect contact of supervisory switches to fire alarm zones indicated.
- .5 Sprinkler System Connections.
 - .1 Refer to Section 21 13 00.
 - .2 Connect contact of sprinkler flow switches and supervisory switches to fire alarm zones indicated.
- .6 Align alarm devices and signals, where grouped together, one above the other.
- .7 Mount devices at the following heights unless otherwise shown:
 - .1 Signal devices:
 - .1 300 mm below finished ceiling
 - .2 2050 mm above floor in unfinished areas.
 - .2 Manual Pull Stations:
 - .1 1200 mm above finished floor level.
 - .3 In areas with separate signal devices for fire suppression and/or pre-action, provide a lamacoid nameplate for base building signalling devices.
- .8 Manufacturer shall examine Drawings and Specifications prior to award of Contract to ensure that detectors, control panels and miscellaneous devices being supplied will provide a satisfactory working installation.

3.03 FIELD QUALITY CONTROL

- .1 Testing and Verification
 - .1 Test each automatic detector to ensure correct wiring and zoning by setting off its rate of rise component and sounding the bells or by ringing it out. Test each smoke detector, sprinkler system and standpipe valves to ensure correct wiring.
 - .2 Provide the service of a competent, factory trained engineer or technician authorized by the manufacturer of the fire alarm equipment to technically supervise and participate during all of the adjustments and tests for the system. All testing shall be in accordance with CAN/ULC-S537.
 - .3 Check for correct connections and test for short circuits, ground faults, continuity, and insulation.
 - .4 Perform audibility test of space and provide annunciation devices to suit ambient sound levels. Ensure coverage for fire alarm signalling devices on base building fire alarm system. Provide

- audible test of signaling devices after other systems have been commissioned to verify operation at computer room ambient sound level.
- .5 [Verify activation of all relocated devices, including flow switches, trouble, and supervisory signals from the relocated pre-action assembly.]
 - .6 Provide the service of a competent, factory-trained engineer or technician authorized by the manufacturer of the fire alarm equipment to technically supervise and participate during all of the adjustments and tests for the system.
 - .7 All initial testing shall be in accordance with CAN/ULC-S537. A representative of the electrical contractor shall be present to participate and assist the manufacturer representative during the course of the verification. The electrical contractor shall make good any deficiencies discovered during the verification. All devices, new and existing, shall be verified. The electrical contractor shall provide one person for assistance with the verification.
 - .8 Include associated costs in Tender Price.
 - .9 Carry out a complete audibility test and submit report.
 - .10 On completion of the verification the manufacturer shall supply a certificate, together with detailed inspection record sheets showing location of each device and certifying the test results per unit, confirming that the system is installed, supervised and operational.
 - .11 Provide functional testing of interconnected systems in accordance with CAN/ULC-S1001.
- .2 Manufacturer Services
- .1 The manufacturer(s) of the fire alarm shall make a complete inspection of all [existing and] new components installed for system(s), such as manual stations, horns, and annunciators and sprinkler and standpipe valves and smoke detectors to ensure the following:
 - .1 That the system is complete in accordance with Specifications.
 - .2 That the system is connected according to ULC requirements.
 - .3 That the system is connected in accordance with the Manufacturer's recommendations.
 - .4 That the regulations concerning the supervision of components have been adhered to (e.g. stations, detectors, supervised valves, bells), and are properly wired and supervised.
 - .5 That all valves are properly connected and displayed correctly on each annunciator.
 - .6 That any subsequent changes necessary to conform to the above will be carried out with technical advice supplied by the manufacturer.
 - .7 That all thermal detectors, smoke detectors and manual pull stations have been operated and are in good working order.
 - .8 That all sprinkler system and standpipe system valves have been operated and are in good working order.
 - .9 That all annunciators correctly pinpoint the origin of any fire alarm.
 - .10 That actual smoke concentration of sufficient density, have been applied to each smoke detector to cause the detector to be set off and that the sensitivity of each smoke detector has been set.

- .11 That all existing devices are in good working order. Include for replacement of any defective/damaged devices at no extra cost to Owner.
- .12 That signal audibility is acceptable in all areas. Submit audibility readings for every room.
- .13 If existing audible signal devices have been discontinued by the manufacturer (for example mechanical horns), allow for replacement of all audible devices so that all devices generate similar sounds and sound patterns when activated.

3.04 CLOSEOUT ACTIVITIES

- .1 At the final inspection a factory trained representative of the manufacturer of the major equipment shall demonstrate that the systems function properly in every respect.
- .2 Provide instruction as required to the building personnel and fire and safety personnel. "Hands-on" demonstrations of the operation of the system shall be provided.

End of Section

1 General

1.01 SUMMARY

- .1 Provide commissioning of fire alarm and interconnected systems to verify that installations are in accordance with project requirements, and to ensure proper system operation.

1.02 RELATED REQUIREMENTS

- .1 Section 01 91 13 – General Commissioning Requirements.

1.03 REFERENCES

- .1 CAN/ULC-S1001-11 – Integrated Systems Testing of Fire Protection and Life Safety Systems.

1.04 SUBMITTALS

- .1 Commissioning plan.

1.05 CLOSEOUT SUBMITTALS

- .1 Final commissioning and functional test report.

1.06 QUALIFICATIONS

- .1 Commissioning Organizations:
 - .1 Certified member of Electrical Contractors Association of Ontario (ECAO) or Canadian Fire Alarm Association (CFAA).

2 Products – Not Used

3 Execution

3.01 SITE TESTS AND INSPECTIONS

- .1 Perform Commissioning of integrated systems in accordance with CAN/ULC-S1001.
- .2 Follow manufacturer's recommendations for testing.
- .3 Inspect wiring connections to all devices comprising the system.
- .4 Verify supervision of wiring at every device connection to a supervised circuit.
- .5 Test operation of every device on a system to verify its function.
- .6 Examine equipment for any apparent damage or tampering that may interfere with its intended operation.
- .7 Test equipment with capabilities for field adjustment to establish that it functions as intended under the conditions prevailing at its point of installation.
- .8 Examine devices for evidence of damage or obstructions which may interfere with their operating mechanisms.
- .9 Test automatic devices by simulating an operating condition.
- .10 Wiring:

- .1 Inspect every device and test to demonstrate that disconnection of the device from the circuit or malfunction of the equipment or wiring activates the required supervisory signals. Inspection shall include verification that:
 - .1 Supervisory signals operate in response to open circuits, short circuits, ground faults and disconnection of plug-in components;
 - .2 Terminations of conductors entering and leaving equipment have been made;
 - .3 Circuit polarities are in accordance with the system design, where applicable.
- .2 In addition, test to establish that the power supplied to any device is within its recommended operating range and that the required voltage levels are maintained and that the fusing is correct.
- .11 Initiating Devices - Manual:
 - .1 Inspect manual alarm stations in consideration of the following:
 - .1 The device shall be mounted with sufficient clearance to facilitate ease of access and proper operation;
 - .2 Operate each manual alarm station, toggle switch and key switch to verify proper functions.
- .12 Automatic heat detectors:
 - .1 Use a heat source reproducible in its intensity, as recommended by the manufacturer of the device, to initiate an alarm.
 - .2 Test equipment - Heat lamp or Air heater. DO NOT USE AN OPEN FLAME HEAT SOURCE.
 - .3 Apply heat source as to not damage or operate fusible disc parts.
- .13 Automatic heat detectors - non-resettable:
 - .1 Test by simulating its electrical operation by jumpering the wiring points (creating a short) adjacent to its operating mechanism.
- .14 Automatic smoke detectors - area type:
 - .1 Test by introducing smoke into its detecting chamber. This may consist of actual smoke from burning materials or artificially generated smoke aerosol spray as recommended by the manufacturer. The sensitivity should be noted and adjusted if necessary.
- .15 Automatic smoke detectors:
 - .1 Examine the air sampling arrangements of the detectors under actual conditions of balanced air circulation by conducting a check of the field sensitivity and a check of the air velocity in accordance with the manufacturers' recommendations.
 - .2 Test gas to be used similar to Automatic Smoke Detector.
- .16 Alarm signals - audible:
 - .1 Test on main power supply and standby power supply with the maximum expected load on the system.
 - .2 The audible signalling appliances shall function as intended and shall be audible throughout the building over the background noise present.

- .3 Decibel recordings in each area covering 100 sq. metres shall be taken.
- .4 The level of sound should usually be 15 dB above ambient noise level.
- .17 Alarm signals - visual:
 - .1 The visual signal appliances shall function as intended and shall be clearly visible.
- .18 Fire suppression supervision:
 - .1 Coordinate with the requirements of Section 21 12 00, and Section 21 13 00.
 - .2 Sprinkler and standpipe trade to activate each sprinkler and standpipe supervisory and alarm device by operating valves and producing flows as required in conjunction with fire alarm technician to observe activation of flow switches, pressure switches, supervised valves, etc.
- .19 Annunciators, printers and workstations:
 - .1 Inspect and operate to establish that their operation in conjunction with the control equipment and other system components, is as intended. The equipment shall be inspected to ensure:
 - .1 The zone of each alarm initiating device is properly indicated;
 - .2 The legend is clearly visible;
 - .3 Adequate voltage under local conditions is present;
 - .4 Wiring connections have been made in a workmanlike manner.
 - .5 Proper care must be taken to establish that each item is complete and satisfactory.
- .20 Standby power supplies - batteries:
 - .1 Examine batteries for possible damage and consideration of the following:
 - .1 The charging system functions as intended;
 - .2 The installation has not resulted in the bypassing of a fuse or a similar protective device;
 - .3 The installation protects the batteries from accidental or mechanical damage.
 - .4 The batteries must be able to operate the fire alarm system with the charger input disconnected for one rated load cycle.
- .21 Control equipment and transponders:
 - .1 Test to establish that they function as intended. The following examinations and tests shall be performed:
 - .1 A visual and physical inspection of all cables, plug interconnections, plug-in circuit components, lamps, sockets and controls to establish that their mechanical and electrical connections and mounting are as required for intended function and, where applicable, to confirm electrical supervision;
 - .2 Verification that all field wiring is terminated in a workman-like manner;
 - .3 All lamps and indicators shall be tested for operation and intended function;
 - .4 All keypad functions shall be tested for operation and intended function;

- .5 All control unit functions shall be operated to verify appropriate response including all software routines and programme functions are simulated;
- .6 Simulation of open circuits, short circuits and ground faults on all relevant internal circuits in order to confirm the appropriate supervisory response;
- .2 Commissioning Report:
 - .1 Provide in accordance with requirements of Section 01 91 13, supplemented as specified herein.
 - .2 Report to include relevant information of the system including:
 - .3 Each system part described.
 - .4 How the system is operated.
 - .5 What functions the system performs.
 - .6 Requirements for tests and service.
 - .7 Itemization of all devices connected on the system, their general location.
 - .8 The date of the performed tests.
 - .9 All pertinent details of the report sheets requested.
- .3 Verification:
 - .1 The Commissioning Report to be submitted to the Commissioning Manager upon completion of commissioning and will be subject to verification by the Commissioning Manager.

3.02 SIMULATIONS OF INTERCONNECTED SYSTEMS

- .1 Provide simulations of all interconnected systems in accordance with CAN/ULC-S1001.

End of Section

1 General

1.01 SECTION INCLUDES

- .1 Hands-free/handset color video intercom security system. (Aiphone JP Series)

1.02 REFERENCES

- .1 American National Standards Institute (ANSI/TIA/EIA) 568 - Commercial Building Telecommunications Cabling Standard.
- .2 International Organization for Standards (ISO) 9001:2000 - Quality Management Systems - Requirements.

1.03 SYSTEM DESCRIPTION

- .1 The JP Series shall provide a large 180 mm (7 in) touch screen monitor for clear visitor identification and easy operation control. The JP Series shall be installed at a maximum of 4 door locations and connected to a maximum of 8 inside locations with internal communication between stations. Connection to and integration of CCTV cameras for surveillance capabilities shall be available.
 - .1 The system shall be hard wired and constructed with a 2-wire communication system for the door stations and a Cat5e/6 communication system for the video locations system.
 - .2 Hearing Assistance: Provide T-Coil connection for hearing aids.
- .2 Functional Components: As indicated on the drawings or as required to complete system.
 - .1 Master Station.
 - .1 JP-4MED: Hands-free/Handset color video intercom master station.
 - .2 Sub Master Station:
 - .1 JP-4HD: Hands-free/Handset color video intercom sub master station.
 - .3 Video Door Station:
 - .1 JP-DA: Pan, Tilt & Zoom video door station, surface mount.
 - .2 JP-DV: Pan, Tilt & Zoom vandal-resistant video door station, surface mount.
 - .3 JP-DVF: Pan, Tilt & Zoom vandal-resistant video door station, flush mount.
 - .4 Door Station:
 - .1 GT-D: Audio only door station.
 - .5 Long Distance/CCTV Adaptor:
 - .1 JPW-BA: Long distance/CCTV adaptor.
 - .6 Distribution Adaptor:
 - .1 JP-8Z: Distribution adaptor.
 - .7 Power Supply:
 - .1 PS-2420UL: 24V DC Power supply.

- .8 Call Extension Speaker:
 - .1 IER-2: Call extension speaker.
- .9 External Devices:
 - .1 RY-3DL: Multiple door release adaptor.
 - .2 AC-10S: Access control keypad, surface mount.
 - .3 JP-DV + AC-10S: Pan, Tilt & Zoom vandal-resistant video door station. Surface mounted with access control keypad.
- .3 System Design: Unless noted otherwise on drawings provide system layout as follows. Three wiring methods are possible; Station-to-Station, Centralized Wiring, or Combined Wiring, where both methods are employed in the same system.
 - .1 Provide Station-to-Station Wiring: Directly connect a master station to a sub master station.
 - .1 Maximum distance of farthest sub master from master station: 300 m (980 feet), cumulative.
 - .2 Maximum distance between sub master stations in station-to-station wiring: 98 feet (30 m) when 3 stations are powered off 1 power supply, or 165 feet (50 m) when 2 stations powered off of 1 power supply.
 - .2 Provide Centralized Wiring: Connect master stations, and sub master stations to a central wiring adaptor.
 - .1 Maximum distance of farthest sub master from distribution adapter (JP-8Z): 165 feet (50 m).
 - .2 Maximum distance of master from distribution adapter (JP-8Z): 650 feet (200 m).
 - .3 Maximum cumulative distance of master and sub masters from distribution adapter (JP-8Z): 980 feet (300m).
 - .3 Provide Combined Wiring: Connect a system using both station-to-station and centralized wiring to meet the requirements of the project.
 - .1 Maximum distance between sub master stations in station-to-station wiring: 98 feet (30 m) when 3 stations are powered off 1 power supply, or 165 feet (50 m) when 2 stations powered off of 1 power supply.
 - .2 Maximum distance of sub masters from distribution adapter (JP-8Z): 165 feet (50 m).
 - .4 Provide Expanded Performance:
 - .1 The wiring distance between the door and master stations by using the JPW-BA adaptor shall be a maximum distance of 980 feet (300 m).
 - .2 Connect CCTV and Audio Door Station: Provide security camera connection using the JPW-BA adaptor. Provide for two way communication as indicated or scheduled with a GT-D audio device.
 - .3 Alarm Inputs: The master station and all sub master stations shall send out an alarm notification when the sensor is triggered. Provide door/window contacts, water sensors, and PERS devices as indicated or scheduled.

1.04 SUBMITTALS

- .1 Submit under provisions of Section 01 33 00.
- .2 Product Data: Manufacturer's data sheets on each product to be used, including:
 - .1 Preparation instructions and recommendations.
 - .2 Storage and handling requirements and recommendations.
 - .3 Installation methods.
- .3 Shop Drawings: Submit the following:
 - .1 Wiring Diagrams: Indicate wiring for each item of equipment and interconnections between items of equipment.
 - .2 Include manufacturer's names, model numbers, ratings, power requirements, equipment layout, device arrangement, complete wiring point-to-point diagrams, and conduit layouts.
- .4 Installation and Operation Manuals:
 - .1 Submit manufacturer's installation and operation manual, including operation instructions and component wiring diagrams.
 - .2 Provide detailed information required for Owner to properly operate equipment.
- .5 Warranty: Submit manufacturer's standard warranty.
- .6 Selection Samples: For each finish product specified, two complete sets of color chips representing manufacturer's full range of available colors and patterns.
- .7 Verification Samples: For each finish product specified, two samples, minimum size 6 inches (150 mm) square, representing actual product, color, and patterns.

1.05 QUALITY ASSURANCE

- .1 Manufacturer Qualifications: ISO 9001:2008 certified company.
- .2 Installer Qualifications: Factory trained and experienced with system installations of scope and size required for the Project.
- .3 Mock-Up: Provide a mock-up for evaluation of surface preparation techniques and application workmanship.
 - .1 Finish areas designated by Architect.
 - .2 Do not proceed with remaining work until workmanship is approved by Architect.
 - .3 Refinish mock-up area as required to produce acceptable work.

1.06 DELIVERY, STORAGE, AND HANDLING

- .1 Delivery: Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly identifying product name and manufacturer.
- .2 Storage: Store materials in clean, dry area indoors in accordance with manufacturer's instructions.
- .3 Handling: Protect materials during handling and installation to prevent damage.

1.07 PROJECT CONDITIONS

- .1 Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

2 Products

2.01 MANUFACTURERS

- .1 Acceptable Manufacturer: Aiphone Corp., which is located at: 6670 185th Ave. NE; Redmond, WA 98052 ; Toll Free Tel: 800-692-0200; Tel: 425-455-0510; Fax: 425-455-0071; Email: [request info \(marketing@aiphone.com\)](mailto:request_info@aiphone.com); Web: www.aiphone.com
- .2 Requests for substitutions will be considered in accordance with provisions of Section 01 60 00.

2.02 HANDS-FREE/HANDSET COLOUR VIDEO INTERCOM SYSTEM

- .1 Color Video Intercom System: JP Series Intercom System as manufactured by Aiphone Corporation.
- .2 Room Master Station: JP-4MED 7 inches (180 mm) Digital PTZ Video Master Station with Memory.
 - .1 The JP Series shall accommodate up to 4 Door Stations and 8 Master Stations in a single system.
 - .2 Provide icon driven One Touch Hands Free operation. Touch the screen to communicate with visitors using the built-in microphone and speaker or use the handset at any time during conversation for privacy.
 - .3 Operation: From Master Station. Provide the following.
 - .1 Room Call: Touch screen icon to call a single sub master station or all sub master stations simultaneously.
 - .2 Play: Touch screen icon to play recorded images from door stations.
 - .3 Settings: Touch screen icon to program settings and adjustments.
 - .4 Security: Touch screen icon to activate the security mode or to change security settings.
 - .5 Monitor: Touch screen icon to monitor a door station or sub master station.
 - .6 Option: Touch screen icon to activate the connected external device(s).
 - .4 Available Functions During Monitoring: Provide the following.
 - .1 Pan-Tilt-Zoom/Wide camera control.
 - .2 When monitoring is started, an image shall be shown in wide mode. Pan & Tilt and adjusting images shall be possible from the Master Station.
 - .3 Door release shall be possible from the Master Station.
 - .4 Volume control shall be possible from the Master Station.
 - .5 Manual recording shall be possible from the Master Station.
 - .6 If a CCTV camera is connected instead of a video door station at entrance, provide audio monitoring and communication via the GT-D.

- .5 Physical Characteristics:
 - .1 Power supply: DC 24V (from power supply).
 - .2 Current Consumption: 390 mA.
 - .3 Communication: Handset - Simultaneous communication.
 - .4 Communication: Hands-free - Auto-voice actuation.
 - .5 Ambient Temperature 32 degree F to 104 degree F (0 to 40 degrees C).
 - .6 Monitor: 7 inches (180 mm) color LCD monitor.
 - .7 Mounting: Wall mount.
 - .8 Electrical box: 3-gang box
 - .9 Material: Flame resistant ABS resin.
 - .10 Color: White.
 - .11 Dimensions: 5-11/16 inches H x 10-1/16 inches W x 1-7/8 inches D (145 mm by 255 mm by 48 mm).
 - .12 Weight: Approx. 1.74 lbs (790 g).
- .3 Room Station (Sub Master Station): JP-4HD.
 - .1 Provide icon driven One Touch Hands Free operation. Touch the screen to communicate using the built-in microphone and speaker or use the handset at any time during conversation for privacy.
 - .2 Physical Characteristics:
 - .1 Power supply: DC 24V (from power supply).
 - .2 Current Consumption: 200 mA.
 - .3 Communication: Handset - Simultaneous communication.
 - .4 Communication: Hands-free - Auto-voice actuation.
 - .5 Ambient Temperature: 32 degree F to 104 degrees F (0 to 40 degrees C).
 - .6 Monitor: 7 inch color LCD monitor.
 - .7 Electrical box: 3-gang box.
 - .8 Material: Flame resistant ABS resin.
 - .9 Color: White.
 - .10 Dimensions: 5-11/16 inches H x 10-1/16 inches W x 1-7/8 inches D (145 mm by 255 mm by 48 mm).
 - .11 Weight: Approx. 1.74 lbs (790 g).
 - .3 The JP-4MED shall automatically record images. Recording starts approximately 2 seconds after receiving a call.

- .4 170 degree wide angle and 100 degree vertical angle camera to minimize blind spots, ensuring a clear view of the door station area.
- .5 Zoom for Clarity/ Pan, Tilt for Control:
 - .1 Video door stations feature a wide angle camera to observe more activity behind the door. In addition, digital Pan, Tilt and Zoom can focus on an area for greater detail.
 - .2 Oversized buttons and intuitive icons allow for quick navigation and control. Conventional push buttons shall not be permitted.
 - .3 Equipped with an advanced light adjustment feature to compensate for varying light levels. If a picture is too dark, increase of the brightness level at the door station shall be controlled at the master station.
- .6 Record Images of Visitors:
 - .1 After a call is placed, the JP Series records 6 images per call to internal memory.
 - .2 Provide an SD / SDHC card (not included) as the primary storage location, with which recording frequency increases to 4 pictures per second for up to 10 seconds per call.
 - .3 Provide documentation of outside disturbances by manually recording them at any time.
- .7 Physical Characteristics:
 - .1 Operating Temperature: 14 degrees F to 140 degrees F (-10 to 60 degrees C).
 - .2 Dimensions:
 - .1 JP-DA 5-1/8 inches x 3-7/8 inches x 1-9/16 inches (131 x 99 x 40 mm).
 - .2 JP-DV 6-13/16 inches x 3-7/8 inches x 1 inch (173 x 98 x 25 mm).
 - .3 JP-DVF 8-1/4 inches x 5-5/16 inches x 7/32 inch (209 x 135 x 5.5 mm).
 - .4 JP-DVF back box 7-3/32 inches x 4-3/8 inches x 1-25/32 inches (180 x 110 x 45 mm)
 - .3 Power Supply: DC 24V (from master station).
 - .4 Current Consumption: 90 mA.
 - .5 Mounting:
 - .1 JP-DA: Surface mount to 2x4 electrical box.
 - .2 JP-DV: Surface mount direct to surface.
 - .3 JP-DVF: Flush mount with included back box.
 - .6 Weight:
 - .1 JP-DA: 0.46 lbs (210g).
 - .2 JP-DV: 1.3 lbs (550g).
 - .3 JP-DVF: 1.2 lbs (550g).
 - .4 Back Box: 0.95 lbs (430g).

- .4 Power Supply: PS-2420UL, 24V DC Power supply.
- .5 Call Extension Speaker: IER-2, Call extension speaker
- .6 External Devices:
 - .1 RY-3DL: Multiple (3) door release adaptor.
 - .2 AC-10S: Access control keypad, surface mount.
 - .3 JP-DV+ AC-10S: Pan, Tilt & Zoom vandal-resistant video door station. Surface mounted with access control keypad.
- .7 Long Distance Adaptor: JPW-BA.
 - .1 Power Supply: DC 24V (from power supply)
 - .2 Current Consumption: 90 mA
 - .3 Operating Temperature: 32 degree F to 104 degrees F (0 to 40 degrees C).
 - .4 Mounting: Wall-mount
 - .5 Weight: Approx. 7 oz (200 g).
- .8 Distribution Adaptor: JP-8Z.
 - .1 Power Supply: DC 24V (from power supply)
 - .2 Current Consumption: 90 mA
 - .3 Operating Temperature: 32 degree F to 104 degrees F (0 to 40 degrees C).
 - .4 Mounting: Wall-mount.
 - .5 Weight: Approx. 7.5 oz (210 g).

3 Execution

3.01 EXAMINATION

- .1 Examine areas to receive integrated security and communication system.
- .2 Notify Architect of conditions that would adversely affect installation or subsequent use.
- .3 Do not begin installation until unacceptable conditions are corrected.

3.02 PREPARATION

- .1 Verify the following compliance before starting installation.
 - .1 All units, except for the entrance station and tenant door station, are designed for indoor use only. Do not use outdoors.
 - .2 The unit turns inoperative during power failure.
 - .3 In areas where broadcasting station antennas are close by, intercom system may be affected by radio frequency interference.

- .4 Keep the intercom wires at least 1 foot (30 cm) away from strong electrical wiring (AC 100-240 V) including, in particular, wiring for inverter electrical appliances. Noise and malfunction could result.
- .5 Keep the unit more than 3.3 feet (1 m) away from radio or TV set.
- .6 If a strong light shines on the main unit screen, the picture may turn white or only silhouettes will be visible.
- .7 Other manufacturer's devices (such as sensor, detectors, door releases) used with this system, comply with the manufacturer's installation requirements.
- .8 The LCD panel is manufactured with very high precision techniques, inevitably will have a very small portion of its picture elements always lit or not lit at all. This is not considered a unit malfunction. Please be aware of this in advance.

3.03 INSTALLATION

- .1 Install integrated security and communication system in accordance with manufacturer's instructions at locations indicated on the Drawings.
- .2 Mount equipment plumb, level, square, and secure. For video entrance stations and video door stations, comply with manufacturer's design requirements to provide optimum picture quality of station monitoring.

3.04 SETUP AND ADJUSTING

- .1 Adjust integrated security and communication system for proper operation in accordance with manufacturer's instructions.

3.05 DEMONSTRATION AND TRAINING

- .1 Demonstration:
 - .1 Demonstrate that integrated security and communication system functions properly.
 - .2 Perform demonstration at final system inspection by qualified representative of manufacturer.
- .2 Instruction and Training:
 - .1 Provide instruction and training of Owner's personnel as required for operation of integrated security and communication system.
 - .2 Provide hands-on demonstration of operation of system components and complete system, including user-level program changes and functions.
 - .3 Provide instruction and training by qualified representative of manufacturer.

3.06 PROTECTION

- .1 Protect installed integrated security and communication system from damage during construction.

End of Section

1 General

1.01 SECTION INCLUDES

- .1 Provide a complete system of conduit, pull boxes, outlets, wiring, and devices for a complete working system.

1.02 RELATED REQUIREMENTS

- .1 Section 26 05 33.13 – Conduit for Electrical Systems.
- .2 Section 26 05 33.16 – Boxes for Electrical Systems.

1.03 REFERENCES

- .1 All work must conform to the following industry accepted practices, and manufacturers' component installation guidelines:
 - .1 CSA C22.1 No. 214-17 (R2021), Communications Cables.
 - .2 CAN/CSA-T530, Commercial Building Standards for Telecommunications Pathways and Spaces.
 - .3 CAN/CSA-T529-95, Commercial Buildings Telecommunications Standards.
 - .4 CAN/CSA-T527, Grounding and Bonding Requirements for Telecommunications in Commercial Buildings.
 - .5 CAN/CSA-T528, Administration Standard for the Telecommunications Infrastructure of Commercial Buildings.
 - .6 Ontario Building Code.
 - .7 Ontario Electrical Safety Code.

2 Products

2.01 OUTLETS

- .1 Wall and door outlets shall be single boxes, or 115 mm square boxes with plaster rings to suit single gang devices unless otherwise noted. Coordinate with Security Contractor.

2.02 CONDUITS

- .1 Provide conduit in all walls, exposed areas, and inaccessible ceilings. All conduit work shall be concealed.
- .2 Minimum 21 mm diameter conduit size.
- .3 Provide conduit from outlets back to security panel for wiring.
- .4 Minimum space requirements in pull boxes for 90 degree pulls, as follows:

Maximum conduit size	Size of pull boxes in millimetres			For each additional conduit size increase width by:
	Width	Length	Depth	
21 mm	150 mm	300 mm	100 mm	50 mm
27 mm	200 mm	400 mm	150 mm	75 mm
35 mm	250 mm	450 mm	200 mm	75 mm
41 mm	300 mm	600 mm	250 mm	100 mm
53 mm	350 mm	750 mm	300 mm	125 mm

2.03 INTRUSION DETECTION SYSTEM

- .1 The existing Chubb AFX security and access control systems shall be expanded to accommodate additions devices as shown on the drawings and a new system partition provided for the proposed Daycare addition.
- .2 The system will monitor the facility for intrusion events, and report Security breaches to the security command centre. The system will provide for arming and disarming of the entire system as well as individual system partitions from each system keypad controller.
- .3 System Operation:
 - .1 Upon entering the facility while the Intrusion System is armed, an audible countdown timer will commence at the system keypads. Upon entering the appropriate PIN code into the keypad, the system will be disarmed. Failure to enter the correct PIN code prior to expiration of the countdown timer will activate the building alarm as described herein.
 - .2 The actuation of any armed alarm initiating device, or expiration of the countdown timer will cause the following to occur:
 - .1 Annunciate the event on the ACS. Each event shall be entered into the system event history file by device, location, date, and time.
 - .2 Annunciate the event on each LCD display annunciator/keypad to indicate the device that has alarmed and its location.
 - .3 Sound the alarm horn, and report the event to the off-site Central Monitoring Facility.
 - .3 The main security control panel shall contain initiating circuits, and shall be connected to all necessary equipment to individually and collectively power and effect the operating of the overall security alarm system. All initiating circuits shall be supervised. The control station shall visually annunciate alarm and trouble conditions.
 - .4 The control panel shall be connected to a primary source of 120 volts, through the UL Listed power supply.
 - .5 Sufficient standby power shall be furnished for no less than four hours of overall system operation at full auxiliary power standby load.
- .4 Equipment:
 - .1 LCD Annunciator Control Station Keypad:
 - .1 Each annunciator shall contain a keypad, sounder, and status indicators for armed, status, and power indications and a 32- character backlit alphanumeric LCD display.
 - .2 The annunciator shall have a back-lit keypad backlight dimmer volume control text for alpha numeric displays shall be freely programmable for all points and partitions.

- .3 Keypads shall support all system control functions and shall be able to access status and control of any and all system partitions.
- .4 The keypads shall be connected to the control panel with #22 AWG, unshielded, 4-wire cable and have a maximum of 1000 feet between the devices.
- .5 Keypad shall be Chubb AFX LCD Plus Series
- .2 Field Devices:
 - .1 Motion Detectors: Furnish and install addressable passive infrared detectors as shown on drawings. Provide devices with adjustable wall or ceiling-mount brackets as indicated on plans or required by site conditions.
 - .2 Concealed Door Contacts: Provide DPDT door contacts with a Form C output where shown and required on the plans. Provide recessed contacts for steel frame doors, and SPDT contacts for overhead doors. Provide addressable Contact Input Modules to monitor conventional devices where otherwise required.

2.04 INTRUSION DETECTION DEVICES

- .1 Motion Sensors (for Security) – Honeywell DT7450C.
- .2 Door Contacts – Sentrol 1078.
- .3 Sirens – Alarmsaf BG-1/HWPOS driver and Burtek SP30 with white finish and surface mounted.

2.05 ACCESS CONTROL DEVICES

- .1 Card Readers – Integrated Control Technology PRX-TSEC-EXTRA-KP-BT-W

2.06 CABLING

- .1 Provide from each device to security panel.
- .2 Provide homerun wiring individually to match existing security wiring in conduit for each security device back to security panel located in Corridor as shown on drawings.

2.07 ACCEPTABLE SUPPLIER/INSTALLER

- .1 Chubb Fire & Security (Archie Galang) – 410 Lewis Road, Unit #18, Stoney Creek, ON, L83 5Y7 (Telephone: 519-580-0917; email: archie.galang@chubbfd.com)
- .2 Other Chubb certified contractors are invited to bid with the understanding that the following information must be submitted to the consultant a minimum of one week prior to tender close for consideration.
 - .1 Confirmation that the contractor has been in business at least 5 years providing installation and testing of similar services.
 - .2 A minimum of five references for whom you have provided services.
 - .3 Confirmation of general and failure to perform liability insurance with a minimum \$5,000,000.00 coverage.
 - .4 Confirmation of valid Workers Compensation coverage.
- .3 Note: All bidding security sub-contractors must be CHUBB reps or CHUBB certified installer.

3 Execution

3.01 INSTALLATION

- .1 Vertically mount outlet boxes, unless noted otherwise, 300 mm to centre above floor, or 150 mm above countertops where shown at counters or benches.
- .2 Fish conduit, clear blockages and outlet and clean out pull boxes at completion of installation. Leave conduit free of water or excess moisture. Install No. 12 gauge galvanized soft iron pull wire, or 1/8 inch nylon pull cord continuously from outlet to outlet, through conduit and fasten at each box.
- .3 Conduit bend radius of not less than nine times conduit diameter. Ream out conduit and identify ends with green paint.
- .4 Install additional steel pull boxes in such a manner that, throughout entire system, there shall be not more than two 90 degree or equivalent bends or more than 30 000 mm in each run, so that wire or cables may be pulled in or withdrawn with reasonable ease. Minimum space requirements in pull boxes having one conduit each in opposite ends of the box, shall be as follows:

<u>Maximum conduit size</u>	<u>Size of pull boxes in millimetres</u>			<u>For each additional conduit size increase</u> <u>Width by:</u>
	<u>Width</u>	<u>Length</u>	<u>Depth</u>	
21 mm	150 mm	300 mm	100 mm	50 mm
27 mm	200 mm	400 mm	150 mm	75 mm
35 mm	250 mm	450 mm	200 mm	75 mm
41 mm	300 mm	600 mm	250 mm	100 mm
53 mm	350 mm	750 mm	300 mm	125 mm

- .5 Provide main conduit system from security panel location to addition area and separate 21 mm conduits from main junction boxes to each device.
- .6 Show as-installed conduit routing and location of all pull boxes on the record drawings, prior to project completion, for use by Security installer to facilitate wiring and equipment installation. Include above noted information on final record drawings at project completion.

End of Section

Part 1 General

1.1 MEASUREMENT PROCEDURES

- .1 Asphalt paving will be measured as noted in the Form of Tender, including all excavation, base preparation, compaction and all incidental items required to complete the installation as shown on the drawings and details.

1.2 REFERENCE STANDARDS

- .1 Ontario Provincial Standard Specifications:
 - .1 OPSS 1101 – Performance Graded Asphalt Cement
 - .2 OPSS 1150 – Material Specification for Hot Mix Asphalt
 - .3 OPSS 1003 – Aggregates – Hot Mix Asphalt
 - .4 OPSS.MUNI 310 - Construction Specification for Hot Mix Asphalt
 - .5 The Contractor shall have the current copies of all OPSS forms and details mentioned in this specification on the site for the duration of this work.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for asphalt mixes and aggregate and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Test and Evaluation Reports:
 - .1 Submit manufacturer's test data and certification that asphalt cement meets specification requirements.
 - .2 Submit asphalt concrete mix design and trial mix test results to Consultant for review at least 4 weeks prior to beginning Work.
 - .3 Submit printed record of mix temperatures at end of each week.
 - .1 Compaction and materials tests as per Section 01450 – Quality Control and Testing.
 - .2 Testing to be conducted for this section of work is as follows:
 - .1 Sub-grade to be minimum 98% Standard Proctor Maximum Dry Density
 - .2 Granular B compacted to 100% Standard Proctor Maximum Dry Density
 - .3 Granular A compacted to 100% Standard Proctor Maximum Dry Density
 - .4 HL8 Asphalt compacted to 96.5% MRD; to be tested for compaction, content, grain size and mix.
 - .5 HL3 Asphalt compacted to 96.5% MRD; to be tested for compaction, content, grain size and mix.

1.4 QUALITY CONTROL

- .1 The asphalt contractor shall have a minimum of five (5) years of experience in asphalt paving work.
- .2 Asphalt plants, spreading equipment and rollers and asphalt paving to meet the requirements of the current applicable OPSS sections.
- .3 Haul trucks to be of adequate size, spread and condition to ensure orderly and continuous operation. Employ suitable hand tools.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Coarse and fine aggregates shall be stored separately, in free draining stockpiles and in such a manner as to prevent contamination and segregation.
- .3 When necessary to blend aggregates from one or more sources to produce required gradation, do not blend in stockpiles.

Part 2 Products

2.1 MATERIALS

- .1 Asphalt Surface:
 - .1 Asphalt work materials and measurements to conform to applicable details.
 - .2 Prime coat: MTO Primer or SS-1 to OPSS 1103.
 - .3 Tack coat: SS-1 to OPSS 1103.
 - .4 Asphalt concrete: to OPSS 1150 as modified by items 5 and 6 below.
 - .5 Hot mix, hot laid HL3 – Reclaimed Asphalt Pavement (RAP) is **not** permitted due to use of streetbond epoxy-modified, acrylic, waterborne coating
 - .6 Hot mix, hot laid HL4 – Reclaimed Asphalt Pavement (RAP) is **not** permitted to use of streetbond epoxy-modified, acrylic, waterborne coating
 - .7 Granular base as indicated on drawings.

2.2 EQUIPMENT

- .1 Pavers: Mechanical grade controlled, self-powered pavers capable of spreading mix within specified tolerances, true to line, grade and crown indicated conforming to OPSS 310.06.01. Blade graders are not permitted for spreading asphalt.
- .2 Rollers: Sufficient number of rollers of type and mass to obtain specified density of compact mix in accordance with OPSS 310.06.02.

Part 3 Execution

3.1 SAW-CUTTING

-
- .1 The limits of existing asphalt to be removed shall be saw-cut prior to asphalt removal. If edge damage occurs during the repair work, the contractor shall saw-cut back beyond the damaged area prior to asphalt placement.
 - .2 Prior to the placement of the hot-mix asphalt, the exposed vertical sides of the surrounding pavement shall be tack coated using SS-1 emulsified asphalt.
- 3.2 SUBGRADE
- .1 Set out work to lines and levels shown on Drawings. Gain approval from the Consultant of lines and levels prior to sub-base installation. Maintain such lines and levels for duration of work.
 - .2 Excavate and prepare all subgrade as noted on details. Remove and dispose of existing unsuitable subgrade materials off site.
 - .3 Verify grades of subgrade for conformity with elevations and sections before placing base material.
 - .4 Disturbed subgrade or clean fill shall be compacted to 100% of Standard Proctor Density in accordance with ASTM D698-70.
 - .5 Obtain subgrade approval from the Consultant prior to placing base material.
- 3.3 GRANULAR BASE
- .1 Exercise caution at all times to prevent base material from becoming contaminated by clay or other deleterious materials.
 - .2 Place base material to compacted thickness as indicated on drawings.
 - .3 Place in layers not exceeding 150mm compacted thickness. Compact to density not less than 100% of Standard Proctor Density in accordance with ASTM D698-70.
 - .4 The granular base surface shall be rolled continuously, compacted and bladed as necessary.
 - .5 The granular base surface shall be within 10 mm of specified grade, but not uniformly high or low.
 - .6 Gain approval from the Consultant of the installed granular base. Installation of asphalt can only commence after granular base test results confirm that the specified compaction has been achieved.
- 3.4 TRANSPORTATION OF ASPHALT MIX
- .1 Transport mix to job site in vehicles cleaned of foreign material.
 - .2 Paint or spray truck beds with light oil, limewater, soap or detergent solution, at least once a day or as required. Elevate truck bed and thoroughly drain. No excess solution will be permitted.
 - .3 Schedule delivery of material for placing during daylight hours.

- .4 Deliver material to pave at a uniform rate and in an amount within the capacity of the paving and compacting equipment.
- .5 Deliver loads continuously in covered vehicles and immediately spread and compact. Deliver and place mixes at a temperature recommended by OPSS documents.
- .6 Air temperature during placing of mixture shall be minimum 7°C (45°F) and rising. Temperature of mixture when spread shall be not less than 120°C (245°F) nor more than 150°C (300°F). Do not increase temperature of mixture to offset long distance hauling.

3.5 ASPHALT PLACING

- .1 Place asphalt to thickness, grades and lines indicated on drawings to provide continuously draining surface free of water ponding such that existing surface drainage is not disrupted.
- .2 Asphalt shall not be placed during rainfall, or on a surface which is wet or covered by ice or snow, or if the temperature is below recommendations in OPSS documents.
- .3 Compact asphaltic mixture as soon as it can bear roller without undue displacement or hair cracking and continue until all roller marks are eliminated. Keep speed of roller slow enough to avoid displacement of mixture. Keep roller wheels slightly moistened by water to prevent adhesion of mixture. Excess water is not permitted. Compact mixture with hot tampers in locations that are not easily accessible to machine roller.
- .4 Use self propelled Class 'B' roller for initial and final rolling.

3.6 COMPACTING

- .1 Roll asphalt continuously to a density not less than 92% of density obtained with Marshall specimens prepared from samples of mixture being used.

3.7 PAVEMENT CONSTRUCTION

- .1 Application of prime coat: OPSS 302.
- .2 Construction of asphalt concrete: OPSS 310.07.

3.8 FINISH TOLERANCES

- .1 Upon completion of compaction each pavement course shall be:
 - .1 Smooth and true to crown and grade with variation not more than 3mm from thickness shown on drawings. Do not place any asphaltic course less than 25mm thick or more than 75mm thick.
 - .2 Finished asphalt surface to be within 10mm of design elevation, but not uniformly high or low, and with no irregularities greater than 10mm within every 4.5m.
 - .3 Compacted to a density of Maximum 96.5% MRD.

3.9 DEFECTIVE WORK

- .1 Correct irregularities which develop before rolling is completed, by loosening surface mix and removing or adding material, as required. If irregularities or defects remain after final compaction, remove surface course promptly and lay new material to form a true and even surface and compact immediately to specified density.
- .2 Repair areas showing checking or hairline cracking.
- .3 Repair any areas exhibiting water ponding, preferably with seamless repair methodology.

3.10 JOINTS

- .1 Cut back bituminous course to its full depth in straight or curved lines as required to expose a fresh, straight, vertical surface. Remove broken and loose material.
- .2 Asphalt shall be placed in such a manner that the joint shall not be allowed to cool before adjacent asphalt course is applied.
- .3 Overlap previously laid strip with spreader by 150mm, plus or minus 50mm.
- .4 Carefully place and compact hot asphaltic material against joints. Correct any unsatisfactory joint before proceeding with work.
- .5 Feathering of joints is not permitted.

3.11 CLEANING

- .1 After completion of asphalt work and prior to final inspection, clean all areas contaminated by asphaltic or other materials resulting from the work.

END OF SECTION

Part 1 GENERAL

1.1 DESCRIPTION

- .1 This Section specifies the work requirements for supply and installation of Streetbond 150 Asphalt and Concrete Coatings.
 - .1 StreetBond Advanced Coatings are specifically formulated for application to asphalt and concrete pavement and have been confirmed by a certified testing facility to possess a balance of performance properties for a durable and color-fast finish.
 - .2 Qualifications. Only Accredited StreetBond Applicators may bid for and perform the this work. Please refer to Section 1.3 DEFINITIONS.
 - .3 StreetBond products are manufactured in ISO9001 / ISO14001 facilities to ensure quality products produced in legally-responsible and environmentally-conscious manner.
 - .4 StreetBond coatings are only available in Canada from HUB Surface Systems (www.hubss.com).
 - .5

1.2 GENERAL

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

1.3 MEASUREMENT AND PAYMENT

- .1 StreetBond Pavement Markings will be measured as noted in the Form of Tender, surface preparation and all incidental items required to complete the installation as shown on the drawings and details.

1.4 REFERENCES

- .1 Comply with following, which are invoked and form part of this specification section, as modified by this section:
 - .1 American Society for Testing and Materials International, (ASTM), latest edition:
 - .1 ASTM D-4541 Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Tester.
 - .2 ASTM D-4060 Test Method for Abrasion Resistance of Organic Coatings by the Taber Abraser.
 - .3 ASTM D-2697 Standard Test Method for Volume of Nonvolatile Matter in Clear or Pigmented Coatings.
 - .4 ASTM D522-93A Standard Test Method for Mandrel Bend Test of Attached Organic Coatings.
 - .5 ASTM D1653 Standard test method for water vapor transmission through organic film coatings.

- .6 ASTM G-154 QUV Accelerated Weathering Environment. Standard Practice for Operating Fluorescent Light Apparatus for UV Exposure of Nonmetallic Materials.
- .7 ASTM D 2369 Weight Solids Standard test method for Volatile Content of Coatings.
- .8 ASTM D 1475 Standard Test method for Density of Paint, Varnish, Lacquer, Other related products.
- .9 ASTM D-2240 (2000) Standard Test Method for Rubber property – Durometer hardness.
- .10 ASTM D-5895 Standard Test Method of drying or curing during film formation of organic coatings using mechanical recorders.
- .11 ASTM D-570 Standard Test Method for water absorption of plastics.

1.5 DEFINITIONS

- .1 Definitions of the referenced ASTM and CSA sections are invoked and apply to this section.
- .2 “Accredited StreetBond Applicator” has valid Certification for both Textured (stamped) and Non-Textured (flatwork) as offered by Quest Construction Products and are reviewed on an annual basis. All Accredited StreetBond Applicators have been qualified by Quest Construction Products to perform the Work and offer a product Warranty.
- .3 “Approved Applicator” has valid Certification for non-textured (flatwork) application ONLY as offered by Quest Construction Products and are reviewed on an annual basis. Product Warranties may be available to Approved Applicators but require approval and supervision by a Quest Construction Products Technical Sales Representative.
- .4 “Applicator” means the installer of the StreetBond coatings.
- .5 “Owner” means the Owner and refers to the representative person who has decision making authority for the Work.
- .6 “TSR” is a HUB Technical Sales Representative who manages the StreetBond product in a given territory.
- .7 “Stamped asphalt pavement” is asphalt pavement that has been subjected to imprinting or texturing in a specific pattern.
- .8 “Non-Stamped asphalt pavement” is asphalt pavement that is unstamped and is sometimes referred to as “flatwork”.
- .9 The “Work” is the asphalt pavement texturing work contemplated in this bid submission and specification.
- .10 “Scuffing” is a “tear” of the asphalt pavement caused by an external force – for example turning the steering wheel of a stationary vehicle. Scuffing is generally the result of poorly designed or improperly installed asphalt and would most-commonly be seen on weaker residential asphalt.

- .11 “Layer” is a signal thin pass of coating, applied with a texture spray gun, which is allowed to dry before the next layer is applied.
- .12 “Warranty” is a guarantee to the property owner that StreetBond150, when properly applied will not peel, delaminate or show abnormal wear over specific period of time depending on the traffic volumes and number of layers applied. Warranty shall follow Manufacturer’s most current Warranty Guide.

1.6 QUALITY CONTROL

- .1 Installer: Only Accredited StreetBond Applicators may bid for and perform the this work. Please refer to Section 1.3 DEFINITIONS.
 - .1 Certificates: A copy of the Accreditation Certificate, available from the Applicator, is required.
 - .2 Submittals
 - .3 Submit samples in accordance with Section 01 40 00 – Quality Requirements and 01 33 00 Submittal Procedures.
 - .4 Submit samples of the following:
 - .1 Coating Colours:
 - .1 Samples for verification: Three 100mmx100mm colour samples of each paint colour. Samples shall use actual paint coatings mounted on plywood backing illustrating colours and textures selected.
 - .1 Submit samples of unit paver to both LGA Architects and Aboud & Associates Inc. (Landscape Architects).
 - .2 Accepted samples become the standard of acceptance for the product produced.
 - .3 Test results from an independent testing laboratory for compliance of concrete pavers with ASTM C 936.
 - .4 Manufacturer’s catalog product data, installation instructions, and material safety data sheets for the safe handling of the specified materials and products.
 - .5 Installer and Manufacturer’s warranty.
 - .5 Submit schedule of coatings to Consultant for review prior to installation.
 - .6 Shop Drawings: For traffic coatings, indicate the following:
 - .1 Location and extent of traffic coatings, including colour, dimensions, width of linework.

1.7 REQUIREMENTS.

- .1 Pre-Installation:
 - .1 Layout all patterns and linework prior to the application of Streetbond coatings for review and approval by Architect/Landscape Architect.

- .2 Pre-Installation Meetings: conduct pre-installation meeting to verify project requirements, manufacturer's installation instructions and manufacturer's warranty requirements.

1.8 DELIVERY, STORAGE & HANDLING

- .1 In accordance with Conditions of the Contract and Division 1 Product Requirement Section. (Modify this to match the general conditions of the specific project)
- .2 Store and protect materials free from mud, dirt and other foreign materials and in accordance with manufacturer's recommendations.

Part 2 PART 2 – PRODUCTS

2.1 STREETBOND COATINGS

- .1 StreetBond150 is a premium epoxy-modified, acrylic, waterborne coating specifically designed for application on asphalt pavements. It has a balance of properties to ensure good adhesion and movement on flexible pavement, while providing good durability. StreetBond150 is durable in both dry and wet environments.
- .2 StreetBond Colorant is a highly concentrated, high quality, UV stable pigment blend designed to add color to StreetBond150 coatings. One unit of Colorant shall be used with one pail of StreetBond coating material.
- .3 Properties of StreetBond coatings
 - .1 The following tables outline the test results for physical and performance properties of the **StreetBond** coatings as determined by an independent testing laboratory.

TABLE 1: Typical Physical Properties of StreetBond Coatings.

Characteristic	Test Specification	SB150
Solids by Volume	ASTM D-2697	53.712%
Solids by Weight	ASTM D-2369	71.020%
Density	ASTM D-1475	13.27 lbs/gal (1.58kg/l)

TABLE 2: Typical Performance Properties of StreetBond Coatings

Characteristic	Test Specification	SB150
Dry time (To re-coat)	ASTM D-5895 23°C; 37% RH	35 min
Taber Wear Abrasion Dry H-10 wheel	ASTM D-4060 1 day cure	0.760g/1000 cycles
Taber Wear Abrasion Wet H-10 wheel	ASTM D-4060 7 days cure	1.670g/1000 cycles
QUV Accelerate Weathering Environment	ASTM G-151 ΔE 1,500hrs.	0.53 (Brick)

Hydrophobicity Water Absorption	ASTM D-570	11.945%
Shore hardness	ASTM D-2240	38.3
Mandrel Bend	ASTM D522-93A	1/4" @ 21° C
Permeance	ASTM D-1653	3.45g/m ² / 24hr/mmHg (52 mils)
VOC	per MSDS	19.14%
Adhesion to Asphalt	ASTM D-4541	Substrate Failure
Friction Wet	ASTM E-303 British Pendulum Tester	Wet=77.3 Dry=81.3

Certificates of Analysis are available upon request for each of these properties.

.4 Product Requirements:

- .1 Style: Streetbond 150
- .2 As manufactured by: HUB Surface Systems
 - .1 Contact: Doug Bain
 - .1 Email: doug.bain@hubss.com
 - .2 Phone:(416) 540-9287
 - .3 Address: 430 Black Drive Milton, ON L9T 6S1
 - .2 Colours:
 - .1 Colour 1: SR Safety Blue
 - .2 Colour 2: Paprika
 - .3 Colour 3: CL Shamrock Green
 - .4 Colour 4: Marigold

2.2 EQUIPMENT FOR STREETBOND APPLICATION

- .1 The equipment described has been designed specifically for optimal application of StreetBond coatings. Other equipment may or may not be suitable and could compromise the performance of the StreetBond coatings and/or reduce crew productivity.
 - .1 The SB Flex Sprayer is a proprietary coating sprayer supplied by Intech Equipment and is capable of applying the StreetBond coatings to the asphalt pavement surface in a thin, controlled film which will optimize the drying and curing time of the coating. A Graco RTX and RapidSprayerII sprayer may also be used.
 - .2 The StreetBond Coatings Mixer is a motorized mixing device designed to ensure efficient and thorough blending of the StreetBond components.
 - .3 Backpack or Hand-Held sprayer to apply the diluted StreetBond Adhesion Promoter Concentrate.
 - .4 The RapidFinisher II is an electric powered broom produced by Integrated Paving Concepts Inc. that can be used in the application of StreetBond coatings to improve productivity. It is especially useful on larger projects.

Part 3 PART 3 - Execution

3.1 GENERAL

- .1 **StreetBond coating** shall be supplied and applied on non-textured asphalt or concrete surface by an **Accredited StreetBond Applicator** in accordance with the plans and specifications or as directed by the Owner. Do not begin installation without confirmation of an Accreditation Certificate. Specifications for the execution of the **StreetPrint®** system can be found at www.hubss.com.

3.2 PRE-CONDITIONS

- .1 The condition of the asphalt or concrete substrate will impact the performance of the **StreetBond** coatings. A highly stable pavement free of defects is recommended.
 - .1 Pre-requisites for new asphalt and concrete pavement
 - .1 A durable and stable pavement formulation installed according to best practices over a properly prepared and stable substrate is a pre-requisite for all long-lasting asphalt pavement surfaces.
 - .2 Pavement Marking Removal: recommended guidelines
 - .1 Pavement markings may be removed by sandblasting, water-blasting, grinding, or other approved mechanical methods. The removal methods should, to the fullest extent possible, cause no significant damage to the pavement surface.
 - .2 The Consultant shall determine if the removal of the markings is satisfactory for the application of **StreetBond** coatings. Work shall not proceed until this approval is granted.
 - .3 Surface Preparation
 - .1 The asphalt or concrete pavement surface shall be dry and free from all foreign matter, including but not limited to dirt, dust, de-icing materials, and chemical residue.

3.3 APPLICATION OF STREETBOND COATINGS

- .1 Coating Application Guidelines:
 - .1 The asphalt pavement surface shall be completely dry and thoroughly cleaned prior to application of the coatings.
 - .2 The coating application shall proceed as soon as practical upon completion of the imprinting of the asphalt pavement where applicable.
 - .3 For polished asphalt, **StreetBond Adhesion Promoter** should be applied directly to the asphalt and allowed to dry completely prior to the first layers of coating.

- .4 For concrete surfaces, **StreetBond Concrete Primer WB** or **StreetBond Concrete Primer QS** should be applied and allowed to cure prior to the first layers of coating. Please consult Technical Data sheets for more details on applications.
- .5 The first layer of coating shall be spray or roller applied then broomed to work the coating material into the pavement surface. Subsequent applications shall be sprayed or rolled then broomed or rolled. Each application of coating material shall be allowed to dry to the touch before applying the next layer.
- .6 The **Applicator** shall apply the **StreetBond** coatings only when the air temperature is 50°F / (10°C) and rising and will not drop below 50°F / (10°C) within 24 hours. No precipitation should be expected within 24 hours.

3.4 COATING COVERAGE & THICKNESS

- .1 Coating coverage and thickness is as outlined in **TABLE 4** below. Actual coverage may be affected by the texture of the asphalt pavement substrate and the imprint pattern selected. There will be less coverage with the first layer and higher coverage with subsequent layers.
- .2 Install four (4) layers of StreetBond coatings for all identified decorative asphalt painting per at rates identified in Table 4 and Table 5 below..

TABLE 4: COATING COVERAGE AND THICKNESS

# OF LAYERS	COVERAGE (approx.)		THICKNESS (approx.)			
	NON-TEXTURED		WET		DRY	
	sqft/unit*	sqm/unit*	mm	mil	mm	mil
3	200	18.6	0.84	33	0.48	19
4	150	13.9	1.12	44	0.66	26
5	120	11.2	1.40	55	0.81	32
6	100	9.3	1.68	66	0.97	38

*1 unit is a nominal 5 gallon pail comprising Part A, Part B and Colorant (approximately 4.12 gallons). 1 unit when sprayed as a single layer covers approximately 600sqft (55.7 sqm), with an approximate thickness of 6.3mil (0.16mm) dry.

3.5 COATING COVERAGE RATES

- .1 Please check with Quest Construction Products in advance to confirm the recommended application for the climate conditions at the project location. TABLE 5: Recommended Coating Coverage Rates

Application	Temperate/Winter Climate
Pedestrian only	3 layers at 600 ft ² (56m ²) per 5 gallon (20 Litre) unit for a net coverage of 200 ft ² (18.6m ²) per 5 gallon (20 Litre) unit
Residential driveway	3 layers at 600 ft ² (56m ²) per 5 gallon (20 Litre) unit for a net coverage of 200 ft ² (18.6m ²) per 5 gallon (20 Litre) unit
Vehicular traffic	
Up to 500 cars per day per lane	4 layers at 600 ft ² (56m ²) per 5 gallon (20 Litre) unit for a net coverage of 150 ft ² (13.9m ²) per 5 gallon (20 Litre) unit

3.6 CLEANING

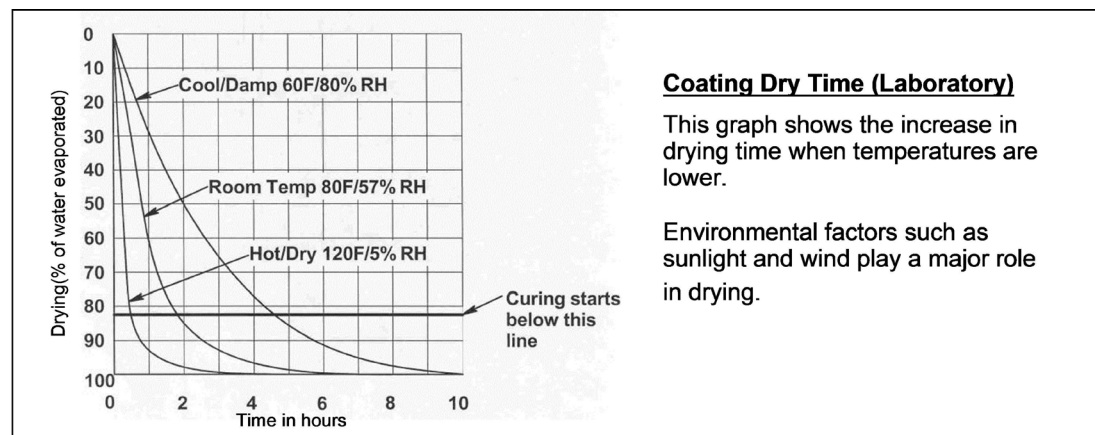
- .1 Cleaning: Remove excess dirt, debris, stains, grit, etc. from Streetbond 150 coated surfaces.
 - .1 Clean in accordance with the manufacturer’s written recommendations.

3.7 PROTECTION

- .1 Protect completed work from damage due to subsequent construction activity on the site.

3.8 OPENING TO TRAFFIC

- .1 Minimally, StreetBond150 coating must be 100% dry and sufficient curing time must be allowed before traffic is permitted on the surface.
- .2 TABLE 6: COATING DRY TIMES (TYPICAL)



- .3 If StreetBond coatings are applied when moisture cannot evaporate, then the coating will not dry. The drying and curing of StreetBond coatings have a direct impact on performance.

3.9 MAINTENANCE MANUAL

- .1 Contractor to provide recommended maintenance program developed in conjunction with Manufacturer outlining:
 - .1 Care and cleaning requirements
 - .2 Maintenance requirements
 - .3 Repair requirements.

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Synthetic turf surfacing, including artificial turf, subbase preparation and placement of aggregate base course, and turf infill.
- B. Related Information:
 - 1. Division 32 Section "Aggregate Base Courses"
 - 2. Division 33 Section "Subdrainage" for piping and drainage course serving as subbase for synthetic turf surfacing.

1.2 REFERENCES

- A. ASTM International (ASTM): www.astm.org:
 - 1. ASTM D1335 - Test Method for Tuft Bind of Pile Yarn Floor Coverings.
 - 2. ASTM D2859 - Standard Test Method for Ignition Characteristics of Finished Textile Floor Covering Materials.
 - 3. ASTM E648 - Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source.

1.3 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Conference: Conduct conference at Project site following award of contract. Review methods and procedures related to synthetic turf surfacing installation including, but not limited to, the following:
 - 1. Review survey of subbase conditions.
 - 2. Review delivery, storage, and handling procedures.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product specified.
- B. Shop Drawings: Provide installation details including roll and seaming layout, methods of attachment and details at penetrations and terminations
 - 1. Show layout of marking plan if any, indicating details for specified activity areas.
- C. Samples: For each type of synthetic turf surfacing indicated.
 - 1. Minimum 12-by-12-inch- square sample of synthetic turf surface with tufted perimeter line and carpet seam.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Installation Schedule: Showing planned commencement and completion dates for each portion of the Work; include critical dates indicated on Owner's project schedule.

- C. Warranty: Sample warranty specified in this Section.

1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A firm experienced in manufacturing synthetic turf surfacing materials similar to those specified for this project, with a record of successful service for a minimum of 5 years.
- B. Installer Qualifications: An experienced Installer certified by the manufacturer, employing workers trained and approved by manufacturer.
- C. Source Limitations: Obtain synthetic turf surfacing materials through one source from a single manufacturer.
 - 1. Provide secondary materials including adhesives, paint, thread, and repair materials of type and from source recommended by manufacturer of synthetic turf surfacing materials.

1.7 PROJECT CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit synthetic turf surfacing installation to be performed according to manufacturers' written instructions and warranty requirements.

1.8 COORDINATION

- A. Coordinate installation of synthetic turf surfacing's with installation of site paving, playground equipment, adjacent lawns, landscaping materials, site lighting, and related work.

1.9 WARRANTY

- A. Manufacturer's Warranty: Submit manufacturer's standard published limited warranty form in which manufacturer agrees to repair or replace components of synthetic turf surfacing installation installed by manufacturer-certified Installer that fail in materials under normal use and maintenance, or provide other relief, within specified warranty period.
 - 1. Failures include ultraviolet degradation, backing integrity, more than 50 percent loss of face fiber, and loss of tuft bind strength.
 - 2. Warranty Period: Life of product.
- B. Installer Project Warranty: Submit synthetic turf surfacing Installer's warranty, signed by Installer, covering the Work of this Section, including installation of all components of synthetic turf surfacing system, for the following warranty period:
 - 1. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis of Design Manufacturer: Subject to requirements of this Section, provide listed products of SYNLawN, Dalton GA 30721; (866) 796-5296; info@synlawn.com; www.synlawn.com.
 - 1. Submit requests for substitution in accordance with Instructions to Bidders and Division 01 General Requirements.

- B. Source Limitations: Obtain synthetic turf surfacing materials through one source from a single manufacturer.
 - 1. Provide secondary materials including adhesives, paint, thread, and repair materials of type and from source recommended by manufacturer of synthetic turf surfacing materials.

2.2 PERFORMANCE REQUIREMENTS

- A. Certification: Provide synthetic turf surfacing system with safety performance testing certified by IPEMA.
- B. Fire-Test-Response Characteristics: Provide products with the critical radiant flux classification indicated in Part 2, as determined by testing identical products per ASTM E648 by an independent testing and inspecting agency acceptable to authorities having jurisdiction.
- C. Accessibility Requirements: Comply with applicable provisions in Accessibility of Ontarians with Disabilities Act, 2005 (AODA) and City of Toronto Accessibility Design Guidelines for recreation surfaces.
 - 1. Provide synthetic turf system meeting requirements of ASTM F1951.

2.3 SYNTHETIC TURF SURFACING

- A. Synthetic Turf Surfacing: Complete surfacing system, consisting of delustered UV-stabilized antimicrobial synthetic yarns bound to water-permeable bio-based primary and secondary backing. IPEMA-certified. Non-abrasive blades with low surface temperature. Anti-Static and Ultra Violet reflective pigment-enhanced.
 - 1. Basis of Design Product: **SYNLawn SYNAugustine 547**.
 - 2. Artificial Turf Fiber and Construction Characteristics:
 - a. Yarn, Turf Zone: Polyethylene; soft omega shape.
 - 1) Color: Field green/Olive/Apple.
 - 2) Denier, ASTM D1577: 9900/9.
 - 3) Antimicrobial Protection: Sanitized[®]
 - 4) Antistatic Protection: StatBlock[™]
 - 5) IR Reflective: DualChill[™]
 - b. Yarn, Thatch Zone: Polyethylene.
 - 1) Color: Field green/Beige.
 - 2) Denier: 5000/8.
 - c. Finished Pile Height, ASTM D5823: 1-3/8 inch.
 - d. Finished Pile Weight, ASTM D5848: 50 oz/sq. yd.
 - e. Tuft Machine Gauge: 3/8 inch.
 - f. Backing, Primary: Polypropylene, 2 layers with fiber-reinforcing core.
 - g. Backing, Secondary: 22 oz. urethane.
 - 1) Enviroloc+[™]
 - a) Anti Fungi and Anti Algae blended into secondary backing.
 - 2)
 - h. Total Weight: 78 oz./sq. yd.
 - i. Temperature-Reducing Infill: Silica sand and moisture-retaining coated sand ballast.
 - 3. Performance Characteristics:
 - a. Tuft Bind, ASTM D1335: Not less than 8 lb.
 - b. Grab tear strength, ASTM D5034: Not less than 200 lbf.

- c. Elongation to break, ASTM D2256: Not less than 30 percent.
- d. Yarn breaking strength, ASTM D5793: Not less than 20 lb.
- e. Foot Traffic Rating: 5.
- f. Softness Rating: 5.
- g. Flammability, ASTM D2859: Pass.
- h. Fire Test Exposure, ASTM E108: Class A

B.

2.4 SUPPLEMENTARY TURF SURFACING MATERIALS

- A. Turf Spikes: Manufacturer's approved fasteners.
- B. Nailer Board: Manufacturer's approved nailer/edger board.
- C. Curbing: Profile and extent as indicated on Drawings.

2.5 MATERIALS

- A. Infill Material: Silica sand in manufacturer's recommended formula for application to synthetic turf surfacing.
 - 1. Product: SYNLawN, Envirofill.
 - a. Color: Green.
- B. Glue, Seaming Fabric, and Thread: As recommended by manufacturer for application.
- C. Aggregate Base Course: 19mm Crusher Run Limestone

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine synthetic turf surfacing base and perimeter conditions, with Installer present, for compliance with requirements for installation tolerances, and other conditions affecting performance of the Work.
 - 1. Verify substrate meets profile required.
 - 2. Confirm base material, compaction of substrate, permeability, and drainage system installation meets requirements.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 SUBBASE PREPARATION

- A. General: Prepare substrates to receive surfacing products according to synthetic turf surfacing manufacturer's written instructions. Verify that substrates are sound and without high spots, ridges, holes, and depressions. Remove organic debris. Grade soil subgrade level and compact.
- B. Finish grade soil subgrade with slope between 0.5 percent and 1.0 percent toward path of site drainage.

1. Compact subgrade in both directions with mechanical compacting equipment to achieve specified compaction at 98 percent SPMDD.
2. Prepare subgrade to tolerance of within 0.5 inch of design grade.
3. Prepare subgrade within 0.25 inch in 10 feet in any direction from design grade entire playing surface.

3.3 AGGREGATE COURSE INSTALLATION

- A. Place aggregate base course, compact by tamping with plate vibrator to 98 percent SPMDD, and screed to depth indicated. Install 3-inch base course unless otherwise indicated.
 1. Slope base course between 0.5 percent and 1.0 percent, measured from the longitudinal center of the installation towards the edges. Grade base course to tolerance of within 0.5 inch of design grade, and with a maximum variation of 0.25 inch in 10 feet in any direction.
- B. Install perimeter boards as indicated on approved submittals.

3.4 SYNTHETIC TURF INSTALLATION

- A. General: Comply with synthetic turf surfacing manufacturer's written installation instructions. Install synthetic turf surfacing over area and in thickness indicated.
- B. Artificial Turf: Loose-lay artificial turf and allow fabric to relax for period recommended by manufacturer. Stretch turf sheet and attach at perimeter and in field of turf in accordance with approved submittals.
- C. Seaming: Form seams flat and snug, with no gaps or fraying. Remove yarns that are trapped within seams. Form seams as recommended in synthetic turf manufacturer's written instructions using manufacturer's provided or recommended materials.

3.5 INSTALLATION, INFILL

- A. Mix and install infill material components in accordance with manufacturer's requirements for approved system. Groom material and leave surface ready for use.

3.6 PROTECTION

- A. Protect completed installation from damage. Prevent traffic over system prior to acceptance by Owner.

3.7 DEMONSTRATION

- A. Instruct Owner's personnel in proper inspection and maintenance of synthetic turf surfacing. Review manufacturer's recommended maintenance procedures and warranty terms and conditions.

END OF SECTION

Part 1 GENERAL

1.1 SCOPE OF WORK

- .1 To supply and install chain link fence, gates and posts as required by School Board. To make any necessary repairs as required. Stake-outs are the responsibility of this contractor, and shall be undertaken as required.
- .2 Submitted prices are as per the unit price, and no consideration will be given to minimum charges and site and weather conditions. Quotation sheets shall match format of bid form and show all quantities. Any extra work shall be noted separately on quotation sheet.

1.2 MAKING GOOD

- .1 The Contractor shall be responsible for making good all damage caused directly or indirectly by the execution of any part of this contract. All damage shall be repaired to the satisfaction of, and at no additional cost to the Owner.

1.3 FENCE INSTALLATION

- .1 The contractor shall supply and install all fence material and foundation material as per provided specifications.
- .2 The contractor shall ensure that all disturbed areas are restored to original condition or better.
- .3 The contractor shall be responsible for utility stakeouts before conducting any underground work.

Part 2 PRODUCTS

2.1 MATERIALS

- .1 Concrete mixes and materials Cast-in-Place Concrete and CSA-A23.1. Compressive strength: 25 MPa minimum at 28 days. 4-7% Air entrainment.
- .2 Fencing shall be supplied with black vinyl coated mesh and black powder coated posts, railings, hardware, and fittings.
- .3 Chain-link fence fabric: to CAN/CGSB-138.1.
 - .1 Type 1, Class A, medium style
 - .2 Mesh size: 38mm x 38mm.
 - .3 Wire size: 9 Gauge including vinyl with galvanized steel core.
 - .4 Height of fabric as indicated on drawings.
- .4 Posts, braces and rails: to CAN/CGSB-138.2, galvanized steel pipe, standard weight.
 - .1 End Posts and Gate Posts: 60.3 mm diameter for fences up to 1524mm in height; 88.9 mm diameter for fences over 1524mm in height.
 - .2 Line Posts: 60.3 mm outer diameter for fences up to 2438m in height

- .3 Top Rails: 42.2 mm outer diameter.
- .4 Bottom Rails: 42.2 mm outer diameter.
- .5 Mid Rails: Not required for fences up to 1524mm in height; 42.2mm outer diameter for fences greater than 1524mm in height.
- .5 Tie wire fasteners: to CAN/CGSB-138. 1, single strand, aluminum (on 305mm centers).
- .6 Tension bar: to ASTM A525M, 5 x 19 mm minimum galvanized steel, flat.
- .7 Swing Gates: All posts shall be 88.9mm O.D.
- .8 Swing gate diagonal brace: 42.2mm O.D.
- .9 Gate frames: to ASTM A53, galvanized steel pipe, standard weight, 42.2 mm outside diameter pipe for outside frame
 - .1 Fabricate gates as indicated with electrically welded joints, and hot-dip galvanized after welding.
 - .2 Fasten fence fabric to gate with twisted selvage at top.
 - .3 Furnish swing gates with galvanized malleable iron hinges, latch and latch catch with provision for padlock, which can be attached and operated from either side of installed gate.
 - .4 Furnish sliding gate with galvanized malleable rear wheels, end and line brackets, 305mm double-wheel carrier, latch and latch catch with provision for padlock, which can be attached and operated from either side of installed gate.
- .10 Fittings and hardware: to CAN/CGSB-138.2, cast aluminum alloy, galvanized steel or malleable or ductile cast iron. Tension bar bands: 5x19 mm minimum galvanized steel.
- .11 Post caps to provide waterproof fit, to fasten securely over posts and to carry top rail.
- .12 Organic zinc rich coating: to CAN/CGSB-1.181.

2.2 FINISHES

- .1 Galvanizing:
 - .1 For chain link fabric: to CAN/CGSB-138.1. Grade 1 coating
 - .2 For pipe: 550 g/m² to ASTM A90.
 - .3 For other fittings: to CAN/CSA-G 164.
 - .4 Vinyl coating: Black .1 (0.045) mm dry film thickness minimum
- .2 Painting
 - .1 Painted posts, rails, gates and hardware shall be finished in a black gloss enamel powder coat application. Prior to powder coating all surfaces are to be chemically cleaned and treated with Parker Bonderite and Chlorothene solvent or approved equivalents. Powder coating must be a Polyester 2000 series applied in a thickness of 4-5 mils by electrostatic coat and oven cured to a smooth even finish.

Part 3 PART 3 - Execution

3.1 GRADING

- .1 Remove debris and correct ground undulations along fence line to obtain smooth uniform gradient between posts. Provide clearance between bottom of fence and ground surface of 25 mm to 50 mm.

3.2 ERECTION OF FENCE

- .1 Erect fence along lines as indicated and in accordance with CAN/CGSB-138.3.
- .2 Excavate post holes to 1200 mm below finished grade level. Width of footing to be 250mm for post O.D. of 60.3mm; 355mm for post O.D. of 88.9mm.
- .3 Space line posts 2438mm Min – 3048mm Max apart, measured parallel to ground surface.
- .4 Space straining/terminal posts at equal intervals not exceeding 50 m if distance between end or corner posts on straight continuous lengths of fence over reasonably smooth grade is greater than 50m.
- .5 Install additional straining/terminal posts at sharp changes in grade. Install corner post where change in alignment exceeds 20 degrees. Install end/terminal posts at end of fence and at buildings. Install gate posts on both sides of gate openings.
- .6 Place concrete in post holes then embed posts into concrete to 100 mm above bottom of concrete. Terminate concrete 100 mm below ground level and slope to drain away from posts. Brace to hold posts in plumb position and true to alignment and elevation until concrete has set.
- .7 Do not install fence fabric until concrete has cured a minimum of 7 days.
- .8 Install brace between end and gate posts and nearest line post, placed in center of panel and parallel to ground surface. Install braces on both sides of corner and straining posts in similar manner.
- .9 Install top rail between posts and fasten securely to posts and secure waterproof caps.
- .10 Install bottom tension wire, stretch tightly and fasten securely to end, corner, gate and straining posts with turnbuckles and tension bar bands.
- .11 Lay out fence fabric. Stretch tightly to tension recommended by manufacturer and fasten to end, corner, gate and straining posts with tension bar secured to post with tension bar bands spaced at 300 mm intervals. Knuckled selvedge at bottom. Twisted selvedge at top.
- .12 Secure fabric to top rails, line posts and bottom tension wire with tie wires at 300 mm intervals. Give tie wires minimum two twists.

3.3 INSTALLATION OF GATES

- .1 Install gates in locations as indicated.
- .2 Level ground between gate posts and set gate bottom minimum 25-50 mm above ground surface within swing path. Install gate latch as indicated.

3.4 TOUCH UP

- .1 Clean damaged surfaces with wire brush removing loose and cracked coatings. Prime with two coats of organic zinc-rich paint to damaged areas. Pre-treat damaged surfaces according to manufacturers' instructions for zinc-rich paint.

3.5 CLEANING

- .1 Clean and trim areas disturbed by operations. Dispose of surplus material.

END OF SECTION

Part 1 General

1.1 MEASUREMENT PROCEDURES

.1 Payment for site furniture will be made as per plan quantities Components included in Contract price include:

.1 All labour, materials, equipment and incidental services necessary (including shipping, storage, delivering to supply and install site furnishings)

1.2 QUALITY CONTROL

.1 Submit product data in accordance with Section 01 33 00 - Submittal Procedures.

.2 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.

.3 Indicate dimensions, sizes, colour, assembly, anchorage and installation details for each product specified.

.4 Contractor to inspect all exterior site furnishings after delivery for signs of damage during transit

.5 Contractor to protect all parts of exterior site furnishings from damage during storage and installation.

.6 Consultant to confirm location and orientation of site furnishings prior to anchoring by contractor

1.3 WASTE MANAGEMENT AND DISPOSAL

.1 Remove from site and dispose of packaging materials at appropriate facilities.

Part 2 Products

2.1 Storage Shed

.1 Brooklin Concrete Products.

.1 Model: Model 40 precast concrete utility building with door.

.2 Material: Concrete

.3 Colour: N/A

.2 Supplier: Brooklin Concrete Products, P: 705-324-8265; E: brooklinsales@brooklin.com

.3 Contractor to provide shop drawing of storage shed assembly for review by Consultant.

Part 3 Execution

3.1 INSTALLATION

- .1 Examine areas to receive furniture.
- .2 Notify Consultant of conditions that would adversely affect installation or subsequent use.
- .3 Do not begin installation until unacceptable conditions are corrected.
- .4 Assemble and install furnishings in accordance with manufacturer's instructions.
- .5 Repair minor damages to finish in accordance with manufacturer's instructions and as reviewed by Consultant and accepted by the Owner.
- .6 Remove and replace damaged components that cannot be successfully repaired as determined by Consultant.
- .7 Clean furniture promptly after installation in accordance with manufacturer's instructions.
- .8 Do not use harsh cleaning materials or methods that could damage finish.
- .9 Protect installed furniture for the duration of construction to ensure that, except for normal weathering, furniture will be without damage or deterioration at time of Substantial Completion.

END OF SECTION

Part 1 General

1.1 DESCRIPTION

- .1 This section specifies the work requirements for supply, installation, and fine grading of topsoil.

1.2 MEASUREMENT PROCEDURES

- .1 Preparation of sub-grade, supply, placing, spreading and finish grading of contractor supplied topsoil will be measured per plan quantities for surface area covered and depth specified. Testing for soil quality is included as part of the base price.
- .2 Payment for supply, application and mixing of soil amendments required by test results will be measured in standard commercial units of volume/weight, as determined by the Consultant

1.3 QUALITY ASSURANCE

- .1 Topsoil testing is a required component of the work.
- .2 Perform one test for each source of on-site or imported topsoil.
 - .1 Testing of on-site topsoil shall be carried out by a soil testing laboratory accredited by the Ontario Ministry of Agriculture, Food and Rural Affairs. The nearest testing laboratory to the project site is:
 - .1 Agri-Food Laboratories
1-503 Imperial Road North
Guelph Ontario N1H 6T9
T:519.837.1600 F:519.837.1242
 - .2 Soil sampling, testing and analysis to be in accordance with Provincial standards.
 - .1 BASIC AGTEST TOPSOIL REPORT
 - .1 pH, Total Salts, % Organic Matter, Phosphorus, Potassium, Magnesium, Calcium, Sodium, Chloride, Sodium Absorption Ratio, CEC, Texture (%Sand, %Silt, %Clay)
 - .1 Including soil modification and fertility recommendations
 - .3 Contractor shall pay for cost of tests
 - .4 Submit soil testing report to consultant for review prior to amending topsoil.

Part 2 Products

2.1 TOPSOIL SOURCE

- .1 Use on-site topsoil supplied by owner where possible.
- .2 Where on-site topsoil is to be supplemented by external sources, test and amend as required.

2.2 TOPSOIL QUALITY

- .1 Ensure that any topsoil used is free from:
 - .1 Debris and stones over 25mm diameter.
 - .2 Course vegetative material, 10 mm diameter and 100 mm length, occupying more than 2% of soil volume.
 - .3 Contain no toxic elements or growth inhibiting materials.
- .2 Topsoil: mixture of particulates, micro organisms and organic matter which provides suitable medium for supporting intended plant growth.
 - .1 pH ranging from 5.5 to 7.5
 - .2 Organic Matter from 4 to 15%
 - .3 Phosphorus from 10-60 parts per million
 - .4 Potassium from 80-250 parts per million
 - .5 Calcium from 1000-4000 parts per million
 - .6 Magnesium from 100-300 parts per million
 - .7 Chloride less than 100 parts per million
 - .8 Sodium less than 200 parts per million
 - .9 Sand Fraction from 20 - 75%
 - .10 Silt Fraction from 5 - 30%
 - .11 Clay Fraction from 5 - 30%
 - .12 Consistency: friable when moist.

2.3 SOIL AMENDMENTS

- .1 Fertilizer:
 - .1 Fertilizer:

-
- .1 Conform to recommendations from soil testing agency with respect to improvement of tested topsoil and apply as specified for each condition.
 - .2 Industry accepted standard medium containing nitrogen, phosphorus, potassium and any other micro-nutrients suitable to the specific plant species or application or defined by the soil test.
- .2 Peatmoss:
- .1 Derived from partially decomposed species of Sphagnum Mosses.
 - .2 Elastic and homogeneous, brown in colour.
 - .3 Free of wood and deleterious material which could prohibit growth.
 - .4 Shredded particle minimum size: 5 mm.
- .3 Sand: washed coarse silica sand, medium to course textured.
- .4 Organic matter: such as compost, rotted manure, hay, straw, bark residue or sawdust, meeting the organic matter, stability and contaminant requirements.
- .5 Limestone:
- .1 Ground agricultural limestone.
 - .2 Gradation requirements: percentage passing by weight, 90% passing 1.0 mm sieve, 50% passing 0.125 mm sieve.
- .6 Bonemeal: Finely ground with a minimum analysis of 3% nitrogen and 20% phosphoric acid.

Part 3 Execution

3.1 PREPARATION OF EXISTING GRADE IN LANDSCAPE AREAS

- .1 Verify that rough grading has been completed and grades are correct. If discrepancies occur, notify Consultant and do not commence work until supplemental instruction is issued by Consultant.
- .2 Grade soil, eliminating uneven areas and low spots, ensuring positive drainage.
- .3 Remove debris, roots, branches, stones in excess of 25mm diameter and other deleterious materials. Remove soil contaminated with calcium chloride, toxic materials and petroleum products. Remove debris which protrudes more than 50mm above surface. Dispose of removed material off site.
- .4 Cultivate entire area which is to receive topsoil to minimum depth of 300mm. Cross cultivate those areas where equipment used for hauling and spreading has compacted soil.

3.2 PLACING AND SPREADING OF TOPSOIL/PLANTING SOIL

- .1 Place topsoil after Consultant has reviewed subgrade.
- .2 Spread topsoil in uniform layers not exceeding 150 mm.
- .3 For sodded areas keep topsoil 25mm below finished grade.
- .4 Spread topsoil as indicated to following minimum depths after settlement.
 - .1 150mm for sodded areas.
 - .2 600mm depth for perennials and shrubs.
 - .3 900mm depth for trees.
- .5 Manually spread topsoil/planting soil around existing trees, shrubs and obstacles.

3.3 FINISH GRADING

- .1 Grade to eliminate rough spots and low areas to promote positive drainage. Prepare loose friable bed by means of cultivation and subsequent raking.
- .2 Consolidate topsoil to required bulk density using equipment reviewed by Consultant. Leave surfaces smooth, uniform and firm against deep footprinting.

3.4 ACCEPTANCE

- .1 Supply topsoil testing reports and documentation of amendments completed.
- .2 Consultant will review topsoil in place for general conformance of material, depth of topsoil, and finish grading.

3.5 SURPLUS MATERIAL

- .1 Dispose of materials except topsoil not required off site.

3.6 CLEANING

- .1 Upon completion of installation, remove surplus materials, rubbish, tools and equipment barriers.

END OF SECTION

Part 1 General

1.1 DESCRIPTION

- .1 This section specifies the work requirements for supply, installation, establishment supports, and establishment maintenance of turf grass sod.

1.2 MEASUREMENT PROCEDURES

- .1 Payment for nursery sod will be made as per plan quantities
- .2 Components included in bid price include: All labour, materials, equipment and incidental services necessary to supply, install, and maintain turf grass sod to the full extent of the contract documents.
 - .1 Bid price for sodding to include establishment period maintenance only.

1.3 SCHEDULING

- .1 Schedule sod laying to coincide with preparation of soil surface.
 - .1 Coordinate sod laying with project work by others.
- .2 Schedule sod installation when frost is not present in ground.

Part 2 Products

2.1 MATERIALS

- .1 Number One Turf Grass Nursery Sod: sod that has been especially sown and cultivated in nursery fields as turf grass crop.
 - .1 Turf Grass Nursery Sod type:
 - .1 Number One Kentucky Bluegrass Sod - Fescue Sod: Nursery Sod grown solely from seed mixture of cultivars of Kentucky Bluegrass and Chewing Fescue or Creeping Red Fescue, containing not less than 50% Kentucky Bluegrass cultivars and 30% Chewing Fescue or Creeping Red Fescue cultivars.
 - .2 Turf Grass Nursery Sod quality:
 - .1 Not more than 2 broadleaf weeds or 10 other weeds per 40 square metres.
 - .2 Density of sod sufficient so that no soil is visible from height of 1500 mm when mown to height of 50 mm.
 - .3 Mowing height limit: 35 to 65 mm.

- .4 Soil portion of sod: 6 to 15 mm in thickness.
- .2 Water:
 - .1 Free of impurities that would inhibit plant growth.
 - .2 Supplied by Contractor.
- .3 Fertilizer:
 - .1 To Canada "Fertilizers Act" and "Fertilizers Regulations".
- .4 Topsoil:
 - .1 See section 32 91 21 Topsoil Placement and Grading for topsoil requirements

Part 3 Execution

3.1 PREPARATION

- .1 Verify that grades are correct and depth of topsoil is satisfactory. Notify Consultant if discrepancies exist, do not proceed until supplemental instruction is issued by Consultant.
- .2 Do not perform work under adverse field conditions such as frozen soil, excessively wet soil or soil covered with snow, ice, or standing water.
- .3 Fine grade surface free of humps and hollows to smooth even grade, to contours and elevations indicated, to tolerance of plus or minus 30 mm, for Turf Grass Nursery Sod, surface to drain naturally.
- .4 Remove and dispose of weeds; debris; stones 50 mm in diameter and larger; soil contaminated by oil, gasoline and other harmful materials; off site.

3.2 SOD PLACEMENT

- .1 Lay sod within 24 hours of being lifted.
- .2 Lay sod sections in rows, joints staggered. Butt sections closely without overlapping or leaving gaps between sections. Cut out irregular or thin sections with sharp implements.
- .3 Provide close contact between sod and soil by light rolling. Use of heavy roller to correct irregularities in grade is not permitted.
- .4 Water soil immediately after laying to a depth of 100mm.

3.3 MAINTENANCE DURING ESTABLISHMENT PERIOD

- .1 Perform following operations from time of installation until acceptance or for 12 weeks after work is completed, whichever is later.
 - .1 Water sodded areas in sufficient quantities and at frequency required to maintain to obtain optimum soil moisture conditions to depth of 75 mm to 100 mm.
 - .2 Cut grass to 50 mm when or prior to it reaching height of 75 mm. Remove clippings which will smother sod and seeded areas.
 - .3 Maintain sodded areas 95% weed free.

3.4 ACCEPTANCE

- .1 Turf Grass Nursery Sod areas will be accepted by Consultant provided that:
 - .1 Sodded areas are properly established.
 - .2 Sod is free of bare or dead spots and extent of weeds apparent in grass is acceptable.
 - .3 No surface soil is visible from height of 1500 mm when grass has been cut to height of 50 mm

- .4 Sodded areas have been cut a minimum of two (2) times prior to acceptance.
 - .2 Areas sodded in the fall will be accepted the following spring one month after start of growing season provided acceptance conditions are fulfilled.
- 3.5 MAINTENANCE DURING WARRANTY PERIOD
- .1 Maintenance to be provided by others under separate contract with Owner.

END OF SECTION

Part 1 General

1.1 DESCRIPTION

- .1 This section describes the requirements for the supply and installation for plant material of different stock sizes and types, accessories, planting, mulching, maintenance, acceptance and warranty information.

1.2 REFERENCES

- .1 Comply with following, which are invoked and form part of this specification section, as modified by this section:
 - .1 Canadian Landscape Standard, First Edition: Appendix G: Canadian Nursery Stock Standard (Ninth Edition), Canadian Society of Landscape Architects and Canadian Landscape Association
 - .2 International Code of Nomenclature for Cultivated Plants, International Society for Horticultural Science
 - .3 ANSI Standard – 133-1, American Standards for Tree Care Operations
 - .4 ANSI A-300, Best Management Practices - Tree Planting
 - .5 ANSI A-300, Best Management Practices - Part 1, 2008 (R2014) Pruning Standard
 - .6 ANSI A-300, Best Management Practices - Part 6, Transplanting Standard

1.3 MEASUREMENT PROCEDURES

- .1 Payment for planting will be made at per plan quantities.
 - .1 Basis of contract price for items included in this section shall be full compensation for all labour, equipment, supply of materials, installation, and establishment maintenance, completed as described herein and as shown on the contract drawings. Warranty maintenance will be provided by the Owner.

1.4 SUBMITTALS

- .1 Submit product data and samples for:
 - .1 Mulch.
 - .2 Growing Medium.
 - .3 Polypropylene type tree tie (Arbortie Green or approved equivalent).

- .2 Submit monthly maintenance reports from time of planting to end of establishment period growing season (May to September) describing:
 - .1 Maintenance work carried out.
 - .2 Watering method, quantity of water used, water source.
 - .3 General development and condition of plant material.
 - .4 Preventative or corrective measures required which are outside Contractor's responsibility.

1.5 QUALITY ASSURANCE

- .1 Planting work is to be carried out by experienced personnel under the direction of a skilled site superintendent.
- .2 Notify Consultant within five (5) working days of pending plant shipment for inspection of plant material prior to shipping to site.
- .3 All plants to be in conformance with Canadian Landscape Standard, First Edition: Appendix G: Canadian Nursery Stock Standard (Ninth Edition)
- .4 There shall be no substitutions of plant materials without prior written approval from the Consultant.
- .5 Contractor shall be responsible for ensuring plant materials delivered to the site are in conformance with the contract documents.

1.6 STORAGE AND PROTECTION

- .1 Protect plant material from frost, excessive heat, wind and sun during delivery.
- .2 Immediately store and protect plant material that will not be installed within 2 hours after arrival at site in storage location reviewed by Consultant.
- .3 Protect plant material from mechanical damage, exposure, and extreme temperatures during transportation:
 - .1 Use enclosed vehicle where practical.
 - .2 Protect foliage and root balls using anti-desiccants and tarpaulins, where use of enclosed vehicle is impractical.
 - .3 Tie, wrap and pad branches and trunks securely to protect against abrasion, exposure and extreme temperature. Avoid binding of plant stock with rope or wire that would damage bark, break branches or destroy the natural shape of the plant. Plant material at no time shall be dropped or handled roughly,
 - .4 Loading and unloading: handle containerized plants by pots to reduce breakage of branches or leaves, handle balled & burlapped and wire basket plants with caution to maintain the firmness of the root balls and protection against damage to stems and branches. Lift wire baskets by attachments at minimum three points or by supporting below the rootball. Trunks

shall be supported in relation to the rootball to prevent tearing of roots or loosening of the rootball. Support shall be such that the cambium is not damaged.

- .4 Protect stored plant material which will not be planted during the current day's operations from frost, wind and sun and as follows:
 - .1 For pots and containers, maintain moisture level in containers, heel in fibre pots.
 - .2 For balled and burlapped and wire basket root balls, heel in or cover rootballs with protective medium such as sawdust, mulch, peat moss or topsoil place to protect branches from damage. Store plants in a upright positions, with care taken to provide enough space between plants to allow light to reach all around to the bottom of the plant in order to avoid sunscald or burning when plants are planting in final location. Maintain moisture level in root zones.
- .5 Where inadvertent damage to plants occurs, Contractor shall document damage and notify supplier and Consultant. Where Consultant accepts plant material despite the damage, prune broken branches back to the appropriate branch collar or bud, with care to avoid tearing of the stem bark, wounds shall be traces to remove shattered bark back to firm cambium without damaging the cambium or enlarging the wound in accordance with ANSI A-300 Best Management Practices - Part 1, 2008 (R2014) Pruning Standard.
- .6 Waste Management and Disposal:
 - .1 Manage waste removal and disposal as per Section 01 74 00.

1.7 SCHEDULING

- .1 Plant bare root plant material during dormancy between spring thaw and May 1st or between October 31st and winter freeze-up
- .2 Plant potted, balled and burlap, and wire basket plant material between April 15th and June 15th or September 1st and November 30th
- .3 Notify Consultant of schedule 7 days in advance of shipment of plant material.
- .4 Schedule to include:
 - .1 Quantity and type of plant material.
 - .2 Shipping dates.
 - .3 Arrival dates on site.
 - .4 Planting Dates.

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- .5 Schedule delivery such that plant material spends a maximum of 36 hours stored on site prior to planting.
 - .6 Coordinate shipping of plants and excavation of planting pits to ensure minimum time lapse between digging and planting
 - .7 Where planting is postponed, plant material shall be stored and maintained with protection and irrigation procedures described in this section.

1.8 WARRANTY

- .1 The Contractor hereby warrants that all plant material as itemized on plant list will remain free of defects, in accordance with GC 12.3 - WARRANTY and an additional 12 months, as required by the City of Waterloo, from the date of substantial performance or interim substantial performance dates as governed by GC 5.4 – Substantial Performance of the Work.
 - .1 Acceptable Survivability rates for planting stock are quantified in 3.8 ACCEPTANCE in this section.
 - .2 Replacements:
 - .1 During warranty period, remove from site any plant material that has died or failed to grow satisfactorily as a result of pests, diseases or failure to provide winter protection, as determined by Consultant.
 - .2 Extend warranty on replacement plant material for a period equal to the original warranty period.
 - .3 Continue such replacements and extend warranty until plant material is acceptable.
 - .4 Warranty of replacements shall not apply where replacement is necessary due to vandalism or inadequate maintenance carried out by others.
 - .3 End of warranty inspection will be conducted by Consultant.
 - .4 The Consultant reserves the right to extend Contractor's warranty responsibilities for an additional year if, at end of initial warranty period, leaf development and growth is not sufficient to ensure future survival, in the opinion of the Consultant.

Part 2 Products

2.1 PLANT MATERIAL

- .1 Type of root preparation, sizing, grading and quality: comply with Canadian Landscape Standard, First Edition: Appendix G: Canadian Nursery Stock Standard (Ninth Edition) referring to size and development of plant material and root ball. Measure plants when branches in their natural position. Height and spread dimensions refer to main body of plant and not from branch tip to branch tip. Use trees and shrubs of No. 1 grade.
 - .1 Source of plant material: All plants shall have been grown in Canada or the north eastern United States and be hardy within the Canadian Plant Hardiness Zone 5a. Plant materials obtained from areas with milder climatic conditions are not acceptable.
- .2 All plant material to:
 - .1 conform to the International Code of Nomenclature for Cultivated Plants and the latest addition of standardized plant names;
 - .2 be true to form and type and representative of their species or variety, densely foliated, structurally sound with well developed branch and root systems;
 - .3 have normal, well-developed branches and vigorous, fibrous root systems have been developed through proper cultivation practices. Plants shall be healthy, vigorous, free from defects, decay, girdling roots, sunscald, injuries, abrasions of the bark, plant diseases, insect pests' eggs, borers and all forms of infestation.
 - .4 be compact and properly proportioned, not weak or thin, or injured by being planted too closely in nursery rows; plants shall have healthy tops to a size proportionate to the root requirements typical of the species or variety. Rootball sizes shall be of sufficient width and depth to encompass enough of the fibrous and absorptive root system to enable full recovery of the plan. Rootballs must be solid and remain intact.
 - .5 have proper development of wound wood surrounding past pruning.

- .3 Deciduous trees shall have a dominant healthy single leader, sturdy straight trunks, well branched and balanced crowns (unless multi-stem form has been specified) and overall natural form characteristic of the species and variety.
- .4 Trees larger than 200 mm in caliper: half root pruned during each of two successive growing seasons, the latter at least one growing season prior to arrival on site.
- .5 Balled & burlapped and Wire Basket: must be dug with root ball in accordance with Canadian Landscape Standard, First Edition: Appendix G: Canadian Nursery Stock Standard (Ninth Edition).
- .6 Collected stock: maximum 40 mm in caliper, with well developed crowns and characteristically branched; no more than 40% of overall height may be free of branches.
- .7 Collected plant material: not acceptable.

2.2 WATER

- .1 Free of organic or chemical contaminants detrimental to humans, animals, healthy plant growth and the environment.
- .2 Supplied by Contractor.

2.3 STAKES

- .1 38mm x 38mm x 2300mm wood stake pointed at one end.

2.4 TREE TIES

- .1 Polypropylene type tree tie (Arbortie Green or approved equivalent) installed per manufacturers recommendations

2.5 GROWING MEDIUM

- .1 Use existing topsoil on site where possible, amend as recommended by testing required in Section 32 91 21 Topsoil Placement and Grading.
- .2 Where imported topsoil is used, perform testing required in Section 32 91 21 Topsoil Placement and Grading and amend as recommended in testing report.

2.6 TRUNK PROTECTION

- .1 PVC Spiral Tree Guard: 60cm high perforated spiralled strip.

2.7 MULCH

- .1 Shredded Pine Mulch (SPM) by GroBark or approved equivalent
 - .1 Non-dyed
 - .2 Composition: 75% or greater bark fiber and 25% or less wood fiber

- .3 pH: 3.8-5.5
- .4 Size gradation: 95% less than 2"
- .5 Organic Matter 70-85% by weight
- .6 Moisture Content 44-55%
- .7 Free of noxious weeds and seeds or other live plant materials.

2.8 ANTI-DESICCANT

- .1 Wax-like emulsion to provide film over plant surfaces reducing evaporation.

Part 3 Execution

3.1 PRE-PLANTING PREPARATION

- .1 Ensure all vegetation control, grading works and other site preparation works are complete and has been reviewed by Consultant for general conformance prior to planting.
- .2 Ensure plant material has been reviewed by Consultant.
- .3 Remove damaged roots and branches from plant material.
- .4 Apply anti-desiccant to conifers and deciduous trees in leaf in accordance with manufacturer's instructions.
- .5 Remove rejected and excess material from the Place of Work within 48 hours

3.2 EXCAVATION AND PREPARATION OF PLANTING BEDS

- .1 Contractor shall verify the locations of all utilities and shall take adequate precautions against any damage. In the event of damage, Contractor shall notify utility company immediately and shall make or pay for required repairs to the satisfaction of the utility company at no additional cost to the Owner.
- .2 Establishment of sub-grade for planting beds is specified in Section 31 22 13.
- .3 Preparation of planting beds is specified in Section 32 91 21 - Topsoil and Fine Grading.

- .4 For individual planting holes:
 - .1 Stake out location for Consultant review prior to excavating.
 - .2 Excavate planting pits in location, size and depths as indicated on Drawings
 - .3 Remove subsoil, rocks, roots, debris greater than 50mm in diameter and toxic material from excavated material that will be used as planting soil for trees and individual shrubs. Dispose of excess material.
 - .4 Excavation of subgrade below rootball shall only be as necessary to permit the bottom of the rootball to sit on undisturbed material or compacted fill such that the top of the rootball remains at the proper finished grade. Disturbed subgrade or fill below the rootball shall be compacted to 95% SPDD to prevent settlement of tree after planting.
 - .5 Where topsoil in planting pit is different in texture, structure or organic content from the surrounding soils or where planting pits are dug by mechanical means, pits shall have all sides scarified to a minimum depth of 100mm and the two soils mixed thoroughly. This is to ensure that there are no glazed surfaces or abrupt interfaces that could impede root development.
 - .6 Where poor drainage is suspected due to soil texture or standing water is observed, notify Consultant to obtain rectification methods to drain planting pit(s) prior to commencing with planting operations. Methods may include but are not limited to penetrating impervious soil layers, raising planting grade and/or adding drainage lines.
 - .1 Remove water which enters excavations prior to planting. Notify Consultant immediately if water source is ground water.

3.3 PLANTING

- .1 Do not perform work under adverse field conditions such as frozen soil, excessively wet soil or soil covered with snow, ice, or standing water. Planting frozen rootballs is not acceptable.
- .2 For plant material in burlapped root balls and wire basket root balls, cut away and remove all string, rope, wire, burlap and other restricting elements from top one-third of root ball. Do not pull burlap, rope or wire from bottom two-thirds of rootball.
- .3 Treated burlap (i.e. burlap that is green), for plant material in plastic and fibre containers, remove and dispose of entire container, all wrappings, and tags, without disturbing rootball.
- .4 Identify root collar (trunk flare) in burlapped and potted root balls, carefully remove overburden soil to uncover portion of collar. Trunk flare shall be 25mm to 50mm visible after tree is planted.
- .5 Plant material shall be set plumb and oriented to give best appearance in relation to structures, roads and walkways. Orient plant material to give best appearance in relation to structures, roads and trails.
- .6 For trees and shrubs:
 - .1 Backfill soil in 150mm lifts using native soil. Tamp each lift to eliminate air pockets. When two thirds of depth of planting pit has been backfilled, fill remaining space with water. After water has penetrated into soil, complete remaining one-third of backfilling to finish grade. Correct any settlement
 - .2 Form watering saucer as indicated on Drawings.
- .7 For ground covers, backfill soil evenly to finish grade and tamp to eliminate air pockets.
- .8 Water all plant material thoroughly.
- .9 After soil settlement has occurred, fill with soil to finish grade.
- .10 Dispose of burlap, wire and container material off site.

3.4 TRUNK PROTECTION

- .1 Install trunk protection on deciduous trees as indicated per manufacturer's directions, carefully bend branches upward as needed without breaking.
- .2 Install trunk protection prior to installation of tree supports when used.
- .3 Remove trunk protection as per maintenance requirements.

3.5 TREE SUPPORTS

- .1 Install tree supports as indicated.
- .2 Use single stake tree support for deciduous trees less than 3 m.
 - .1 Place stake on prevailing wind side and 150 mm from trunk.
 - .2 Drive stake minimum 150 mm into undisturbed soil beneath roots. Ensure stake is secure, vertical and unsplit.
 - .3 Install Arbortie per manufacturer's instructions.
- .3 After tree supports have been installed, remove broken branches with clean, sharp tools.

3.6 MULCHING

- .1 Ensure mulch sample has been submitted and reviewed by Consultant prior to spreading.
- .2 Ensure soil settlement has been corrected prior to mulching.
- .3 Spread mulch in continuous beds and as indicated in Drawings.

3.7 MAINTENANCE RESPONSIBILITIES DURING ESTABLISHMENT PERIOD

- .1 Perform following maintenance operations from time of planting to acceptance by Consultant:
 - .1 Water to maintain soil moisture conditions for optimum establishment, growth and health of plant material without causing erosion.
 - .1 Water newly planted plants at least once per week for the first four weeks, such that the water penetrates to a minimum depth of 300mm and the sufficiently thereafter to maintain optimum growing conditions.
 - .1 Water in early morning, late afternoon, early evening or when weather is cool to minimize water evaporation by sun and humidity.
 - .2 Water plants thoroughly in late fall prior to freeze-up to saturate soil around root system.
 - .2 Soil moisture to be monitored throughout the growing season:
 - .1 Watering schedule to be increased prior to plant materials reaching the permanent wilting point.
 - .2 Watering schedule to be reduced when a sufficient volume of rainfall has penetrated the soil fully as required
 - .3 Remove weeds in planting beds.

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- .1 Control outbreaks of perennial weeds and annual weeds by mechanical or chemical means utilizing acceptable integrated pest management practices to meet acceptance/success targets
 - .1 If chemical means are used, comply with Federal, Provincial and Municipal regulations as and when required to control unwanted vegetation.
 - .4 Replace or respread damaged, missing or disturbed mulch in planting beds.
 - .5 Report to Consultant any pests or diseases inflicting any plant material. The principles of Integrated Pest Management (IPM) should be applied to control insect pests, diseases, and invasive and noxious plants. IPM methods should be a combination of physical, cultural, biological and chemical methods chosen for the most effective, environmentally safe and economical control of plants.
 - .6 Apply pesticides in accordance with Federal, Provincial and Municipal regulations as and when required to control insects, fungus and disease. Obtain product approval from Owner and local authorities prior to application.
 - .7 Remove dead or broken branches from plant material.
 - .8 Keep trunk protection and guy wires in proper repair and adjustment.
 - .9 Remove and replace dead plants and plants not in healthy growing condition. Make replacements in same manner as specified for original plantings.
 - .10 Provide adequate protection against damage, including mechanical damage and damage caused by rodents.

3.8 ACCEPTANCE

- .1 Plantings will be accepted by Consultant after planting operation is completed provided that plant material is planted per this Section and Drawings and future survival and true to form growth is expected as determined by the Consultant. All planting beds shall be free of weeds at time of acceptance. Plant material will not be granted acceptance separately from the balance of the Work.
- .2 Plant material will not be accepted after October 15th of any year. These plants will be accepted in spring of the following year, one month after leaf out, provided all acceptance conditions are fulfilled.

3.9 MAINTENANCE RESPONSIBILITIES DURING WARRANTY PERIOD

- .1 Perform following annual maintenance operations from time acceptance of practical completion to end of warranty period on trees and planting beds.
 - .2 End of Winter (March/April)
 - .1 Remove dead or broken branches prior to leaf budding.
 - .2 Keep trunk protection and guy wires in proper repair and adjustment.

- .3 Remove dead plants and plants not in healthy growing condition. Make replacements in same manner as specified for original plantings in the spring.
- .4 Clear away any litter from planting beds.
- .3 Spring (May)
 - .1 Water to maintain soil moisture condition for optimum establishment, growth and health of plant material without causing erosion. Apply root growth fertilizer.
 - .2 Plant winter replacement planting in same manner as specified for original plantings.
 - .3 Remove weeds.
 - .4 Prune plant material in accordance with good horticultural practices.
 - .5 Keep trunk protection and guy wires in proper repair and adjustment.
 - .6 Replace or spread damaged, missing or disturbed mulch.
- .4 Summer (June to August)
 - .1 Water to maintain soil moisture condition for optimum establishment, growth and health of plant material without causing erosion.
 - .2 Remove dead plants and plants not in healthy growing condition. Make replacements in same manner as specified for original plantings in the Fall.
 - .3 Remove weeds.
 - .4 Remove dead or broken branches prior to leaf budding.
 - .5 Keep trunk protection and guy wires in proper repair and adjustment.
 - .6 Apply pesticides in accordance with Federal, Provincial and Municipal regulations, as and when required to control insects, fungus and disease.
- .5 End of Season (October/November)
 - .1 Water to maintain soil moisture condition for optimum establishment, growth and health of plant material without causing erosion.
 - .2 Replace or respread damaged, missing or disturbed mulch.
 - .3 Plant summer replacement planting in same manner as specified for original plantings.
 - .4 Remove weeds.
 - .5 Remove dead or broken branches prior to leaf budding.
 - .6 Keep trunk protection and guy wires in proper repair and adjustment.
 - .7 Remove trunk wrap, tree stakes and guy wire eyebolts at end of warranty period.

.6 Maintenance Reports

- .1 The Contractor shall submit seasonal Maintenance Reports stating date of maintenance visits and work undertaken including replacements, pruning, watering, mulch top up, fertilizing, repair work, weeding, to Consultant.

3.10 END OF WARRANTY PERIOD FINAL ACCEPTANCE

- .1 Final acceptance of plant material shall take place when:
 - .1 All plant material is healthy, vigorous and free of insects and disease.
 - .2 Plant material is good shape and any pruning that has occurred has not deformed the tree.
 - .3 All planting beds shall be free of weeds, litter, debris, mulch layer is replenished.
 - .4 Tree trunk wrap, tree stakes, and any protection/supports have been removed
 - .5 Survivability rates for plants are:
 - .1 100% at end of warranty.
- .2 Remove dead plants and plants not in healthy growing condition. Make replacements in same manner as specified for original plantings in the spring.
- .3 Failure to meet these criteria will require replanting at the Contractors expense.

END OF SECTION