

PROJECT MANUAL

Issued for Tender

York University - Classroom Renewal Y3 Phase 1, 2, and 3

Project No. 22124

May 2, 2025

Document Responsibility and Project Directory

1.1 Document Responsibility

- .1 Refer to Project Manual, Section 00 01 10 - Table of Contents, for indication of document responsibility (DR). Abbreviations for entity responsible for document preparation are as follows:
 - .1 A - Denotes documents prepared by Architect.
 - .2 AV - Denotes documents prepared by Audio-Visual Consultant.
 - .3 E - Denotes documents prepared by Electrical Engineer.
 - .4 M - Denotes documents prepared by Mechanical Engineer.
 - .5 O - Denotes documents prepared by Owner.
 - .6 S - Denotes documents prepared by Structural Engineer.
- .2 Professional seals if applied next to company names in the project directory (below) govern only those specification sections and schedules identified by the corresponding document responsibility (DR) abbreviation in Section 00 01 10.

1.2 Project Directory

- .1 Owner:
York University
4700 Keel Street
Toronto, Ontario
M3J 1P3

Tel: 416-736-2100
- .2 Architect (the *Consultant*):
Architecture Counsel Inc.
75 Berkeley Street
Toronto, Ontario
M5A 2W5

Tel: 416-603-1515
- .3 (Reserved)
- .4 Mechanical Engineer:
Quasar Consulting Group
250 Rowntree Dairy Road

Document Responsibility and Project Directory

Woodbridge, Ontario
L4L 9J7

Tel: 905-507-0800

.5 Electrical Engineer:

Quasar Consulting Group
250 Rowntree Dairy Road
Woodbridge, Ontario
L4L 9J7

.6 Audio-Visual Consultant:

Techwave Communications
23 Galtee Road
Brampton, Ontario
L6X 0J5

Tel: 905-453-9663

END OF SECTION

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DR - indicates entity responsible for preparation of listed documents (see Section 00 01 05)

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Product Substitution Procedures

PART 1 - GENERAL

1.1 Approved Alternates and Approved Equals

- .1 Named *Product* alternates or equals, indicated by the phrases "or approved alternate by XYZ Manufacturing" or "or approved equal by XYZ Manufacturing", shall be interpreted to mean that named *Product* alternate or equal, if selected for use in lieu of indicated or specified *Product*, meets or exceeds performance, appearance, general arrangement, dimensions, availability, code and standards compliance, and colour of specified *Product*. Be responsible for costs and modifications associated with the inclusion of named *Product* alternate or equal at no additional cost to the *Owner*.
- .2 The process for proposing and approving alternates or equals shall be the same process as for proposing and approving substitutions (refer to paragraph 1.2 below).
- .3 Confirm delivery timeline of specified items prior to proposing alternates or equals.

1.2 Substitutions

- .1 Submission of substitutions:
 - .1 Proposals for substitutions of *Products* and materials must be submitted in accordance with procedures specified in this section.
 - .2 *Consultant* may review submissions, if directed by *Owner*, but in any case with the understanding that the *Contract Time* will not be altered due to the time required by the *Consultant* to review the submission and by the *Contractor* to implement the substitution in the *Work*.
- .2 Submission requirements:
 - .1 Description of proposed substitution, including detailed comparative specification of proposed substitution with the specified *Product*.
 - .2 Manufacturer's *Product* data sheets for proposed *Products*.
 - .3 Respective costs of items originally specified and the proposed substitution.
 - .4 Confirmation of proposed substitution delivery, in writing by *Product* manufacturer.
 - .5 Compliance with the building codes and requirements of authorities having jurisdiction.
 - .6 Affect concerning compatibility and interface with adjacent building materials and components.
 - .7 Compliance with the intent of the *Contract Documents*.
 - .8 Effect on *Contract Time*.
 - .9 Reasons for the request.
 - .10 Detailed availability of maintenance services and sources of replacement materials and parts, including associate costs and time frames.
- .3 Substitutions submitted on shop drawings without following requirements of this section prior to submission of the affected shop drawings will cause the shop drawings to be rejected.

Product Substitution Procedures

- .4 Proposed substitutions shall include costs associated with modifications necessary to other adjacent and connecting portions of the *Work*.
- .5 *Consultant's* decision concerning acceptance or rejection of proposed substitutions is final.

PART 2 - PRODUCTS

Not applicable.

PART 3 - EXECUTION

Not applicable.

END OF SECTION

Requests for Interpretation

PART 1 - GENERAL

1.1 Request for Interpretation – RFI

- .1 A request for interpretation (RFI) is a formal process used during the *Work* to obtain an interpretation of the *Contract Documents* pursuant to GC 2.2.7 through GC 2.2.10 (inclusive).
 - .1 An RFI shall not constitute notice of claim for a delay.
- .2 Submittal procedures:
 - .1 RFI form:
 - .1 Submit RFI on “Request for Interpretation” in form acceptable to the *Consultant*, an example of which is appended to this section. The *Consultant* shall not respond to an RFI except as submitted on the form accepted by the *Consultant*.
 - .2 Where RFI form does not provide sufficient space for complete information to be provided thereon, attach additional sheets as required.
 - .3 Submit with RFI form necessary supporting documentation. The *Consultant* shall not respond to an RFI where necessary information is missing, insufficient, unclear, or ambiguous.
 - .2 Submit RFI form as follows:
 - .1 Submit RFIs sufficiently in advance of affected parts of the *Work* so as not to cause delay in the performance of the *Work*. Costs resulting from failure to do this will not be paid by the *Owner*.
 - .2 RFIs shall be submitted only to the *Consultant*.
 - .3 RFIs shall be submitted only by *Contractor*. RFIs submitted by *Subcontractors* or *Suppliers* shall not be accepted.
 - .4 Number RFIs consecutively in one sequence in order submitted.
 - .5 Submit one distinct RFI per RFI form.
 - .3 RFI log:
 - .1 Maintain log of RFIs sent to and responses received from the *Consultant*, complete with corresponding dates.
 - .2 Submit updated log of RFIs with each progress draw submittal.
 - .4 *Consultant* shall review RFIs from the *Contractor* submitted in accordance with this section, with the following understandings:
 - .1 *Consultant's* response shall not be considered as a *Change Order* or *Change Directive*, nor does it authorize changes in the *Contract Price* or *Contract Time* or changes in the *Work*.
 - .2 Only the *Consultant* shall respond to RFIs. Responses to RFIs received from entities other than the *Consultant* shall not be considered.
 - .5 Allow 5 *Working Days* for review of each RFI by the *Consultant*.

Requests for Interpretation

- .1 *Consultant's* review of RFI commences on date of receipt by the *Consultant* of RFI submittal and extends to date RFI returned by *Consultant*.
- .2 When the RFI submittal is received by *Consultant* before noon, review period commences that day; when RFI submittal is received by *Consultant* after noon, review period begins on the next *Working Day*.
- .3 If, at any time, the *Contractor* submits a large enough number of RFIs such that the *Consultant* cannot process these RFIs within 5 *Working Days*, the *Consultant*, will confer with the *Contractor*, within 1 *Working Day* of receipt. The *Consultant* and the *Contractor* will jointly prepare an estimate of the time necessary for processing the RFIs and determine the order of priority between the RFIs submitted. The *Contractor* shall accommodate such necessary time at no increase in the *Contract Time* and at no additional cost to the *Owner*.
- .6 *Contractor* shall satisfy itself that an RFI is warranted by undertaking a thorough review of the *Contract Documents* to determine that the claim, dispute, or other matters in question relating to the performance of the *Work* or the interpretation of the *Contract Documents* cannot be resolved by direct reference to the *Contract Documents*. *Contractor* shall describe in detail this review on the RFI form as part of the RFI submission. RFI submittals that lack such detailed review description, or where the detail provided is, in the opinion of the *Consultant*, insufficient, shall not be reviewed by the *Consultant* and shall be rejected.

PART 2 - PRODUCTS

Not applicable.

PART 3 - EXECUTION

Not applicable.

END OF SECTION

Contractor's Request for Interpretation

Consultant's Supplemental Instructions

Date	# of Pages
To	From
Co.	Co.
Phone #	Phone #
Fax #	Fax #
Email	Email

Project:	_____	RFI No.:	_____
Owner:	_____	Date of Request:	_____
To:	_____	Contractor:	_____
	(Consultant's Representative)		
Project No.:	_____	Contractor's Representative:	_____
Consultant's Fax No.:	_____	Fax No.:	_____

Interpretation Requested: (Description of request for interpretation and references to relevant portions of *Contract Documents*)

Attachments: _____

Requested by: _____

Consultant's Supplemental Instruction:

Attachments: _____

Reply By: _____

The work shall be carried out in accordance with these *Supplemental Instructions* issued in accordance with the *Contract Documents* without change in *Contract Price* or *Contract Time*. Prior to proceeding with these instructions, indicate acceptance of these instructions as being consistent with the *Contract Documents* by returning a signed copy to the *Consultant*.

Supplemental Instruction Issued:	Supplemental Instruction Accepted:
By: _____	By: _____
Consultant _____ Date _____	Contractor _____ Date _____
Cc: <input type="checkbox"/> Owner <input type="checkbox"/> Consultant <input type="checkbox"/> Contractor	<input type="checkbox"/> Field <input type="checkbox"/> Other:

Project Meetings

PART 1 - GENERAL

1.1 Administrative

- .1 The *Contractor* shall schedule meetings as specified herein.
 - .1 Such scheduling shall be in consultation both with the *Owner* and with the *Consultant*.
- .2 The *Contractor* shall prepare agendas for meetings specified herein.
 - .1 Agendas shall include, as a minimum, the agenda items specified in the *Contract Documents*.
- .3 The *Contractor* shall distribute written notice of each meeting specified herein, complete with meeting agenda, 5 *Working Days* in advance of meeting date to the *Consultant* and the *Owner* and other affected parties.
- .4 The *Contractor* shall chair and record the minutes of meetings specified herein.
 - .1 *Contractor* shall distribute copies of minutes to the *Owner*, the *Consultant*, and all others in attendance within 3 *Working Days* after date of meeting.
- .5 Representatives of parties attending meetings shall be authorized to act on behalf of the parties they represent.
- .6 *Subcontractors* and *Suppliers* shall attend meetings only when directed by the *Consultant*, or when specifically called for in the *Contract Documents*.
- .7 The *Contractor* shall prepare, and distribute to the *Consultant* and the *Owner* 4 days in advance of next progress meeting date, the following:
 - .1 Monthly progress reports containing updated construction schedule, submittal logs, requests for interpretation logs, and budget.

1.2 Contract Start-Up Meeting

- .1 Within 5 days after award of *Contract*, request a meeting of parties in *Contract* to discuss and resolve administrative procedures and responsibilities prior to the commencement of the *Work*.
- .2 Attendees at *Contract* start-up meeting shall include the following:
 - .1 *Contractor*.
 - .2 *Contractor's* site superintendent(s).
 - .3 *Consultant*.
 - .4 *Owner*.
 - .5 Independent inspection and testing company.
- .3 Agenda to include the following:
 - .1 Owner's guidelines and policies.
 - .2 Appointment of official representative of participants in the *Project*.
 - .3 Status of permits, fees and requirement of authorities having jurisdiction. Action required.

Project Meetings

- .4 Establishing a schedule for progress meetings.
- .5 Requirements for *Contract* modification and interpretation procedures, including, but not limited to: requests for interpretation, contemplated change orders, *Change Orders*, *Change Directives*, *Supplemental Instructions*, procedures, approvals required, mark-up percentages permitted, time extensions, overtime, and administrative requirements.
- .6 Submittal requirements and procedures.
- .7 Schedule of submission of samples, colour chips, and items for Owner's and/or Consultant's consideration.
- .8 Construction schedule and progress scheduling.
- .9 Delivery schedule of specified equipment.
- .10 Appointment of independent inspection and testing agencies or firms.
- .11 Requirements for notification for reviews. Allow a minimum of 48 hours' notice to *Consultant* for review of the *Work*.
- .12 Requirements for temporary facilities, signs, offices, storage sheds, utilities, fences.
- .13 Requirements for firestopping coordination and preparation of firestopping manual (refer to Section 01 33 00).
- .14 Security requirements at and for the *Place of the Work*.
- .15 *Owner* supplied *Products*.
- .16 Review of waste management and disposal procedures and requirements.
- .17 As-built documents.
- .18 Operation and maintenance manuals.
- .19 Take-over procedures, acceptance, warranties.
- .20 Publication to be used for publishing certificate of substantial performance.
- .21 Progress claims, administrative procedures, holdbacks.
- .22 Insurances, transcripts of policies.
- .23 *Contractor's* safety procedures.
- .24 Workplace Safety and Insurance Board Certificate.

1.3 Pre-Installation Meetings

- .1 As far as possible, pre-installation meetings shall be scheduled to take place on the same day as regularly scheduled progress meetings.
- .2 Attendees at pre-installation meetings shall include the following:
 - .1 *Contractor*.
 - .2 *Subcontractors* affected by the work for which the pre-installation meeting is being conducted.
 - .3 *Consultant*.

Project Meetings

- .4 Manufacturer's representatives, as applicable.
- .5 Independent inspection and testing company, as applicable.
- .3 Agenda to include the following:
 - .1 Owner's guidelines and policies.
 - .2 Appointment of official representatives of participants in the *Project*.
 - .3 Review of existing conditions and affected work, and testing thereof as required.
 - .4 Review of installation procedures and requirements.
 - .5 Review of environmental and site condition requirements.
 - .6 Schedule of the applicable portions of the *Work*.
 - .7 Schedule of submission of submittals, samples, mock-ups, and items for *Consultant's* consideration.
 - .8 Requirements for temporary facilities, site sign, offices, storage sheds, utilities, fences.
 - .9 Requirements for notification for reviews. Allow a minimum of 48 hours' notice to *Consultant* for review of the *Work*.
 - .10 Requirements for inspections and tests, as applicable. Schedule and undertake inspections and tests.
 - .11 Delivery schedule of specified equipment.
 - .12 Special safety requirements and procedures.
 - .13 Publication to be used for publishing certificate of substantial performance.

1.4 Progress Meetings

- .1 During the course of the *Work* prior to *Substantial Performance of the Work*, schedule progress meetings in accordance with Section 01 00 00.
- .2 Attendees at progress meetings shall include the following:
 - .1 *Contractor*.
 - .2 *Contractor's* site superintendent(s).
 - .3 *Consultant*.
 - .4 *Owner*.
- .3 Agenda to include the following:
 - .1 Owner's guidelines and policies.
 - .2 Review, approval of proceedings of previous meeting.
 - .3 Review of items arising from proceedings.
 - .4 Review of progress of the *Work* since previous meeting and *Contractor's* monthly progress report.
 - .5 Field observations, problems, conflicts.
 - .6 Update construction schedule.

Project Meetings

- .7 Problems that impede compliance with construction schedule.
- .8 Review of off-site fabrication delivery schedules.
- .9 Review material delivery dates/schedule.
- .10 Corrective measures and procedures to regain construction schedule.
- .11 Revisions to construction schedule.
- .12 Progress, schedule, during subsequent period of the *Work*.
- .13 Review submittal schedules.
- .14 Review status of submittals.
- .15 Maintenance of quality standards.
- .16 Pending changes and substitutions.
- .17 Review of *Contract* modifications and interpretations including, but not limited to: requests for interpretation and log, contemplated change orders, *Change Orders*, *Change Directives*, *Supplemental Instructions*, for effect on construction schedule and on *Contract Time*.
- .18 Review of status of as-built documents.
- .19 Other business.

1.5 Pre-Takeover Meeting

- .1 60 days prior to application for *Substantial Performance of the Work*, schedule a pre-takeover meeting.
- .2 Agenda to include the following:
 - .1 Review, approval of proceedings of previous meeting.
 - .2 Review of items arising from proceedings.
 - .3 Review of procedures for *Substantial Performance of the Work*, completion of the Contract, and handover of the *Work*.
 - .4 Field observations, problems, conflicts.
 - .5 Review of outstanding *Contract* modifications and interpretations including, but not limited to: requests for interpretation and log, contemplated change orders, *Change Orders*, *Change Directives*, *Supplemental Instructions*, for effect on construction schedule and on *Contract Time*.
 - .6 Problems which impede *Substantial Performance of the Work*.
 - .7 Review of procedures for deficiency review. Corrective measures required.
 - .8 Review of arrangements for hydro, heating, and other services.
 - .9 Progress, schedule, during succeeding period of the *Work*.
 - .10 Review submittal requirements for warranties, manuals, and all demonstrations and documentation required for *Substantial Performance of the Work*.
 - .11 Review of keying and hardware requirements.
 - .12 Review of status of as-built documents and record drawings.

Project Meetings

- .13 Status of commissioning and training.
- .14 Review *Contractor's* deficiency list and status.
- .15 Cleaning for occupancy.
- .16 Other business.

1.6 Post-Construction Meeting

- .1 Prior to application for completion of *Contract*, schedule a post-construction meeting. 5 *Working Days* prior to date for meeting, *Consultant* shall confirm a date for meeting based on evaluation of completion requirements.
- .2 Agenda to include the following:
 - .1 Review, approval of proceedings of previous meeting.
 - .2 Confirmation that no business is arising from proceedings.
 - .3 Confirmation of completion of the *Contract*, and handover of reviewed documentation from the *Consultant* to the *Owner*.
 - .4 Confirmation of completion of contemplated change orders, *Change Orders*, *Change Directives*, and *Supplemental Instructions*.
 - .5 Problems that impede *Contract* completion.
 - .6 Identify unresolved issues or potential warranty problems.
 - .7 Confirmation of completion of deficiencies.
 - .8 Corrective measures required.
 - .9 Confirmation of arrangements for hydro, heating and other services.
 - .10 Confirm submittal requirements for warranties, manuals, and demonstrations and documentation for *Contract* completion are in order.
 - .11 Review of procedures for communication during post-construction period.
 - .12 Handover of reviewed record documents by the *Contractor* to the *Owner*.
 - .13 Submission of final application for payment.
 - .14 Review and finalize outstanding claims, pricing, and allowance amounts.
 - .15 Status of commissioning and training.
 - .16 Demobilization and the *Place of the Work* restoration.
 - .17 Review of requests for interpretation log.
 - .18 Other business.

1.7 Special Meetings

- .1 *Owner* and/or *Consultant* reserve the right to require special meetings which may be held on short notice and at which attendance by *Contractor* and representatives of affected *Subcontractors* and *Suppliers* is mandatory. *Contractor* shall keep detailed and accurate meeting notes and distribute copies within 3 *Working Days* to all in attendance and those affected by agreements made at such meetings.

Project Meetings

PART 2 - PRODUCTS

Not applicable.

PART 3 - EXECUTION

Not applicable.

END OF SECTION

Engineered Submittal Procedures

PART 1 - GENERAL

1.1 General Requirements

- .1 Submit submittals as requested by the *Contract Documents*, in accordance with Section 01 33 00, as specified herein, and in accordance with the conditions of the *Contract*.
- .2 Engineered submittals:
 - .1 Submittals for items required to be sealed by professional engineer (engineered) shall be duly prepared, sealed, and signed under the direct control and supervision of a qualified professional engineer licensed in the jurisdiction in which the *Place of the Work* is located, having in force, professional liability insurance with minimum coverage limit of \$2,000,000 per claim and annual aggregate.
 - .2 Include with engineered submittal, proof of insurance identifying insurer, policy number, policy term, and limit of liability, on duly signed letterhead and / or certificate of insurance.
 - .3 Design includes life safety, sizing of supports, anchors, framing, connections, spans, and as additionally required to meet or exceed requirements of applicable codes, standards, regulations, authorities having jurisdiction, and design requirements of the *Contract Documents*.
 - .4 Engineered submittals shall include design calculations, complete with references to codes and standards used in such calculations, supporting the proposed design represented by the submittal.
 - .5 Professional engineer responsible for the preparation of engineered submittals shall undertake periodic field review, including review of associated mock-ups where applicable, at locations wherever the work as described by the engineered submittal is in progress, during fabrication and installation of such work, and shall submit a field review report after each visit. Field review reports shall be submitted to the *Consultant*, to authorities having jurisdiction as required, and in accordance with the building code.
 - .6 Field reviews shall be at intervals as necessary and appropriate to the progress of the work described by the submittal to allow the engineer to be familiar with the progress and quality of such work and to determine if the work is proceeding in general conformity with the *Contract Documents*, including reviewed shop drawings and design calculations.
 - .7 Upon completion of the parts of the *Work* covered by the engineered submittal, the professional engineer responsible for the preparation of the engineered submittal and for undertaking the periodic field reviews described above, shall prepare and submit to the *Consultant* and authorities having jurisdiction, as required, a letter of general conformity for those parts of the *Work*, certifying that they have been *Provided* in accordance with the requirements both of the *Contract Documents* and of the authorities having jurisdiction over the *Place of the Work*.
 - .8 Costs for such field reviews and field review reports and letters of general conformity are included in the *Contract Price*.

PART 2 - PRODUCTS

Not applicable.

PART 3 - EXECUTION

Not applicable.

END OF SECTION

Project Firestopping Manual and Coordination

PART 1 - GENERAL

1.1 General Requirements

- .1 The *Contractor* shall assign a firestopping and smoke seal firestopping coordinator to coordinate the firestopping details and systems required in the *Work*. Applicator shall designate a single individual as *Project* foreperson who shall be present at the *Place of the Work* throughout the *Work*.

1.2 Firestopping manual

- .1 *Contractor* and firestopping and smoke seal coordinator shall prepare a preliminary fire stopping manual, inclusive of all firestopping systems in the *Work*, to be submitted to the *Consultant* prior to the installation of any firestopping and smoke seal work.
- .2 Manual shall include:
 - .1 Project key plans of each level, with enlarged key plans at areas where required, which identify and tag each anticipated penetration and fire stopping location and type (i.e. multiple metallic pipes through gypsum board wall assembly; single metallic pipe through concrete floor assembly, and the like)
 - .2 *Product* data sheets: data and installation instructions for *Products* providing descriptions sufficient for identification at the *Place of the Work*.
 - .1 Materials list of *Products* proposed for use in the *Work*; complying with listed systems designs.
 - .2 Listing agency's detailed drawing showing joint assemblies and firestopping materials, identified with listing agency's name and number or designation, fire rating achieved, and date of listing.
 - .3 Manufacturers' installation instructions and recommendations.
 - .3 Shop drawings:
 - .1 Submit drawings indicating fire resistance rated assembly number, required temperature, hose stream, and flame rating, material thicknesses, installation methods and materials of firestopping and smoke seals, primers, supports, damming materials as applicable, reinforcements, anchorages, fastenings and methods of installation for each condition to be encountered.
 - .2 Designate on shop drawings static through penetrations and dynamic joint systems, relative positions, expansion and control joints in rated slabs and walls, and firestopping details.
 - .3 Engineered shop drawings; for engineering judgements:
 - .1 Where *Project* conditions require modification to an accredited third party testing agency's listed system design to address a particular firestopping condition that is not covered by a listed system, submit engineered shop drawings detailing the modifications to the listed system design as an engineering judgment or equivalent fire-resistance-rated assembly, for each *Project* location and condition.

Project Firestopping Manual and Coordination

- .2 Submit the manufacturer's engineering judgment identification number and shop drawing details prepared by a professional engineer. The engineering judgment submittal shall include both *Project* name, *Project* location, and *Subcontractor's* name who will install firestop system as described in engineering judgement shop drawings.
- .3 Provide complete details of specific application of listed system and its modifications upon which the engineered judgement is based upon.
- .4 For perimeter fire barrier systems:
 - .1 Submit engineered shop drawings for engineering judgements covering perimeter fire barrier systems. Identify each cladding assembly type in contact with each perimeter fire barrier system.
- .4 Fire resistance rating test listings for firestopping and smoke seal systems.
- .3 Firestopping manual shall be submitted within 4 weeks of *Contract* award.
- .4 Prior to concealment of firestopping conditions above a ceiling or by another assembly or finish, the *Contractor* shall submit an updated firestopping manual including as-built drawings that identify firestopping conditions and penetrations.

1.3 Closeout submittals

- .1 Submit closeout submittals in accordance with Section 01 78 00.
- .2 Submit the following certification documents with closeout submittals:
 - .1 Manufacturer's certification: Submit manufacturer's certification that installed firestopping and smoke seal *Products* are suitable for the use indicated and comply with specified requirements.
 - .2 Installation certification: Installer shall submit certification that all joint firestopping system installations are completed and that installations comply with listed systems designs.
 - .3 As-built copy of the firestopping manual.

PART 2 - PRODUCTS

Not applicable.

PART 3 - EXECUTION

Not applicable.

END OF SECTION

PART 1 - GENERAL

1.1 Section Includes

- .1 General administrative and procedural requirements for quality assurance and quality control as specified elsewhere in the *Contract Documents*.

1.2 Related Requirements

- .1 Pre-installation meetings: in accordance with Section 01 31 19.
- .2 Materials and workmanship quality assurance and reference standards: in accordance with Section 01 60 00.
- .3 Balancing and testing of systems - under Divisions 21, 22, and 23, and Divisions 26, 27, and 28.

1.3 Contractor's Quality Assurance Program

- .1 Submit to the *Owner* and the *Consultant* for their information, a quality assurance program (the "Quality Assurance Program").
- .2 The Quality Assurance Program shall meet the requirements of Canadian Standards Association CSA CAN3-Z299.3 or such other requirements as set out in the *Contract Documents*.
 - .1 The Quality Assurance Program shall be designed so that quality requirements are obtained by progressive implementation of the controls and inspection functions stated in the Quality Assurance Program.
 - .2 The *Contractor* shall make any modifications to the Quality Assurance Program as reasonably requested by the *Owner* and/or the *Consultant*.
 - .3 The Quality Assurance Program shall include, but shall not be limited to, the following:
 - .1 A system by which changes to the *Contract Documents* and correspondence with *Subcontractor* and other correspondence is handled in a controlled manner.
 - .2 A system for purchased or manufactured materials to be identified, inspected to the specified standard, and covered by a material test report.
 - .3 A system by which measuring and testing equipment is properly stored, handled, and calibrated to a known standard.
 - .4 A system by which incoming materials are: inspected to the specified standard; accepted; allocated safe storage; and properly recorded.
 - .5 A system by which process inspection requirements shall be clearly stated for operations and carried out by qualified personnel.
 - .6 A system by which final inspections will be carried out and accepted by authorized personnel prior to release for shipping or major assembly.
 - .7 A system by which non-conformance to requirements of the *Contract Documents* shall be recorded and solutions proposed by the *Owner* or the *Consultant* are also recorded.

Quality Control

- .8 A system by which instructions for handling and storage of equipment shall be given.
 - .9 A system by which SBO items can be inspected and received in a manner which allows replacement or correction.
 - .10 A system by which a record of quality inspections, tests, and actions shall be kept.
 - .11 A system by which the *Owner* and the *Consultant* shall be afforded access to manufacturing areas and quality records and issued with copies of pertinent drawings and manufacturing schedules.
- .3 The *Contractor* shall provide the *Owner* and the *Consultant* with regular Quality Assurance Reports for their information according to an agreed schedule.

1.4 **Contractor's Field Quality Control**

- .1 The *Contractor* is responsible for field quality control of the *Work* including quality control of *Subcontractors* and material *Suppliers*.
- .2 Ensure that the only specified or approved *Products* and materials are used.
- .3 Provide and maintain an effective quality control program, in accordance with the Quality Assurance Program, and perform sufficient inspections and tests of all items of work, including those of *Subcontractors*, to ensure compliance with *Contract Documents*.
- .4 Furnish appropriate facilities, instruments, and testing devices required for performance of the quality control function.
- .5 Required certificates of inspection testing or approval shall be secured by the *Contractor* and delivered to the *Owner* in such time as not to delay progress of the *Work*.
- .6 The *Contractor* shall develop a field quality control manual covering both factory and field installation. The form of the manual shall be reviewed and accepted by the *Consultant*. This manual will document quality control practices of the *Contractor*, *Subcontractors*, and major *Suppliers*. The manual shall include, but not be limited to, specific criteria related to:
 - .1 Concrete slab moisture and pH testing and surface preparation, including flatness and levelness.
 - .2 Surface preparation.
 - .3 Fastener and anchor installation.
 - .4 Air barrier continuity: identify continuity of air barrier systems, including joints and overlapping of dissimilar systems.
 - .5 Air barrier, adhesion testing.
 - .6 Sealant mixing, tack time, set time.
 - .7 Sealant staining of porous substrate testing.
 - .8 Sealant adhesion testing, including butterfly tests where applicable.
 - .9 Painting, verification and adhesion testing where required.
 - .10 Material compatibility testing.

Quality Control

- .11 On line fabrication quality control practices.
- .12 Shipping.
- .13 Field installation.
- .14 Field inspection and testing (by *Contractor*).
- .15 Field inspection and testing (independent).
- .7 Inspection and testing shall be performed by company qualified to perform the inspections or tests specified or required.
- .8 The *Contractor* is to maintain a logbook (copies to be provided to the *Consultant* at completion of fabrication) documenting date, time, results, and significance of in-plant testing carried out, where applicable, linked to daily production. The form of this logbook shall be reviewed and accepted by the *Consultant*.

1.5 Independent Inspection and Testing – Owner’s Quality Assurance

- .1 Independent inspection and testing services will be used to verify compliance with requirements of the *Contract Documents*. These services do not relieve the *Contractor* of responsibility for compliance with the *Contract Documents*.
 - .1 Specified tests, inspections, and related actions do not limit the *Contractor's* other quality assurance and control procedures that facilitate compliance with the *Contract Documents* requirements.
 - .2 Requirements for the *Contractor* to provide quality control services required by *Consultant*, *Owner*, or authorities having jurisdiction are not limited by provisions of this section.
 - .3 Inspections and tests specified or required that are not specified as independent inspection and testing are the responsibility of the *Contractor* and are not covered under the *Owner's* quality assurance requirements.
- .2 The *Owner* will appoint independent inspection and testing companies, representing, reporting and responsible to the *Owner*. Payment will be by *Owner*, unless otherwise specified.
- .3 Additional testing services required because of changes in materials, proportions of mixes requested by *Contractor* or *Subcontractors* as well as additional testing services for materials occasioned by lack of identification or by failure of such materials being replaced to meet requirements of the *Contract Documents* or testing of structure or elements including load testing, shall be carried out at no additional cost to the *Owner*.
- .4 Inspection and testing required by codes or ordinances, or by an authority having jurisdiction, and made by a legally constituted authority, shall be the responsibility of the *Contractor* and shall be paid for by the *Contractor* and not be paid by *Owner*, unless otherwise specified in the *Contract Documents*.
- .5 Inspection or testing performed exclusively for *Contractor's* convenience shall be sole responsibility of *Contractor*, and will not be paid by *Owner*.
- .6 Independent inspection and testing shall be performed by company qualified to perform the inspections or tests specified or required.
- .7 Requirements of regulatory companies:

Quality Control

- .1 Testing shall be conducted in accordance with requirements of the building code.
- .2 Obtain certification where required by the building code and standards.
- .8 Cooperation with independent inspection and testing companies:
 - .1 Provide independent inspection and testing companies with materials and installation information as required and /or requested.
 - .2 Provide access to the *Work* for representatives of independent inspection and testing companies.
 - .3 Cooperate with independent inspection and testing companies and give adequate notification of any changes in source of supply, additional work shifts and other proposed changes.
 - .4 Permit access to the *Work* for independent inspection and testing companies wherever the *Work* is in progress, or wherever *Products*, materials, or equipment are stored prior to shipping.
 - .5 Supply labour required to assist independent inspection and testing companies in sampling and making tests.
 - .6 Repair work damaged as a result of inspection and testing work.
 - .7 Inspection and testing company services do not relieve the *Contractor* of responsibility for normal shop and site inspection, and quality control of manufacturing and installation.
- .9 Where evidence exists that defective workmanship may have occurred, or that the *Work* may have been carried out incorporating defective materials, or tests demonstrate that installed conditions do not comply with the requirements of the *Contract Documents*, the *Consultant* reserves the right to have appropriate inspections, tests, and surveys performed, analytical calculation of structural strength made and the like in order to help determine the extent of defect and whether such work must be replaced. Inspections, tests, and surveys carried out under these circumstances will be made at the *Contractor's* expense, and will not be paid by *Owner*, unless the results indicate that the work so tested, inspected or surveyed is not defective or that, in *Consultant's* opinion, the work so tested, inspected, or surveyed may be accepted, in which case tests, inspections or surveys will be paid by *Owner*.
- .10 Prepare schedule for independent inspection and testing company services in accordance with Section 01 33 00 and as follows:
 - .1 Establishing schedule:
 - .1 By advance discussion with the independent inspection or testing company, determine the appropriate time necessary to perform the required services and to issue related reports.
 - .2 Allow for required time within construction schedule.
 - .2 Adherence to schedule:
 - .1 *Contractor* shall advise independent inspection and testing companies in advance when inspection and testing of the *Work* is required.
 - .1 Amount of advance notice shall be as required by the independent inspection and testing company, but shall be no less than 2 *Working Days*.

Quality Control

- .2 When independent inspection and testing company is ready to perform inspection and testing according to predetermined schedule, but is prevented from inspection and testing or taking specimens due to incompleteness of the parts of the *Work* scheduled for inspection and testing, extra costs for inspection and testing attributable to the delay may be back-charged to *Contractor* at no additional cost to the *Owner*.
 - .3 Notify independent inspection and testing company at least 3 *Working Days* before work required to be inspected commences, and arrange for a meeting at the *Place of the Work*, to be held 1 *Working Day* before the work starts with the following present:
 - .1 The *Contractor*, and the *Subcontractor* responsible for the work to inspected and/or tested, the independent inspection and testing company representatives, the product manufacturer's representative when required, and the *Consultant*.
 - .4 Give 2 *Working Days*' prior notice to independent inspection and testing company of the commencement of each phase of the *Work* requiring inspection, and provide independent inspection and testing company with materials and installation information.
- .11 Reports and documents:
- .1 Independent inspection and testing company shall submit shop inspection and site inspection reports within 5 *Working Days* of each inspection.
 - .2 Distribute reports as follows:
 - .1 *Owner*, 2 copies.
 - .2 *Consultant*, 1 copy.
 - .3 *Contractor*, 2 copies.
 - .4 Consulting engineers, as applicable; 1 copy each.
 - .3 Independent inspection and testing companies shall submit a written report for each inspection or test, including pertinent data such as conditions at the *Place of the Work*, dates, test references, locations of tested materials, actual *Product* identification, testing methodology, procedures, and descriptions, site instructions given, recommendations and/or any other information required by standard applicable to reporting of tests and inspections.
 - .1 Report shall clearly indicate failure of *Product* or procedures to meet applicable standards, give recommendations for retesting or correction. Inspector shall contact *Contractor* and *Consultant* immediately when *Product* or *Product* assembly fails to meet requirements of the Contract Documents.
 - .4 Upon completion of portions of the *Work* subject to independent inspection and testing, submit to the *Consultant* duplicate certificates of acceptance of the installation issued by the independent inspection and testing company.
- .12 Inspection and test specimens:
- .1 Inspection and testing will, generally, consist of procedures listed in the following paragraphs, but additional tests may be performed as required to verify conformance to *Contract Documents*.

Quality Control

- .2 Specimens and samples for testing, unless otherwise specified in the *Contract Documents*, will be taken by the independent inspection and testing company; sampling equipment and personnel will be provided by the independent inspection and testing company; and deliveries of specimens and samples to the testing company will be performed by the testing company unless otherwise specified.
- .3 Independent inspection and testing company shall take samples necessary to verify quality as specified. Taking of samples shall not endanger the structure or life safety, and shall be taken so as to best represent the *Work* as a whole.
- .4 Samples shall be handled, packaged, stored and delivered in accordance with specified tests. Sample handling where required shall duplicate conditions at the *Place of the Work* (such as site-cured concrete cylinders).

1.6 Mock-Ups

- .1 *Provide* field or shop erected example of work complete with specified materials and workmanship.
- .2 Erect mock-ups at locations as specified and as acceptable to *Consultant*. Do not proceed with work for which mock-ups are required prior to *Consultant's* review of mock-ups.
- .3 Protect and maintain mock-ups until directed to be removed. Commence work demonstrated in mock-up only after review and acceptance of workmanship. If possible, mock-up may become part of finished work, at sole discretion, and with prior written acceptance of *Consultant*.
- .4 Reviewed and accepted mock-ups will become standards of workmanship and material against which installed work will be compared.
- .5 Remove and replace materials or assemblies not matching reviewed mock-ups.
- .6 Resubmit mock-ups until written acceptance is obtained from *Consultant*.

1.7 Manufacturer's Field Review

- .1 Where manufacturer's field review is specified, manufacturer's representative shall review the relevant parts of the work at the *Place of the Work*, or wherever such affected work is in progress, to ensure that work is being executed in accordance with manufacturer's written recommendations and verify its product to be fit-for-purpose intended.
- .2 Manufacturer's field review is to ensure that the *Products* specified are being used in the *Work* and are being applied on surfaces prepared in accordance with their recommendations and the requirements of the *Contract Documents*.
- .3 Unless otherwise indicated, manufacturer's representative shall undertake a minimum of 1 field review, with additional reviews as deemed necessary by the manufacturer, to determine that the work of such sections is in accordance with the manufacturer's written recommendations.
- .4 Manufacturer's representative shall submit a type-written report on manufacturer's letterhead within 2 *Working Days* after each field review. Report shall document manufacturer's representative's field observations and recommendations.
- .5 Manufacturer's field review reports shall be prepared and distributed following the procedures specified for preparation and submittal of inspection and testing reports given above.

PART 2 - PRODUCTS

Not applicable.

PART 3 - EXECUTION

Not applicable.

END OF SECTION

Product Requirements

PART 1 - GENERAL

1.1 Availability of Products

- .1 In the event of delays in supply of *Products*, and should it subsequently appear that the *Work* may be delayed for such reason, *Consultant* reserves the right to substitute more readily available *Products* of similar character, at no additional cost to the *Owner*.

1.2 Product Handling

- .1 Handle and store *Products* in a manner to prevent damage, adulteration, deterioration and soiling and in accordance with manufacturers' and *Supplier's* recommendations and so as to ensure preservation of their quality and fitness for the *Work*, and protect from vandalism and theft.
- .2 Store packaged or bundled *Products* in original and undamaged condition with manufacturer's seals and labels intact, facing to outside. Do not remove from packaging or bundling until required in the *Work*.
- .3 Store materials susceptible to environmental damage in a weathertight enclosure raised clear of ground so that they are protected from weather, dampness and deterioration. Do not use such materials which have been damaged by exposure to moisture.
- .4 Keep sand, when used as ingredients for grout, mortar or similar mixed materials, clean and dry. Store sand on wooden platforms and cover with waterproof tarpaulins during inclement weather.
- .5 Store sheet materials, lumber and other *Products* susceptible to deterioration on flat, solid supports and keep clear of ground or slab. Slope to shed moisture.
- .6 Handle materials to preclude damaging existing surfaces and work of others.
- .7 Remove damaged *Products* and replace with new undamaged *Products*.
- .8 Transportation:
 - .1 Pay cost of transportation of *Products* required in performance of *Work*.
 - .2 Transportation cost of *Products* supplied by *Owner* will be paid for by *Owner*. Unload, handle and store such *Products* at the *Place of the Work*.
 - .3 Reject *Products* damaged during transport.
 - .4 Transportation of *Products* must be undertaken to suit construction schedule. *Contractor* is responsible for determining mode of transport to ensure delivery, obtaining shop drawings, placement of orders, and on-time premium costs, air freight, and the like.

PART 2 - PRODUCTS

2.1 Product Requirements and Quality

- .1 Compatibility of options: If given option of selecting between two or more products, select product compatible with products previously selected, even if previously selected products were also options.

Product Requirements

- .2 *Products* and *Product* installation shall be in compliance with building code, regulations and requirements of authorities having jurisdiction.
- .3 Specified options: The *Work* is based on materials, *Products* and systems specified by manufacturer's catalogued trade names, references to standards, by prescriptive specifications and by performance specifications.
 - .1 Where only one manufacturer's trade name is specified for a *Product*, the *Product* is single sourced and shall be supplied by the specified manufacturer.
 - .2 Where more than one manufacturer's trade name is specified for a *Product*, supply one *Product* from list of *Products* specified.
 - .3 When a *Product* is specified by reference to a standard, select one *Product* from manufacturer that meets or exceeds the requirements of the standard and manufacturer's written application directions.
 - .4 When a *Product* or system is specified by prescriptive or performance specifications, *Provide* one *Product* or system which meets or exceeds the requirements of the prescriptive or performance specifications and manufacturer's written application directions.
 - .5 The onus is on the *Contractor* to prove compliance with governing published standards, prescriptive specifications and with performance specifications.
 - .6 Visual selection specification:
 - .1 Where specifications include the phrase "as selected by *Consultant* from manufacturer's full range" or similar phrase, select a product that complies with requirements. *Consultant* will select color, gloss, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.
 - .7 Visual matching specification:
 - .1 Where specifications require "match *Consultant's* sample", provide a product that complies with requirements and matches *Consultant's* sample. *Consultant's* decision will be final on whether a proposed product matches.
- .4 *Products*, materials, equipment and articles (referred to as *Products* throughout the *Contract Documents*) incorporated in the *Work* shall be new, not damaged or defective, and of the quality standards specified, for the purpose intended. If requested, furnish evidence as to type, source and quality of *Products Provided*.
- .5 Basis of design:
 - .1 Where *Contract Documents* list "basis of design", this indicates the *Product* or system that was used in the preparation of the design included in the *Contract Documents*, and which may be deemed as an acceptable *Product*.
 - .2 The basis of design establishes the significant qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics for purposes of evaluating comparable products from other manufacturers.

Product Requirements

- .3 This does not preclude the use of other *Products* or systems in the *Work*, provided the proposed *Product* or system complies with the design and performance requirements contained in the *Contract Documents*, and *Products* or systems proposed for use in the work that are not the named basis of design follow procedures for product substitutions specified under Section 01 25 00.
- .6 Where *Contract Documents* list acceptable *Products* or acceptable manufacturers, select as applicable, one *Product* meeting performance of specifications and manufacturer's written application directions.
- .7 Where *Contract Documents* require design of a *Product* or system, and minimum material requirements are specified, the design of such *Product* or system shall employ materials specified within applicable section. Where secondary materials or components are not specified, augment with materials meeting applicable code limitations, and incorporating compatibility criteria with adjacent work.
- .8 Defective *Products*, whenever identified prior to completion of the *Work*, will be rejected, regardless of previous reviews. Review of the *Work* by the *Consultant* or independent inspection and testing companies does not relieve the *Contractor* of the responsibility for executing the *Work* in accordance with the requirements of the *Contract Documents*, but is a precaution against oversight or error.
- .9 Should dispute arise as to quality or fitness of *Products*, the decision rests strictly with *Consultant* based upon the requirements of the *Contract Documents*.
- .10 Unless otherwise indicated in the *Contract Documents*, maintain uniformity of *Product* and manufacturer for any like item, material, equipment or assembly for the duration of the *Work*.
- .11 *Products* exposed in the finished work shall be uniform in colour, texture, range, and quality, and be from one production run or batch, unless otherwise indicated.
- .12 Permanent labels, trademarks and nameplates on *Products* are not acceptable in prominent locations, except where required for operating instructions, or when located in mechanical, electrical, machinery or like rooms.
- .13 *Owner* retains right to select from choices available within specified *Products* for colours, patterns, finishes or other options normally made available. Submit full range of *Product* options in accordance with 01 33 00 for such selection.
- .14 Quality control:
 - .1 Implement a system of quality control to ensure compliance with *Contract Documents*.
 - .2 Notify *Consultant* of defects in the *Work* or departures from intent of *Contract Documents* that may occur during construction. *Consultant* will recommend appropriate corrective action in accordance with requirements of the *Contract*.
- .15 Exposed to weather: *Products* and materials in environments not protected by the building's HVAC and/or climate control systems shall be considered exposed to weather.

2.2 Inserts, Anchors, and Fasteners

- .1 Use only factory made, threaded or toggle type inserts as required for supports and anchors, properly sized for load to be carried.

Product Requirements

- .2 Where inserts cannot be placed, use factory made expansion shields for light weights only.
- .3 Supply and locate inserts, holes, anchor bolts and sleeves during placement or fabrication of structural elements.
- .4 Fasteners stressed in withdrawal are not acceptable, except where otherwise indicated.
- .5 Metal fastenings shall be uniform to metals materials and components being anchored or of a metal which will not set up a galvanic action causing damage to the fastening or metal component under moist conditions.
- .6 Fastenings for prefinished materials shall be of concealed type unless otherwise indicated, and when exposed finish is required, of matching prefinishing materials.
- .7 Metal fastenings and accessories shall be same texture, colour and finish as material on which they occur, as selected by *Consultant*.
- .8 Power actuated fasteners:
 - .1 Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 10 times design load, as determined by testing per ASTM E1190-11 conducted by a qualified independent testing agency.
 - .2 Do not use power actuated fasteners which are stressed in withdrawal in finished work.
 - .3 Do not use power actuated fasteners within 100 mm (4") of the edge of concrete or masonry, unless otherwise accepted in writing by *Consultant*.
 - .4 Do not use power actuated fasteners in post-tensioned concrete.

PART 3 - EXECUTION

3.1 Manufacturer's Instructions

- .1 Unless otherwise indicated in the *Contract Documents*, install or erect *Products* in accordance with manufacturer's written requirements. Do not rely on labels or enclosures supplied with *Products*. Obtain written requirements directly from manufacturers.
- .2 Notify *Consultant* in writing, of conflicts between the *Contract Documents* and manufacturer's requirements.
- .3 Improper installation or erection of *Products*, due to failure in complying with these requirements, authorizes *Consultant* to require removal and re-installation at no additional cost to the *Owner*.
- .4 Manufacturers' representatives shall have access to the *Work* at all times. *Contractor* shall render assistance and facilities for such access in order that the manufacturers' representatives may properly perform their function.

3.2 Overloading

- .1 Protect the existing building from loads which may cause permanent deformation.
- .2 Protect the *Work* from loads which may cause permanent deformation.

Product Requirements

3.3 Galvanic/Dissimilar Metal Corrosion

- .1 Insulate dissimilar metals from each other by suitable plastic strips, washers or sleeves to prevent galvanic corrosion where conductive liquid or electrolyte (rainwater or condensation) exists.

3.4 Penetrations

- .1 Holes or voids created in assemblies or partitions for penetrating mechanical, electrical, or sprinkler service items, shall be of sufficient size to accommodate the penetrating item as well as additional required fill materials, such as sealants, firestopping and smoke sealants, insulation, and the like, without exceeding the maximum opening allowable by the manufacturer of the additional required fill material and design requirements appropriate for size of penetration.
 - .1 Finish penetrations in areas exposed to view to satisfaction of *Consultant*.

3.5 Product Installation Requirements

- .1 General:
 - .1 Execute the *Work* using workers experienced and skilled in the respective duties for which they are employed.
 - .2 Do not employ an unfit person or anyone unskilled in their required duties.
 - .3 Upon request by the *Consultant*, submit proof, in the form of CCDC 11 - Contractor's Qualification Statement, of qualifications of *Subcontractors* to verify *Subcontractor's* qualifications and experience meet or exceed the requirements of the *Contract Documents*.
 - .1 If, upon review of the Contractor's Qualification Statement, it is found that the *Subcontractor* does not meet the qualification requirements specified in the *Contract Documents* pertaining to the parts of the *Work* for which the *Subcontractor* has been retained, the *Contractor* shall replace the unqualified *Subcontractor* with a qualified *Subcontractor*, satisfactory to the *Contractor* and the *Owner*, at no additional cost to the *Owner* and at no increase in the *Contract Time*.
 - .4 Remove *Products* or materials that have been broken, chipped, cracked, discoloured, abraded, or damaged during construction period and *Provide* undamaged *Products* or materials meeting the requirements of the *Contract Documents*.
- .2 Coordination:
 - .1 Ensure cooperation of workers in layout of the *Work*. Maintain efficient and continuous supervision.
 - .2 Be responsible for coordination and placement of openings, sleeves and accessories.
- .3 Backer plates:
 - .1 Provide backer plates to support and provide anchorage base to carry loads from surface or recessed applied materials.
- .4 Concealment:

Product Requirements

- .1 In finished areas, conceal pipes, ducts and wiring in floors, walls and ceilings, except where indicated otherwise.
- .2 Before installation, inform *Consultant* of any contradictory situation. Install as directed by *Consultant*.
- .5 Cutting and remedial work:
 - .1 Perform cutting and remedial work required to make parts of the *Work* come together. Coordinate the *Work* to ensure this requirement is maintained. Obtain permission from *Consultant* before commencing any cutting. Refer also to requirements of Section 01 73 29.
- .6 Location of fixtures:
 - .1 Consider location of fixtures, access panels, outlets and mechanical and electrical items indicated as approximate only. Locate fixtures, and the like approximately; Architectural drawings will relate these items to known dimensions, such as ceiling tile grid or wall locations and the like.
 - .2 Obtain *Consultant's* acceptance for precise locations of fixtures, access panels, outlets, mechanical, and electrical items.
 - .3 *Consultant* reserves the right to relocate electrical outlets and mechanical fixtures at a later date, but prior to installation, without cost, provided that the relocation per outlet does not exceed 3050 mm (10') from the original location.
 - .4 Inform *Consultant* of conflicting installations. Install only as directed by *Consultant*.
- .7 Protection of work in progress:
 - .1 Take reasonable and necessary measures, including those required by authorities having jurisdiction, to *Provide* protection.
 - .2 Adequately protect parts of the *Work* completed or in progress. Parts of the *Work* damaged or defaced due to failure in providing such protection is to be removed and replaced, or repaired, as directed by the *Consultant*, at no additional cost to the *Owner*.
 - .3 Prevent overloading of any part of the building. Do not cut, drill or sleeve any load bearing structural member without written permission of *Consultant*, unless specifically indicated. Refer also to Section 01 73 29.
 - .4 Adequately protect finished flooring from damage. Take special measures when moving heavy loads or equipment on them.
 - .5 Keep floors free of oils, grease or other materials likely to discolour them or affect bond of applied surfaces.
 - .6 Protect work of other *Subcontractors* from damage while doing subsequent work. Damaged work shall be made good by appropriate *Subcontractors* but at expense of those causing damage.
 - .7 Protect existing buildings, curbs, roads and lanes. If, during the *Work*, any buildings, curbs, roads or lanes are damaged, bear costs for repairs.
- .8 Protection of mechanical and electrical *Products* or materials:

Product Requirements

- .1 Wrap in protective plastic and seal mechanical and electrical items of mechanical and electrical equipment prior to and during shipment, storage at the *Place of the Work* and after installation.
- .2 Remove protective coverings only to the extent required for installation of the items. Re-install protection immediately following installation.
- .3 Remove protective coverings in stages, as work areas are completed, or when directed by *Consultant*.
- .9 Operational requirements:
 - .1 Operable *Products* shall be *Provided* fully operational and ready for intended use.
 - .2 Adjust operating hardware and accessories for a tight fit at contact points and weather stripping for smooth operation and weathertight closure. Lubricate hardware and moving parts for smooth squeak-free function, in accordance with manufacturer's requirements.
- .10 Alterations:
 - .1 Restore new or existing work which is altered by new work and make good. Materials and installation quality shall be match existing materials and workmanship. Exposed materials shall match and blend in with the appearance of the existing undamaged surfaces in all respects, including, colours, textures, layout, jointing, and material types so as to not vary in appearance when compared to adjacent materials from a distance of 1830 mm (6').

END OF SECTION

Cutting and Patching

PART 1 - GENERAL

1.1 Cutting, Patching and Remedial Work

- .1 Submittal Items:
 - .1 Comply with administrative requirements of Section 01 33 00.
 - .2 Submit written request in advance of cutting, coring, and alteration that affects:
 - .1 Structural integrity of any element of *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 *Owner* or work of other contractors.
 - .3 Include in request:
 - .1 Identification of *Project*.
 - .2 Location and description of affected work.
 - .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 *Owner* or work of other contractors.
 - .7 Written permission of affected separate contractor.
 - .8 Date and time work will be performed.
 - .9 Non-destructive structural survey: Radiography (X-ray) imaging of work to be cut or cored.
 - .4 Do not commence cutting, patching, or remedial work until request has been reviewed by *Consultant*.
- .2 Preparation:
 - .1 Inspect existing conditions, including elements subject to damage or movement during cutting and patching.
 - .2 After uncovering, inspect conditions affecting performance of the *Work*.
 - .3 Beginning of cutting or patching means acceptance of existing conditions.
 - .4 *Provide* supports to assure structural integrity of surroundings; devices and methods to protect other portions of the *Work* from damage.
 - .5 *Provide* protection from elements for areas which may be exposed by uncovering work.
 - .6 Where uncovering of area exposes local deterioration, cracking, evidence of water infiltration, structural settlement, previous modifications, or other unexpected conditions, advise *Consultant* immediately in writing and leave conditions exposed until receipt of *Consultant's* written instructions.

Cutting and Patching

.3 Execution:

- .1 Execute cutting, fitting, and patching to complete the *Work*. Under no circumstances will overcutting of corners of opening be accepted. Ensure corners of openings to be cut are predrilled or sawed.
- .2 Remove and replace defective and non-conforming work.
- .3 Remove samples of installed work for testing if directed by *Consultant*.
- .4 Shop drawings identifying precise locations and size of openings to be cored and cut are to be submitted for review by *Consultant*. *Provide* non-destructive structural survey of structural concrete to be cored or cut, for *Consultant* review. Coring and cutting work locations shall be reviewed by *Consultant* for acceptance before proceeding.
- .5 *Provide* openings in non-structural elements of the *Work* for penetrations of mechanical and electrical work.
- .6 Perform work by methods to avoid damage to other work, and which will *Provide* proper surfaces to receive patching and finishing.
- .7 Employ qualified installer with at least 3 years of relevant experience to perform cutting and patching for weather-exposed and moisture-resistant elements, and sight-exposed surfaces.
- .8 Cut rigid materials using masonry saw or core drill. Pneumatic or impact tools not allowed to be used anywhere within existing buildings unless approved by *Consultant*.
- .9 Restore work with new *Products* in accordance with requirements of *Contract Documents*.
- .10 Fit work to pipes, sleeves, ducts, conduit, and other penetrations through surfaces and with suitable allowance for deflection, expansion, contraction, and firestopping.
- .11 Enclose pipes, ducts, conduit and wires passing through floors at areas where faucets occur in a 100 mm (4") high metal sleeve and make air and watertight with water resistant firestopping.
- .12 Completely seal voids of penetrations of fire rated wall, ceiling, and floor constructions with firestopping and smoke seals.
- .13 Refinish surfaces to match adjacent finishes. Refinish continuous surfaces to nearest intersection. Refinish entire assembly units.

PART 2 - PRODUCTS

Not applicable.

PART 3 - EXECUTION

Not applicable.

END OF SECTION

Closeout Submittals

PART 1 - GENERAL

1.1 Section Includes

- .1 As-built documents.
- .2 Record drawings.
- .3 Operation and maintenance manuals.
- .4 Operation and maintenance book.
- .5 *Project* data book.
- .6 Shop drawing book.
- .7 Warranty book.
- .8 Posted operating instructions.
- .9 Spare parts, maintenance materials, and special tools.

1.2 Administrative Requirements

- .1 Collect reviewed submittals, and assemble required closeout submittals executed by *Subcontractors*, *Suppliers*, and manufacturers. Prior to submitting closeout submittals to the *Consultant*:
 - .1 Review maintenance manual contents (operating, maintenance instructions, as-built drawings, materials) for completeness.
 - .2 Review supply and completeness of spare parts required by *Documents* and manufacturers.
 - .3 Review in relation to *Contract Price*, *Change Orders*, *Change Directives*, holdbacks and other adjustments to the *Contract Price*.
 - .4 Review inspection and testing reports to verify conformance to intent of *Contract Documents* and that changes, repairs or replacements have been completed.
 - .5 Execute transition of performance bond and labour and materials payment bond to warranty period requirements.
 - .6 Submit a final statement of accounting giving total adjusted *Contract Price*, previous payments, and monies remaining at time of application for completion of the *Contract*. *Consultant* will issue a final change order reflecting approved adjustments to *Contract Price* not previously made.
- .2 Submit to the *Consultant* the closeout submittals specified in this section and elsewhere in the *Contract Documents* in accordance with GC 5.4.
- .3 For equipment put into use with *Owner's* permission during the *Work*, submit required closeout submittals within 10 *Working Days* after start-up.
- .4 For items of the *Work* delayed materially beyond date of *Substantial Performance of the Work*, provide updated closeout submittals within 10 *Working Days* after acceptance, listing date of acceptance as start of warranty period.

Closeout Submittals

- .5 Neither the *Consultant's* review to determine if *Substantial Performance of the Work* has been achieved, nor acceptance of the *Work*, will take place until receipt, by the *Consultant*, of acceptable copies of the closeout submittals required herein and by the *Contract Documents*.

1.3 As-Built Documents

- .1 Prepare as-built documents in accordance with Section 01 32 16.
- .2 Submit as-built documents as follows:
 - .1 Submit 4 sets of as-built documents in hard copy.
 - .1 In addition, submit digital scanned copy ("PDF" files) of as-built documents. Submit using digital storage medium or transfer process acceptable to the *Consultant* and the *Owner*.

1.4 Operation and Maintenance Manuals

- .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 operation and maintenance manuals as follows:
 - .1 Submit 4 copies of operation and maintenance manuals in hard copy.
 - .2 In addition, submit digital copies ("PDF" files) of operation and maintenance manuals. Submit using digital storage medium or transfer process acceptable to the *Consultant* and the *Owner*.

1.5 Operation and Maintenance Manual Format

- .1 Organize operation and maintenance manuals into the following general components:
 - .1 Operation and maintenance book.
 - .2 *Project* data book.
 - .3 Shop drawing book.
 - .4 Warranty book.
- .2 Organize data in the form of an instructional manual.
- .3 Bind each general component of the operation and maintenance books in separate vinyl hard covered, 3 ring loose leaf binders.
- .4 Enclose title sheet, labelled as applicable, with project name, date and list of contents.
- .5 Organize contents into applicable sections of work to parallel project specifications breakdown. Mark each section by labelled tabs protected with celluloid covers fastened to hard paper dividing sheets.
- .6 When multiple binders are used, correlate data into related consistent groupings. Identify contents of each binder on spine.

Closeout Submittals

- .7 Cover: Identify each binder with typed or printed title "Operation and Maintenance Manual", name of *Project* or facility, and subject matter of contents.
- .8 Text: Manufacturer's printed data, or typewritten data.

1.6 Operation and Maintenance Book

- .1 Operation and maintenance books shall contain operating and maintenance data and information specified below for supplied *Products*.
- .2 Neatly type lists and notes. Use clear drawings, diagrams of manufacturers' literature.
- .3 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.
- .4 Panel Board Circuit Directories: provide electrical service characteristics, controls, and communications.
- .5 Include installed colour coded wiring diagrams.
- .6 Description, operation and maintenance instructions for equipment and parts list. Indicate nameplate information such as make, size, capacity, serial number.
- .7 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.
- .8 Maintenance Requirements: include routine procedures and guide for trouble shooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.
- .9 Provide servicing and lubrication schedule, and list of lubricants required.
- .10 Include manufacturer's printed operation and maintenance instructions.
- .11 Include sequence of operation by controls manufacturer.
- .12 Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.
- .13 Provide installed control diagrams by controls manufacturer.
- .14 Provide Contractor's coordination drawings, with installed colour coded piping diagrams.
- .15 Provide charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.
- .16 Provide list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.
- .17 Include testing and balancing reports.
- .18 Include additional content as specified in technical Specifications sections.

1.7 Project Data Book

- .1 *Project Data Book* shall include the following information supplemented by additional required data specified elsewhere in the *Contract Documents*:

Closeout Submittals

- .1 Maintenance instructions for finished surfaces and materials.
- .2 Copy of hardware and paint schedules.
- .3 Names, addresses and phone numbers of *Subcontractors* and *Suppliers*, as applicable.
- .4 Additional material used in the *Work* listed under various sections showing name of manufacturer and source of supply.
- .5 Report recording demonstration and instruction provided to *Owner* for operation and maintenance of building systems.
- .6 Key construction photos.
- .7 Permits and forms:
 - .1 Certificate of Clearance from the Workplace Safety and Insurance Board (WSIB).
 - .2 Certificates of approval of the *Work* by local building department (if available).
 - .3 Electrical authority certificate of inspection.
- .8 Waste management and disposal reports, prepared in accordance with Section 01 74 00.

1.8 Shop Drawing Book

- .1 Submit one copy of each final accepted shop drawing issued for the *Work* on which have been recorded changes made during fabrication and installation caused by unforeseen conditions.
- .2 Engineered shop drawings shall include copies of the certificate of insurance, the engineer's field review reports, and the engineer's letters of general conformity that were provided as part of the engineered submittal in accordance with Section 01 33 01 appended to the pertinent engineered shop drawing in the shop drawing manual.

1.9 Warranty Book

- .1 Submit copies of bonds, guarantees, warranties and extended warranties together, complete with an indexed summary list of warranties and expiration dates. Warranties to be in accordance with Section 01 78 36.
- .2 Separate each warranty with index tab sheets keyed to Table of Contents listing.
- .3 List each warrantor with complete contact information.
- .4 Verify that documents are in proper form and contain full information. Warranties shall be for the correct duration and shall be in *Owner's* name.
- .5 Include maintenance bond(s).

1.10 Posted Operating Instructions

- .1 Prepare operating instructions in English for posting near equipment and systems. Posted instructions to be glass covered, framed and mounted.

Closeout Submittals

- .2 Posted instructions to consist of simplified, consolidated equipment, control and power diagrams graphically representing the entire system, including concise instructions on how to start and stop systems, what settings and conditions are to be observed by the operators, and what control adjustments are to be made or maintained by the operator.
- .3 Posted instructions shall include control diagrams with added specific operating instructions, controls, interlocks, and the like.
- .4 Posted instructions shall include:
 - .1 HVAC controls for each system.
 - .2 One line schematic diagrams of water supply.
 - .3 One line isometric diagrams of sanitary drainage.
 - .4 One line diagrams of steam distribution, hot and cold water systems, including risers, valves, control devices, etc.

1.11 Spare Parts, Maintenance Materials, and Special Tools

- .1 Provide overage, extra stock, and maintenance materials, including keys, in quantities specified in the *Contract Documents*.
- .2 Submit to *Consultant* a typed inventory list of maintenance materials prior to application for *Substantial Performance of the Work*. List all items, complete with quantities, and storage locations. Include *Consultant* reviewed inventory listing in final submission to *Owner*.
- .3 Prepare and submit a master list identifying maintenance materials and maintain a log of when materials are turned over to *Owner* and signing authority for acceptance of materials on behalf of *Owner*.
- .4 Provide tags for special tools identifying their function and associated *Product*.
- .5 Supply spare parts, maintenance materials, and special tools in quantities specified in technical Specifications sections.
- .6 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*.
 - .1 Replace incorrect or damaged maintenance materials.
- .7 Deliver to and store items at location and time directed by *Owner*. Store in original packaging with manufacturer's labels intact and in a manner to prevent damage or deterioration.
 - .1 Clearly mark cartons or packaging as to contents, project name, and *Supplier*.
 - .2 If applicable give colour and finish, room number or area where material is used.
 - .3 Include necessary information for re-ordering of materials as part of packaging of materials.
- .8 Catalogue all items and submit to *Consultant* an inventory listing organized by Specifications section. Include *Consultant* reviewed inventory listing in operation and maintenance manual.

PART 2 - PRODUCTS

Not applicable.

PART 3 - EXECUTION

Not applicable.

END OF SECTION

PART 1 - GENERAL

1.1 Summary

- .1 Section includes:
 - .1 Demolition and removal of selected non-structural portions of building.
 - .2 Salvage:
 - .1 Salvaging of designated items for reuse by *Owner*.
 - .3 Removal of surplus materials from the *Place of the Work*.
 - .4 Related mechanical and electrical work and demolition requirements are covered under Divisions 21, 22, and 23 and Divisions 26, 27, and 28 respectively.
- .2 Section excludes:
 - .1 Demolition, removal, remediation, or abatement of designated substances or materials and toxic and hazardous substances.
 - .2 Demolition of concrete: in accordance with Structural specifications and drawings.

1.2 Administrative Requirements

- .1 Pre-demolition meeting:
 - .1 Schedule a pre-demolition meeting following the procedures specified for pre-installation meetings in accordance with Section 01 31 19.
 - .2 Review existing conditions at the *Place of the Work* thoroughly to establish full extent of items to be removed and items to remain. Commencement of demolition work will be considered to be acceptance of existing conditions at the *Place of the Work* and removal of such items.
 - .3 Examine adjacent properties to determine extent of protection required.

1.3 Submittals

- .1 Submit required submittals in accordance with Section 01 33 00.
- .2 Special procedures submittals:
 - .1 Existing conditions documentation:
 - .1 Document existing conditions of adjoining construction and site improvements, including pre-existing damage to finish surfaces that might be misconstrued as damage caused by demolition operations.
 - .2 Submit existing conditions documentation before demolition work begins.
 - .2 Inventory of items to be salvaged:
 - .1 Prepare typed inventory of units to be salvaged and cross-reference to drawing showing existing elevations.
 - .2 Submit inventory following procedures for submittal of shop drawings in accordance with Section 01 33 00.

Demolition

1.4 Quality Assurance

.1 Qualifications:

.1 Subcontractor:

- .1 Shall have 5 years' specialized demolition experience, minimum.
- .2 Shall be able to deploy adequate equipment and skilled personnel to complete work expediently in an efficient and orderly manner.

PART 2 - PRODUCTS

Not applicable.

PART 3 - EXECUTION

3.1 Examination

- .1 Verify that utilities have been disconnected and capped.
- .2 Observe existing conditions and correlate with requirements indicated to determine extent of selective demolition required.
- .3 Inventory and record the condition of items to be removed and reinstalled and items to be removed and salvaged.
- .4 When unanticipated mechanical, electrical, or structural elements that conflict with intended function or design are encountered, investigate and measure the nature and extent of conflict. Promptly submit a written report to *Consultant*.
- .5 Survey of existing conditions: Record existing conditions by use of photographs.

3.2 Utility Services and Mechanical / Electrical Systems

- .1 Refer to Divisions 21, 22, and 23 and Divisions 26, 27, and 28 respectively.

3.3 Selective Demolition, General

- .1 Demolish and remove existing construction only to the extent required by new construction, and as otherwise indicated. Use methods required to complete the work within limitations of governing regulations and as follows:
 - .1 Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.
 - .2 Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping, to minimize disturbance of adjacent surfaces. Temporarily cover openings to remain.
 - .3 Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.

Demolition

- .4 Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain fire watch and portable fire-suppression devices during flame-cutting operations.
- .5 Maintain adequate ventilation when using cutting torches.
- .6 Remove decayed, infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
- .7 Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
- .8 Dispose of demolished items and materials promptly.
- .2 Dispose of demolished materials from *Project* site except where noted otherwise and in accordance with authorities having jurisdiction. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
- .3 Do not sell demolished material at the *Place of the Work*.
- .4 Clean existing surfaces specified to receive new applied finishes to assure proper adherence.

3.4 Selective Demolition Procedures for Specific Materials

- .1 Masonry: Demolish in small sections. Cut masonry at junctures with construction to remain, using power-driven saw, then remove masonry between saw cuts.

3.5 Salvage

- .1 Remove and store items indicated or directed for salvage. Remove, handle and transport such items to storage area designated in the *Contract Documents*, to an area within the *Place of the Work* designated by *Consultant*, or to an area away from the *Place of the Work* as directed by the *Consultant*. Perform such work to prevent damage to the items during removal and in storage.
- .2 The *Owner* shall review *Place of the Work* prior to commencement of demolition and instruct the *Contractor* of the items to be retained for re-use or be turned over to the *Owner*.
- .3 Remove and store indicated items for future use by *Owner*. Remove, handle and transport such items to storage area indicated in the *Contract Documents* or to an area within the *Place of the Work* designated by *Consultant*. Perform such work carefully and with diligence to prevent any damage to the items during removal and in storage.

3.6 Protection

- .1 Prevent movement, settlement or damage of adjacent structures, services, walks, paving, trees, landscaping, adjacent grades and parts of existing building to remain. Make good damage caused by demolition.
- .2 Take precautions to support affected structures and, if safety of building being demolished or adjacent structures or services appears to be endangered, cease operations and notify demolition engineer, *Contractor* and *Consultant*.
- .3 *Provide* temporary weather enclosures in accordance with Section 01 52 00.
- .4 Prevent debris from obstructing active services and drainage systems.

Demolition

- .5 Protect work to remain against damage. Repair or replace damaged work at no additional cost to the *Owner*.

END OF SECTION

Stair Nosing Inserts

PART 1 - GENERAL

1.1 Summary

- .1 Section includes:
 - .1 Stair nosing inserts (TC-1).

1.2 Submittals

- .1 Submit required submittals in accordance with Section 01 33 00.
- .2 *Product* data sheets
 - .1 Submit manufacturer's *Product* data sheets for *Products* proposed for use in the work of this section.
- .3 Shop drawings:
 - .1 Clearly indicate fabrication details, plans, elevations, hardware, and installation details.
- .4 Samples:
 - .1 Submit duplicate samples of each product specified.
- .5 Templates:
 - .1 Submit templates to *Contractor* for use by installers and fabricators as required for proper location and installation of hardware.

1.3 Closeout Submittals

- .1 Submit closeout submittals in accordance with Section 01 78 00.
- .2 Operation and maintenance data:
 - .1 Submit operation and maintenance data for incorporation into maintenance manual.

PART 2 - PRODUCTS

2.1 Materials

- .1 Incorporate reinforcing, fastenings and anchorage required for building in of products.
- .2 Nosing insert:
 - .1 Photoluminescence contrasting warning strip:
 - .1 In accordance with ASTM E2072.
 - .2 Slip resistant in accordance with UL410.
 - .3 Abrasion resistant in accordance with ASTM D1242.
 - .4 Width: 25 mm (1").
 - .5 Colour: to later selection by *Consultant*.
 - .6 Acceptable *Product*.

Stair Nosing Inserts

- .1 Ecoglo 'G6001 Photoluminescent Guidance Strip'.
- .2 Substitutions: in accordance with Section 01 25 00.
- .3 Adhesive:
 - .1 Acceptable *Product*:
 - .1 Bostik '915FS'.
 - .2 Substitutions: in accordance with Section 01 25 00.

PART 3 - EXECUTION

3.1 Installation

- .1 Submit manufacturer's information and templates required for installation of work of this section, and assist or supervise, or both, the setting of anchorage devices, and construction of other work incorporated with *Products* specified in this section in order that they function as intended.
- .2 Install work to meet manufacturers' recommended specifications, true, tightly fitted, and level or flush to adjacent surfaces, as suitable for installation.
- .3 Include reinforcing, anchorage and mounting devices required for the installation of each *Product*.
- .4 Fit joints and junction between components tightly and in true planes, conceal and weld joints where possible.
- .5 Fabricate *Products* with materials and component sizes, metal gauges, hardware, reinforcing, anchors, and fastenings of adequate strength to ensure that items will remain free of warping, buckling, opening of joints and seams, and distortion within limits of intended use.
- .6 Supply handling instructions, anchorage information, roughing-in dimensions, templates and service requirements for installation of the work of this section, and assist or supervise, or both, the setting of anchorage devices and construction of other work incorporated with *Products* specified in this section.
- .7 Back paint components where contact is made with building finishes preventing electrolysis.

END OF SECTION

PART 1 - GENERAL

1.1 Summary

- .1 Section includes:
 - .1 Work of this section includes architectural woodwork including, but not limited to, the following:
 - .1 Benches.
 - .2 Factory and site finishing of architectural woodwork.

1.2 Administrative Requirements

- .1 Coordination:
 - .1 Coordinate with other work for satisfactory and expeditious completion of the work of this section. Coordinate with partition accessories, electrical, communications, and finish components to ensure that proper provisions are made for the installation of the work of this section and for work by others.
 - .2 Where woodwork is to be fitted to other construction, check actual dimension of other construction by accurate field measurements before manufacturing woodwork; show recorded measurements on final shop drawings. Coordinate manufacturing schedule with construction progress to avoid delays in the *Work*.
 - .3 *Provide* forms, templates, anchors, sleeves, inserts and accessories required to be fixed to or inserted in the work of this section and set in place. Instruct applicable *Subcontractors* as to their locations.
 - .4 *Provide* cut-outs for raceways, sleeves, grommets and other manufactured accessories which are required for the work of this section and for work by others.

1.3 Submittals

- .1 Submit required submittals in accordance with Section 01 33 00.
- .2 *Product* data sheets:
 - .1 Submit manufacturer's *Product* data for each type of *Product* and process proposed for use in the work of this section and incorporated into items of architectural woodwork.
- .3 Shop drawings:
 - .1 Submit shop drawings for the work of this section complying with the North American Architectural Woodwork Standards 4.0 requirements.
 - .2 Submit engineered shop drawings for the following architectural woodwork assemblies:
 - .1 Benches.
 - .3 Indicate quality standards and grades.
 - .4 Include full scale drawings of exposed-to-view edge conditions.

Architectural Woodwork

Section revised by Addendum No. 03

- .5 Include plans, sections and large scale details, and indicate components and methods of assembly, fastenings, and other fabrication information required for the work of this section. Indicate assembly joint lines.
- .6 Include materials and their characteristics and finishes as applicable including the following:
 - .1 Panel core and material types, thicknesses, compliance with specified standards, special treatments.
 - .2 Adhesive types to be used and locations.
 - .3 Finishing requirements including North American Architectural Woodwork Standards 4.0 finish system number, sheen, and required application steps.
- .7 Submit coordination drawings indicating locations of concealed grounds, cut-outs, plates, and other required fabrications.
- .8 Show relation to adjoining construction, details of outside and inside corners and door openings.
- .4 Selection samples:
 - .1 Submit 3 sets of samples for initial selection purposes of actual veneers showing full range of grain variation, colour and matching, natural characteristics reflecting wood cut and species, manufacturing characteristics, and for each wood species specified. Submit samples as many times as required until approved by *Consultant*. First submission to include one set of samples per *Consultant* request plus one set lighter in tone and one set darker in tone.
 - .1 Solid wood with factory finish, and each type of edge trim: set of 3 pieces, 50 mm x 19 mm x 450 mm (2" x 3/4" x 18"), for each color and finish and installed condition, finished on one side.
 - .2 Veneered panels, with each type of edge trim with factory finish: 3 finished samples, minimum 450 mm x 450 mm (18" x 18") or larger size for each finish and installed condition, four piece matched veneer cut and color as specified to fully illustrate natural characteristics, manufacturing characteristics, colour and matching, and special characteristics.
- .5 Verification samples:
 - .1 Submit samples for purpose of verification of compliance with specified requirements.
 - .2 Submit 3 sets of 200 mm x 200 mm (8" x 8") samples, or 200 mm (8") long as applicable, of each specified *Product*, material and finish, including but not limited to the following:
 - .1 Shop finished materials, showing each type of finish and color.
 - .2 Samples of each specified *Product*, in each specified color and finish.

1.4 Closeout Submittals

- .1 Submit closeout submittals in accordance with Section 01 78 00.
- .2 Operation and maintenance data:

Architectural Woodwork

Section revised by Addendum No. 03

- .1 Submit maintenance and cleaning instructions for finishes requiring specific care, noting particularly those procedures or materials which will cause damage to finished surfaces to be included in maintenance manuals.

1.5 Quality Assurance

- .1 Qualifications:
 - .1 Manufacturers:
 - .1 Architectural woodwork shall be manufactured by a firm having 5 years' experience, minimum, on work of similar size and quality.
 - .2 Shall be a member in good standing of the Architectural Woodwork Institute or the Architectural Woodwork Manufacturers Association of Canada or the Woodwork Institute.
 - .3 Solid surfacing fabricator: Fabrication to be performed by a solid surface manufacturer's certified fabricator. Submit certification letter prepared by the solid surfacing manufacturer.
 - .2 Installers:
 - .1 Has successfully completed 2 architectural woodwork projects similar in scope, materials and design to this *Project* within the last 5 years.
- .2 Quality standard:
 - .1 Work shall be in accordance with the North American Architectural Woodwork Standards 4.0, Premium Grade, or the highest grade available for performance and appearance characteristics of materials in Sections 3 – 5 used that apply to *Product* fabrication and installation requirements governed by Sections 6 – 12.
- .3 Requirements of regulatory agencies: the work of this section that functions to resist forces imposed by dead and live loads shall conform to requirements of jurisdictional authorities.
- .4 Mock-ups:
 - .1 Veneer and solid types.
 - .2 Edge and joint types.
 - .3 Veneer panels, minimum showing specified veneer layout.

1.6 Delivery, Storage, and Handling

- .1 Protect architectural woodwork during transit, delivery, storage and handling to prevent damage, spoilage, and deterioration.
- .2 Do not deliver woodwork until painting, wet work, grinding, and similar operations that could damage, soil, or deteriorate architectural woodwork have been completed in installation areas. If woodwork must be stored in other than installation areas, store only in areas whose environmental conditions meet requirements specified under paragraph 1.7 Field Conditions.
- .3 The architectural woodwork manufacturer and the *Contractor* shall be jointly responsible to make certain that architectural woodwork is not delivered until the building and storage areas are sufficiently dry so that the architectural woodwork will not be damaged by excessive changes in moisture content.

Architectural Woodwork

Section revised by Addendum No. 03

1.7 Field Conditions

.1 Environmental conditions:

- .1 During storage and installation: Obtain and comply with North American Architectural Woodwork Standards 4.0 for optimum temperature and relative humidity conditions for woodwork during its storage and installation. Do not install woodwork until these conditions have been attained. Woodwork shall be acclimatized for a minimum of 72 hours prior to commencing woodwork installation.
- .2 During finishing: Comply with Architectural Woodwork Standard's temperature and humidity requirements before, during, and after application of finishes.
- .3 During service life of woodwork: Obtain and comply with woodwork manufacturer's advice for optimum temperature and humidity conditions. Note that building humidity control is not in operation 24 hours per day or 365 days per year and system is intermittent during winter and summer months. As a result, fabrication of wood components should anticipate major changes in humidity levels.

1.8 Warranty

- .1 Warrant work of this section in accordance with Section 01 78 36.

PART 2 - PRODUCTS

2.1 Sustainable Design Requirements

- .1 Wood-based materials are to contain no added urea-formaldehyde.

2.2 Performance/Design Requirements

- .1 Casework integrity shall meet the minimum acceptance levels in accordance with SEFA 8-1999 as outlined in the North American Architectural Woodwork Standards 4.0 and additional or greater loading capacities as specified throughout the North American Architectural Woodwork Standards 4.0.
- .2 Maximum allowable adjustable shelf lengths shall comply with shelves assembly rules per the North American Architectural Woodwork Standards 4.0 based on shelf thickness indicated or scheduled.

2.3 Wood Materials

.1 Lumber:

- .1 Hardwood for concealed blocking and framing: Custom grade, any species that, when painted, will not show any defects.
- .2 Hardwood for exposed blocking: species and grade to match panel veneer.
- .3 Moisture content: *Provide* kiln-dried (KD) lumber with moisture content range between 6% to 12% for interior architectural woodwork. Maintain temperature and relative humidity during fabrication, storage and finishing operations so that moisture content values for woodwork at time of installation do not exceed 5% to 10%.
- .1 Solid hardwood for transparent finish.

Architectural Woodwork

Section revised by Addendum No. 03

- .1 WD-1A:
 - .1 Species: White Oak.
 - .2 Cut: Rift.
- .2 Wood veneers:
 - .1 Allowable wood veneer face grade characteristics shall comply with North American Architectural Woodwork Standards 4.0 referenced grade and referenced standards.
 - .2 Hardwood veneer; for transparent finish:
 - .1 WD-2A:
 - .1 Species: White Oak.
 - .2 Veneer thickness: Minimum 1.02 mm (0.040") thick after sanding.
 - .3 Veneer cut: Rift.
 - .4 Veneer leaf matching: Random.
 - .5 Veneer assembly matching: Balance and Centre.
 - .6 Veneer end matching: Architectural.

2.4 Panel Materials

- .1 Panel material schedule; except where indicated otherwise:
 - .1 Core panels:
 - .1 Plywood backing; countertops, backsplashes, and where indicated: Exterior grade plywood with no added urea-formaldehyde used in composition.
 - .2 Maximum moisture content at time of installation: 10% to 12%.
- .2 Plywood:
 - .1 Veneer core plywood non telegraphing grain: Sanded good one side or good two sides (when both sides exposed or to receive applied finish materials) plywood:
 - .1 Hardwood plywood: in accordance with ANSI/HPVA HP-1-2009.
 - .2 Softwood plywood: to US Plywood Standard APA PS-1-09 Structural Plywood (with Typical APA Trademarks).
 - .2 FSC Baltic Birch (Forest Sustainable Certification); exposed and semi-exposed: Birch facers and core veneers, type 2 hot press glue bond (E-1 rating meets European low formaldehyde emission standard), European Face Grade B - Premium grade on exposed faces (patch free clear faces, uniform white in color), premium edge quality where cut to expose, free of gaps and defects.

2.5 Fasteners and Adhesives

- .1 Fasteners shall comply with North American Architectural Woodwork Standards 4.0.

Architectural Woodwork

Section revised by Addendum No. 03

- .2 Adhesives: Shall be used for intended purpose and manufacturer materials applications and installation, applied in accordance with manufacturer's written requirements and shall comply with the "adhesive usage guidelines" recommendations of North American Architectural Woodwork Standards 4.0

2.6 Finishes - Interior Architectural Woodwork

- .1 General: The entire finish of interior architectural woodwork is specified in this section, regardless of whether factory applied or applied after installation.
- .2 Preparations for finishing:
 - .1 Prior to finishing, exposed portions of woodwork shall have handling marks or effects of exposure to moisture removed with a thorough final sanding over surfaces of the exposed portions, using appropriate grit sandpaper, and shall be cleaned prior to applying sealer or finish. Sanding shall be completed just prior to stain or finishing application.
 - .2 Concealed surfaces of woodwork that might be exposed to moisture, such as those adjacent to exterior concrete or masonry walls, shall be back-primed.
 - .3 Comply with referenced quality standard in Part 1 for sanding, filling countersunk fasteners, sealing concealed surfaces and similar preparations for finishing of architectural woodwork, as applicable to each unit of work.
- .3 Finish for veneer and solid wood:
 - .1 Comply with requirements indicated below for finish system, staining, and sheen.
 - .1 Sheen: Flat. Sheen range measurements in accordance with North American Architectural Woodwork Standards 4.0.
 - .2 Factory finish with transparent, Post Catalyzed Lacquer in accordance with the North American Architectural Woodwork Standards 4.0, Section 5.
 - .1 Transparent finish:
 - .1 Clear (natural).

2.7 Fabrication

- .1 Fabricate woodwork to dimensions, profiles, and details indicated with openings and mortises pre-cut, where possible, to receive hardware and other items of work.
- .2 Complete fabrication, assembly, finishing, hardware application, and other work before shipment to maximum extent possible. Trial fit in shop and disassemble components only as necessary for shipment and installation. Where necessary, provide ample allowance for scribing, trimming, and fitting. Reassemble with concealed fasteners.
- .3 *Provide* woodwork, solid tops and other indicated materials with pre-cut openings, where possible, for hardware, appliances, plumbing fixtures, electrical work, telephone cut-outs and similar items. Locate openings accurately and *Provide* proper size and shape. Smooth edges of cut-outs and, where located in countertops, seal edges of cut-outs with a water-resistant coating.
- .4 *Provide* framing for architectural woodwork, complete with bracing and fastening devices as required for a rigid installation, and as required to sustain the imposed loads.

Architectural Woodwork

Section revised by Addendum No. 03

- .5 Reinforcing shown is minimum. *Provide* additional reinforcing as required to ensure a rigid assembly. Take responsibility for the stability of furniture and fitments.
- .6 *Provide* balancing sheets as required, and specified, complying with the North American Architectural Woodwork Standards 4.0.
- .7 *Provide* surface mount blocking and strapping necessary to support the work of this section. Such blocking shall not be exposed upon completion of work.
- .8 Prefinish work at the factory, except where specified or indicated otherwise.
- .9 Panel construction; solid edgebanded with overlaid veneer:
- .10 Solid wood edging: No end grain shall be visible; mitre external corners; house internal corners.

PART 3 - EXECUTION

3.1 Preparation

- .1 Condition woodwork to field conditions in installation areas before installing. Ensure that field conditions have been provided as requested and specified.
- .2 Before installing architectural woodwork, examine shop-fabricated work for completion and complete work as required, including back priming and removal of packing.
- .3 *Provide* grounds, nailers and other required fabrications which are to be built into other work when required.
- .4 Ensure that wall and ceiling variations are not in excess of 6.4 mm (1/4") in 3658 mm (144") and that floors are not in excess of 12.7 mm (1/2") in 3658 mm (144") of being plumb, level, flat, straight, square, of the correct size. Variations shall be corrected prior to installation of work of this section.
- .5 Report conditions contrary to requirements preventing proper installation. Do not proceed with the installation until unsatisfactory conditions have been corrected.

3.2 Installation

- .1 Install woodwork to comply with North American Architectural Woodwork Standards 4.0 for same grade specified in Part 1 of this section for type of woodwork involved.
- .2 Install woodwork plumb, level, true, and straight with no distortions.
- .3 Scribe and cut woodwork to fit adjoining work and refinish cut surfaces or repair damaged finish at cuts.
- .4 Anchor woodwork to anchors or blocking built in or directly attached to substrates. Secure to grounds, stripping and blocking with countersunk, concealed fasteners and blind nailing as required for a complete installation. Except where prefinished matching fastener heads are required, use fine finishing nails for exposed nailing, countersunk and filled flush with woodwork and matching final finish where transparent finish is indicated.
- .5 Complete the finishing work specified in this section to whatever extent not completed at shop or before installation of woodwork.

Architectural Woodwork

Section revised by Addendum No. 03

3.3 Installation - Tolerances

- .1 Install to a tolerance of 3 mm in 2400 mm (1/8" in 8'-0") for plumb and level (including tops) and with no variations in flushness of adjoining surfaces unless otherwise acceptable in accordance with the North American Architectural Woodwork Standards 4.0.

3.4 Adjusting and Cleaning

- .1 Repair damaged and defective woodwork where possible to eliminate defects functionally and visually; where not possible to repair, replace woodwork.
- .2 Clean, lubricate, and adjust hardware.
- .3 Clean woodwork on exposed and semi-exposed surfaces. Touch up factory-applied finishes to restore damaged or soiled areas.

3.5 Protection

- .1 Protect architectural woodwork during remainder of construction period to ensure that work will be without damage or deterioration at time of acceptance.
- .2 *Provide* final protection and maintain conditions, in a manner acceptable to manufacturer and installer, that ensure that woodwork is without damage or deterioration at time of *Substantial Performance of the Work*.

END OF SECTION

Intumescent Fire-Resistant Materials (IFRM)

PART 1 - GENERAL

1.1 Summary

- .1 Section includes:
 - .1 Intumescent fire-resistant materials (IFRM) to surfaces of structural steel components required to have fire rated hourly classification, complete with painted finish where exposed.

1.2 Administrative Requirements

- .1 Conduct a pre-installation meeting in accordance with Section 01 31 19.

1.3 Submittals

- .1 Submit required submittals in accordance with Section 01 33 00.
- .2 *Product* data sheets:
 - .1 Submit manufacturer's *Product* data sheets for *Products* proposed for use in the work of this section including, but not limited to:
 - .1 Brand names and descriptive catalogue data of proposed *Products*.
 - .2 Complete references to tests by UL/ULC or WH that substantiate design to be applied. Test data shall be evaluated or developed under CAN/ULC S101-14 temperature criteria.
 - .3 Include complete test report in cases where references are not published by testing laboratories, and where authority having jurisdiction has approved significant changes from tested assembly on basis of an engineering study; study calculations shall accompany report.
 - .4 Submit test reports and certificates at least 8 weeks prior to application of materials.
 - .5 Submit compatibility statement demonstrating compatibility testing of topcoat for each intumescent fireproofing system from intumescent fireproofing manufacturer.
- .3 Samples:
 - .1 Submit 305 mm x 500 mm (12" x 20") samples of full IFRM coating system. Step back each additional coating layer to show range of materials from substrate to finish coat, including colour and texture as applicable.

1.4 Closeout Submittals

- .1 Submit closeout submittals in accordance with Section 01 78 00.
- .2 Operation and maintenance data:
 - .1 Submit daily log book.

1.5 Quality Assurance

- .1 Qualifications:

Intumescent Fire-Resistant Materials (IFRM)

- .1 Installers: Shall have 5 years' experience, minimum, in application of *Products*, systems and assemblies specified and with approval and training of *Product* manufacturers.

1.6 Delivery, Storage, and Handling

- .1 Deliver materials and *Products* to the *Place of the Work* in original undamaged containers with manufacturer's seals intact.
- .2 Store materials and *Products* in a dry location at 10°C, minimum. Protect materials from elements.

PART 2 - PRODUCTS

2.1 Performance/Design Requirements

- .1 Carry out the work of this section in accordance with fire test report data, under CAN/ULC S101-14 procedures and as listed by accredited testing agency.
- .2 Materials and applied systems shall have full acceptance by authority having jurisdiction.
- .3 Fire rated hourly classification of 2 hour minimum, and as indicated,

2.2 Materials

- .1 General:
 - .1 Install only *Products* as supplied by one manufacturer/*Supplier* for the work of this section.
- .2 Intumescent fire-resistant material (IFRM):
 - .1 Interior grade (water based materials):
 - .1 Acceptable *Products*:
 - .1 AD Fire Protection System, a Division of Carboline 'A/D Firefilm III'.
 - .2 Carboline 'A/D Firefilm III'.
 - .3 Cafco 'SprayFilm WB3/Isolatek Type WB3 or WB5/Isolatek Type WB5'.
 - .4 Hilti Inc. 'Fire Finish CFP-SP WB'.
 - .5 Substitutions: in accordance with Section 01 25 00.
- .3 Materials shall be listed in accordance with CAN/ULC S101-14.
- .4 High temperature or fibre mesh: as recommended by intumescent fireproofing manufacturer.
- .5 Primer: Primer to be approved by fireproofing manufacturer. Coordinate with Structural drawings and specifications.

2.3 Coating Thickness

- .1 Review *Contract Documents* to determine necessary coating thicknesses as based upon M/D calculations and as required to conform to building code. *Contract Price* includes complete systems as required to meet fire ratings.

Intumescent Fire-Resistant Materials (IFRM)

PART 3 - EXECUTION

3.1 Examination

- .1 Examine and verify that surfaces are dry, clean and free from oil, grease, dirt, loose primer, mill scale or other deleterious material that would impair bond.
- .2 Verify that all surfaces have been primed with a suitable primer compatible with basecoat to ensure proper bonding.
- .3 Examine surfaces to receive the work of this section and proceed only when conditions are satisfactory. Report unsatisfactory conditions promptly.
- .4 Verify compatibility of adjacent fireproofing to protect required fire protection to meet the building code.

3.2 Preparation

- .1 Confirm locations of surfaces to receive IFRM with *Consultant* prior to application.
- .2 Remove dirt, dust and other deleterious substances from surface to be coated.
- .3 Remove and replace accessory objects as required. Do not coat devices thereby exposed.
- .4 Apply high temperature or fibreglass mesh in accordance with manufacturer's recommendations.
- .5 Mask adjacent surfaces.
- .6 Mix materials and *Products* in accordance with manufacturer's written requirements.

3.3 Installation

- .1 Apply IFRM system in accordance with manufacturer's written requirements and in compliance with listed system design.
- .2 Apply IFRM to proper loading thickness to achieve required fire protection rating.
- .3 Thoroughly mix IFRM materials before application and applied without cutting or admixture of any kind except as may be directed by the manufacturer. Apply IFRM evenly, in full coats free from application marks, sags, runs, crawls and other defects. Finish shall be uniform in sheen, colour and texture.
- .4 Finished application shall be architecturally smooth; rough textures and orange peel finish are not acceptable.

3.4 Field Quality Control

- .1 Conduct quality control in accordance with Section 01 45 00, supplemented as follows:
 - .1 Maintain daily log book, including:
 - .1 Temperature conditions.
 - .2 Humidity conditions.
 - .3 Substrate conditions.
 - .4 Heating apparatus used to maintain temperature conditions (as applicable).
 - .5 Areas of the *Work* completed.

Intumescent Fire-Resistant Materials (IFRM)

- .2 Manufacturer's field review to be in accordance with Section 01 45 00.

3.5 Adjusting and Cleaning

- .1 Clean and make good to *Consultant's* acceptance, surfaces soiled or otherwise damaged in connection with work of this section. Pay cost of replacing finishes, materials and *Products* that cannot be satisfactorily cleaned.
- .2 Upon completion of the work of this section, remove all debris, equipment and excess material resulting from work of this section from the *Place of the Work*.

END OF SECTION

Joint Firestopping and Smoke Seals

PART 1 - GENERAL

.1 Section includes:

- .1 Materials installed in joints to restrict the spread of fire and smoke.
- .1 Joints in or between fire-resistance-rated constructions.

.2 Section excludes:

- .1 Firestopping and smoke seals, for mechanical, electrical and communications penetrations of fire resistant assemblies, and firestopping and smoke seals within their respective assemblies. Refer to Divisions 21, 22, and 23 and Divisions 26, 27, and 28.

1.2 Administrative Requirements

.1 Coordination:

- .1 Coordinate joint firestopping and smoke seal work with Section 01 33 02.
 - .2 Coordinate with other sections to assure that pipes, conduit, cable, and other items that penetrate fire rated construction, have been permanently installed prior to installation of firestop assemblies.
 - .3 Schedule the *Work* to assure that penetrations and other construction that conceals penetrations are not erected prior to the installation of firestop and smoke seals.
- .2 Conduct a pre-installation meeting in accordance with Section 01 31 19.
- .1 Representatives for mechanical and electrical work and independent inspection and testing company shall attend pre-installation meeting.

1.3 Submittals

- .1 Submit required submittals in accordance with Section 01 33 00.
- .2 *Product* data sheets: Submit data and installation instructions for *Products* providing descriptions sufficient for identification at the *Place of the Work*.
 - .1 Materials list of *Products* proposed for use in the work of this section; complying with listed systems designs.
 - .2 Listing agency's detailed drawing showing joint assemblies and firestopping materials, identified with listing agency's name and number or designation, fire rating achieved, and date of listing.
 - .3 Certificates:
 - .1 Submit the following certification documents with closeout submittals:
 - .1 Manufacturer's certification: Submit manufacturer's certification that installed firestopping and smoke seal *Products* are suitable for the use indicated and comply with specified requirements.
 - .2 Installation certification: Installer shall submit certification that all joint firestopping system installations are completed and that installations comply with listed systems designs.

Joint Firestopping and Smoke Seals

- .4 Submit fire resistance rating test listings for firestopping and smoke seal systems.
- .3 Shop drawings:
 - .1 Submit drawings indicating fire resistance rated assembly number, required temperature, hose stream, and flame rating, material thicknesses, installation methods and materials of firestopping and smoke seals, primers, supports, damming materials as applicable, reinforcements, anchorages, fastenings and methods of installation for each condition to be encountered.
 - .2 Designate on shop drawings static and dynamic joint systems, relative positions, expansion and control joints in rated slabs and walls, and firestopping details.
 - .3 Engineered shop drawings; for engineering judgements:
 - .1 Where *Project* conditions require modification to an accredited third party testing agency's listed system design to address a particular firestopping condition that is not covered by a listed system, submit engineered shop drawings detailing the modifications to the listed system design as an engineering judgment or equivalent fire-resistance-rated assembly, for each *Project* location and condition.
 - .2 Submit the manufacturer's engineering judgment identification number and shop drawing details prepared by a professional engineer. The engineering judgment submittal shall include both *Project* name, *Project* location, and *Subcontractor's* name who will install firestop system as described in engineering judgement shop drawings.
 - .3 Provide complete details of specific application of listed system and its modifications upon which the engineered judgement is based upon.
 - .4 For perimeter fire barrier systems:
 - .1 Submit engineered shop drawings for engineering judgements covering perimeter fire barrier systems. Identify each cladding assembly type in contact with each perimeter fire barrier system.
- .4 Manufacturers' instructions:
 - .1 Manufacturer of *Products* proposed for use in work of this section shall prepare firestopping manual scheduling products to be used for each assembly and installation required in the *Work*.
 - .1 Coordinate with project firestopping manual specified under Section 01 33 02.
 - .2 Manual shall include manufacturer's *Product* data sheets as specified under paragraph 1.3.2.
 - .3 Firestopping manual shall be submitted within 4 weeks of *Contract* award.

1.4 Quality Assurance

- .1 Qualifications:
 - .1 Installers: Shall have 5 years' experience, minimum, in application of *Products*, systems and assemblies specified and with approval, training and certification of *Product* manufacturers.

Joint Firestopping and Smoke Seals

- .1 Submit proof of manufacturer's installer certification for each installer of firestopping and smoke sealant systems.
 - .1 Manufacturer'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 Applicator shall designate a single individual as *Project* foreperson who shall be present at the *Place of the Work* at all times throughout the work of this section when the work of this section is being performed.

1.5 Delivery Storage, and Handling

- .1 Deliver materials to *Place of the Work* in manufacturer's unopened containers, containing classification label, with labels intact and legible at time of use.
- .2 Store materials in accordance with manufacturer's recommendations with proper precautions to ensure fitness of material when installed.
- .3 Do not use damaged or adulterated materials and materials exceeding their expiry date.

1.6 Field Conditions

- .1 Comply with manufacturer's requirements relative to temperature and humidity conditions, before, during and after installation.

1.7 Warranty

- .1 Warrant work of this section in accordance with Section 01 78 36.
- .2 Extended warranty:
 - .1 Labour, materials, and workmanship for work of this section.
 - .2 Duration: 2 years.

PART 2 - PRODUCTS

2.1 Manufacturers

- .1 General: Manufacturers of firestopping and smoke seal system *Products* and installation specialists for the work of this section are limited to applicable assemblies as required for the *Work* and having listing mark on packaging.
- .2 Subject to compliance with requirements, provide products by one of the following:
 - .1 3M Canada Inc.
 - .2 Hilti Canada Corp.
 - .3 NUCO Inc.
 - .4 STI Firestop.
 - .5 Tremco Commercial Sealants & Waterproofing.

Joint Firestopping and Smoke Seals

2.2 Performance/Design Requirements

- .1 Firestop and smoke sealant systems shall consist of material, or combination of materials installed to retain integrity of fire-rated construction by effectively impeding spread of flame, smoke, and/or hot gasses through perimeter joint or gaps, construction joints, or at perimeter fire containment in or adjacent to fire-rated barriers.
- .2 Smoke sealants applied over firestopping materials or combination smoke seal/firestop seal material shall form air tight barriers to prevent passage of gas and smoke.
- .3 Fire-resistance rating of firestopping system shall be equivalent to rating of adjacent floor, wall or other fire separation assembly.
- .4 Firestopping system at fire rated assemblies with assembly STC rating requirements shall provide STC rating equal to STC rating of fire rated assembly.
- .5 Confirm locations of exposed/non-exposed firestopping/smoke seal surfaces with *Consultant* prior to application.
- .6 *Provide* movement capability at movement joints in accordance with design requirements for movement joint.
- .7 Head-of-wall joints; with dynamic designation:
 - .1 Joint assemblies shall permit vertical movement allowing wall to move independent of structure due to forces including, but not limited to, live loads, dead loads, thermal expansion/contraction, and wind sway. Such movement shall not damage the wall assembly or its fire protection components.
 - .1 Provide head-of-wall joints with dynamic designation.
- .8 Regulatory requirements:
 - .1 Joint firestop systems shall be listed in accordance with CAN/ULC-S115-11 and shall achieve required fire resistance rating in accordance with building code.
 - .2 Proposed firestopping and smoke seal materials and methods shall conform to applicable governing codes having local jurisdiction.

2.3 Materials

- .1 Single source responsibility for firestopping and smoke seal materials:
 - .1 Obtain firestopping and smoke seal materials from single manufacturer for each different *Product* required.
 - .2 Manufacturer shall instruct applicator in procedures for each material.
- .2 Firestopping and smoke seal systems shall conform to the following:
 - .1 VOC content not to exceed 250 gm/litre minus water.
 - .2 Asbestos-free materials and systems capable of maintaining an effective barrier against flame, smoke and gasses in compliance with requirements of CAN/ULC-S115-11 and not to exceed opening sizes for which they are intended.
 - .3 *Provide* firestopping materials and systems with fire-resistance rating not less than the fire-resistance rating of applicable adjacent assembly.
 - .4 Listed in accordance with CAN/ULC-S115-11.

Joint Firestopping and Smoke Seals

- .5 Use only joint firestop systems that have been tested by an accredited third party testing agency for specific fire-rated construction conditions conforming to construction assembly type, joint type and fire-rating requirements for each separate instance.
 - .1 Where there is no specific third party tested and classified firestop system for a particular firestop configuration, submit engineered shop drawings.
- .6 For joints in fire-separations, provide listed systems designs for the joint firestop and smoke seal systems as required by building code to maintain the integrity of the fire separations.
- .7 *Products* shall be compatible with abutting dissimilar membranes, architectural coatings, finishes at floors, walls and ceilings. Check with requirements of *Contract Documents* and manufacturer of selected materials being installed.
- .3 Smoke sealants for overhead and vertical joints shall be non-sagging; sealants for floors shall be self-levelling.
- .4 Smoke seal sealant colour at exposed locations: Grey. (Red will not be accepted).

PART 3 - EXECUTION

3.1 Preparation

- .1 Examine sizes, anticipated movement and conditions to establish correct thickness and installation of back-up materials.
- .2 Prepare surfaces in accordance with manufacturer's written specifications and to requirements of listed system designs.

3.2 Installation

- .1 Install joint firestopping and smoke seal systems in accordance with manufacturer's written requirements and in compliance with listed system designs. Products and installation requirements must comply with listed system designs.
- .2 For materials that will remain exposed after completing the *Work*, finish to achieve smooth, uniform surfaces. Tool or trowel exposed surfaces.
- .3 Notify *Consultant* when random completed installations are ready for review, as directed by *Consultant*, prior to concealing or enclosing firestopping and as applicable, smoke seals.
- .4 Protect materials from damage on surfaces subjected to traffic.

3.3 Identification and Documentation

- .1 Provide documentation for each joint firestop system application addressed. This documentation is to identify each joint location on the entire Project.
- .2 Documentation for installed joint firestop systems is to include:
 - .1 Sequential location number.
 - .2 Project name.
 - .3 Date of installation.

Joint Firestopping and Smoke Seals

- .4 Detailed description of joint firestop system location.
- .5 Listed firestop system design number or engineered judgment number.
- .6 Type of joint.
- .7 Width of joint.
- .8 Overall length of joint.
- .9 Number of sides addressed.
- .10 Hourly rating of firestop joint system to be achieved.
- .11 Installers name.

3.4 Field Quality Control

- .1 Conduct quality control to be in accordance with Section 01 45 00.
 - .1 Field tests and inspections:
 - .1 Examine completed firestop joint installations to ensure proper installation before concealing or enclosing areas. Keep areas of work accessible until inspections are completed.
 - .2 Inspection consultant to review installation of the work of this section and to perform random tests to verify its completion in accordance with the requirements of the *Contract Documents*.
 - .3 Give at least 48 hours notice before operations commence, and arrange for a pre-job conference with *Contractor*, installer, independent inspection and testing company, manufacturer, and *Consultant* present.
 - .4 Independent inspection and testing company shall examine installed firestopping in accordance with ASTM E2393-20a. Independent inspection and testing company shall examine firestopping and shall determine, in general, that firestopping has been installed in accordance with requirements of the *Contract Documents* and in compliance with each listed firestop system design.
 - .5 Representatives of the manufacturer(s) shall have access to the *Work*. *Contractor* shall provide assistance and facilities for such access in order that the manufacturer(s) representative(s) may properly perform its function.
- .2 Manufacturer's field review to be in accordance with Section 01 45 00.

END OF SECTION

Joint Sealants

PART 1 - GENERAL

1.1 Summary

- .1 Section includes:
 - .1 Joint sealants – interior locations.
- .2 Section excludes:
 - .1 Glazing system assembly sealants.
 - .2 Fluid-applied flooring sealants.
 - .3 Mechanical and electrical sealants.
 - .4 Acoustic sealants.

1.2 Administrative Requirements

- .1 Conduct a pre-installation meeting in accordance with Section 01 31 19.
 - .1 The following items shall be addressed at the pre-installation meeting:
 - .1 Analysis of the work and weather conditions.
 - .2 Shape factor of the joint.
 - .3 Recommendations for priming joints.
 - .4 Inspection of surfaces and joints.
 - .5 Compatibility of materials.
 - .6 Backing materials.

1.3 Submittals

- .1 Submit required submittals in accordance with Section 01 33 00.
- .2 *Product* data sheets:
 - .1 Submit manufacturer's *Product* data sheets for *Products* proposed for use in the work of this section.
 - .2 Submit manufacturer's and *Product* name for each sealant which will be used in the *Work* prior to commencing the *Work*.
- .3 Samples:
 - .1 Submit "wet sample" sealant colour samples for each sealant *Product* and colour.
- .4 Test and evaluation reports:
 - .1 Test sealant in contact with samples of materials to be sealed to verify adhesion will be achieved and no staining of the material will result. Prepare sample joints at the *Place of the Work* of each type of sealant for each joint condition.
 - .1 Submit test results to *Consultant* prior to application of sealants.
 - .2 Test sealant in contact with samples of porous materials to be sealed to ensure that no staining of the material will result in accordance with ASTM C1248-22.

Joint Sealants

- .1 Submit test results to *Consultant* prior to application of sealants.

1.4 Closeout Submittals

- .1 Submit closeout submittals in accordance with Section 01 78 00.
 - .1 Include manufacturer's warranties.
- .2 Maintenance instructions:
 - .1 Submit maintenance instructions for all items for incorporation into the operation and maintenance manuals.

1.5 Quality Assurance

- .1 Qualifications:
 - .1 *Subcontractor*.
 - .1 Shall have 5 years' experience, minimum, in application of *Products*, systems and assemblies specified.
 - .2 Installer to comply with quality assurance articles referenced in ASTM C1193-16 for installation of joint sealants.

1.6 Field Conditions

- .1 Conform to sealant manufacturer's specifications and recommendations.
- .2 Do not proceed with installation of joint sealants under the following conditions:
 - .1 When ambient and substrate temperature conditions are outside limits permitted by joint sealant manufacturer, or are below 5° C (40° F).
 - .2 When joint substrates are wet.
 - .3 Where joint widths are less than those allowed by joint sealant manufacturer for applications indicated.
 - .4 Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

1.7 Warranty

- .1 Warrant work of this section in accordance with Section 01 78 36.

PART 2 - PRODUCTS

2.1 Performance/Design Requirements

- .1 Interior sealants shall have a VOC limit of 50 g/L maximum, unless otherwise specified, and comply with South Coast Air Quality Management District (SCAQMD) Rule 1168, Adhesive and Sealant Applications.
- .2 Joint sealants:
 - .1 Shall perform as air tight and water-tight joints.
 - .2 Defects shall include, but are not limited to:
 - .1 Staining from abutting materials or filler.

Joint Sealants

- .2 Migrating, bleeding into, or staining abutting materials.
- .3 Unsightly surface deformation.
- .4 Excessive colour change, chalking, or dust pick-up.
- .5 Failing adhesively or cohesively where maximum elongation is less than 25% of designed width of exposed joints.
- .6 Hardening to more than 25% over specified hardness.

2.2 Sealants

.1 General:

- .1 Colours: Sealant colours shall match colours of adjacent materials, as selected and approved by *Consultant*.
 - .1 Colours: shall be selected from manufacturer's full range of colours.
- .2 In accordance with ASTM C920-14 and other requirements indicated for each liquid-applied chemically curing sealant, including those referencing ASTM C920-14 classifications for type, grade, class, and uses.
- .3 For sealants to be applied to porous substrates:
 - .1 Provide products that have undergone testing in accordance with ASTM C1248-22 and have not stained porous joint substrates indicated for *Work*.
- .4 Sealant supplied shall not exude any material(s) which travel into adjacent materials, or travel onto surfaces of adjacent materials; causing damage, or attracting soiling, which becomes apparent during the service life of the building.

.2 Interior general sealants:

- .1 VOC limit: Maximum 50 g/L, unless otherwise indicated.
- .2 Interior sealant; at joints with painted gypsum board: one-component paintable acrylic in accordance with ASTM C834-10 Type OP; or polyurethane in accordance with ASTM C920-14 Type S, Grade NS, Class 35.
 - .1 Acceptable *Products*:
 - .1 Acrylic sealants:
 - .1 Master Builders Solutions Canada 'MasterSeal NP 520'
 - .2 Tremco, Inc. 'Tremflex 834'.
 - .3 Substitutions: in accordance with Section 01 25 00.
 - .2 Polyurethane sealants:
 - .1 Sika 'Sikaflex 1A'.
 - .2 Substitutions: in accordance with Section 01 25 00.
- .3 Interior sealant; at movement joints in vertical surfaces: one-component polyurethane sealant in accordance with the following: ASTM C920-14, Type M or S, Grade NS, Class 25.
 - .1 Acceptable *Products*:

Joint Sealants

- .1 Master Builders Solutions Canada 'MasterSeal NP1'.
- .2 Sika 'Sikaflex 15LM'.
- .3 Tremco, Inc. 'Dymonic 100'.
- .4 Substitutions: in accordance with Section 01 25 00.

2.3 Accessories

- .1 General: *Provide* joint sealants, primers, backings, and fillers that are compatible with one another and with joint substrates and other sealants or joint fillers specified and approved for applications indicated under joint sealant scheduled and under conditions of service and application as demonstrated by joint sealant manufacturer based on proven test results and field experience. When incompatible, inform *Consultant* and change to compatible type acceptable to *Consultant*.
- .2 Cylindrical sealant backings: *Provide* joint backings that meet ASTM C1330-02, Type O (open-cell polyurethane), or Type B (non-absorbent bi-cellular backing materials with surface skin), sized 25 percent or greater than joint opening with proper density to control sealant depth and profile. Follow joint sealant manufacturer's recommendations with backing selections for optimum joint sealant performance, in accordance with the following schedule:
 - .1 Use open cell foam with non-absorbing closed cell skin (Sof-Rod) for vertical joints; round shape for open joints and triangular shape for angular joints.
 - .2 Use closed cell foam for horizontal joints.
- .3 Bond-breaker tape: Polyethylene tape or other approved plastic tape as recommended by joint sealant manufacturer to prevent 3-sided joint adhesion to rigid, inflexible joint fillers or joint surfaces at back of joint where such adhesion would restrict proper sealant movement or result in sealant failure.
- .4 Masking tape: Non-staining, non-absorbent and compatible with joint sealants and adjacent surfaces.
- .5 Sealant primers: Use primers only as recommended by sealant manufacturer where required to enhance adhesion of sealant to specific joint substrates indicated and as determined for use from pre-construction mock-up testing. Select primers in consultation with sealant manufacturer and manufacturer of substrate material which do not have a detrimental effect on sealant adhesion or in-service performance.
- .6 Cleaners for nonporous surfaces:
 - .1 *Provide* non-staining, chemical cleaners of type which are acceptable to manufacturer of sealant and sealant backing material, which are not harmful to substrates and adjacent nonporous materials, and which do not leave oily residues or otherwise have a detrimental effect on sealant adhesion or in-service performance.
 - .2 *Provide* cleaner conditioner required for glass and glazed surfaces as recommended by sealant manufacturer.

Joint Sealants

PART 3 - EXECUTION

3.1 Manufacturer's Recommendations

- .1 Unless specified otherwise herein, comply with the recommendations and directions of the manufacturer whose materials are being used in the work of this section.

3.2 Preparation

- .1 Protect adjacent work areas and finished surfaces from damage during joint sealant installation.
- .2 Clean and prepare joint surfaces and substrates of substance that could impair the bond of joint sealants immediately before installing joint sealants.
- .3 Provide a dry, dust-free and cleaned substrate for optimum results.
- .4 Clean porous joint surfaces by using heavy-duty brushing, light abrasive, mechanical abrading or combination of these methods to produce a clean, sound surface for optimum bond with joint sealants per manufacturer's recommendations.
- .5 Clean non-porous surfaces using the two-cloth wipe method as referenced in ASTM C1193-16 and outlined by joint sealant manufacturer's written requirements.
- .6 Prepare rusting or scaling surfaces using abrasive cleaning methods as recommended by joint sealant manufacturer prior to joint sealant installation. Remove and neutralize efflorescence, mould, mildew and algae prior to joint sealant installation.
- .7 Prepare finish-coated surfaces per joint sealant manufacturer's specific recommendations.
- .8 Test materials for indications of staining or poor adhesion before any sealing is commenced. Submit reports in writing to *Consultant* of results.

3.3 Masking

- .1 Where necessary to prevent contamination or marring surfaces of adjacent materials, mask areas adjacent to joints with masking tape prior to priming or sealing application. Remove tape immediately after joint has been completed and an initial set achieved.

3.4 Installation

- .1 Install in accordance with joint sealant manufacturer's installation written requirements for products, primers and applications indicated unless more stringent project-specific instructions or requirements apply.
- .2 Apply joint sealants for continuous waterproof sealant joint protection. Lap vertical joints over horizontal joints as recommended by sealant manufacturer. Comply with installation recommendations in ASTM C1193-16 for use of joint sealants as applicable to each specific sealant installation.
- .3 Install sealant primers only when recommended by sealant manufacturer and demonstrated at pre-construction tests after joint surface preparation has been completed and when surfaces are verified as clean and dry. Allow any primer installation to completely dry or cure prior to installation of backing or joint sealants. Primer is mandatory for gun applied sealants.

Joint Sealants

- .4 Install joint sealants using proven techniques that comply with the following and in proper sequence with installation of primers and backings.
 - .1 Using proper joint sealant dispensing equipment, place sealants by pushing sealant beads into opening to fully wet-out joint sealant substrates. Fill sealant joint opening to full and proper configuration.
 - .2 *Provide* uniform cross-sectional shapes and depths in relation to joint width for optimum sealant movement capability per joint sealant manufacturer's written requirements.
- .5 Joint sealant tooling is required for non-sag joint sealant installations. Immediately after placing fresh sealants and before skinning or curing begins, tool sealants using metal spatulas designed for this purpose in accordance with manufacturer's recommendations. Provide a smooth, uniform sealant finish, eliminating air pockets and ensuring good contact for optimum sealant adhesion within each side of the joint opening.
 - .1 Provide concave joint configuration as indicated per figure 5-A in ASTM C1193-16 unless otherwise indicated.
 - .2 Use tooling agents that are approved in writing by sealant manufacturer and that do not discolour sealants or adjacent surfaces.
 - .3 Remove excess sealant from surfaces adjacent to joint openings using metal spatula, promptly cleaning any sealant residue from adjacent finished surfaces. Remove masking after joint sealant is installed.
- .6 Allow single-component sealants to fully cure before adhesion testing is performed as recommended by joint sealant manufacturer.
- .7 Match approved sealant mock-up for colour, finish and overall aesthetics. Remove, refinish or re-install work not in compliance with the *Contract Documents*.
- .8 When surfaces of adjacent materials are to be painted, perform sealant work before these surfaces are painted.
- .9 Check form release agent used on concrete for compatibility with primer and sealant. If they are incompatible inform *Consultant* and change primer and sealant to compatible type, or clean concrete to sealant manufacturer's acceptance.
- .10 Install joint backing material, filler strips, gaskets, bond breakers and similar type material of comparable performance characteristics. Install bond breaker tape or packing over asphalt impregnated fibre board as recommended by sealant manufacturer.
- .11 Where joints are 12.7 mm (1/2") or deeper, insert backing material in continuous uniform compression with setback from finished face of adjoining materials equal to required depth of sealant (width/depth ratio) as specified herein.
- .12 On horizontal traffic surfaces, support joint filler against vertical movement which might result from traffic loads, including foot traffic.
- .13 Install bond breaker tape in bottom of joints in lieu of sealant backing where proper depth cannot be obtained when backing is installed.
- .14 Maintain correct sealant depth. Sealant depth shall be 1/2 the width of the joint, maximum depth shall be 12.7 mm (1/2"), minimum depth shall be 6 mm (1/4"). Comply with manufacturer's written recommendations.

Joint Sealants

- .15 Fillet bead sealant joints to be sized to provide proper contact area with substrates, in accordance with manufacturer's written recommendations.
- .16 Apply sealants using pressure-operated guns fitted with suitable nozzles in accordance with manufacturer's directions. Apply sealants in such manner as to ensure good adhesion to sides of joints and to completely fill voids in joints.
- .17 Apply sealants so that surfaces of joints are smooth, full bead, free from ridges, wrinkles, sags, air pockets and embedded impurities. Tool sealant surfaces to produce a smooth surface.
- .18 Install sealant with exterior face of sealant set back 10 mm (3/8") from face of adjacent materials at building movement joints, unless otherwise indicated.
- .19 Do not apply sealants to areas where installation of paints, coatings or flooring is in progress. Apply sealants after such work is complete and fully cured.

3.5 Interior Sealant Schedule

- .1 Include in work of this section sealants to seal open joints in surfaces exposed to view, and to make building weather-tight and air-tight, as applicable, as indicated, and as otherwise specified, except where specified under the work of other sections.
- .2 Install sealant to:
 - .1 Movement and control joints on exposed insitu concrete walls.
 - .2 Interior control and expansion joints in floor and wall surfaces.
 - .3 Raked out joints at junctions of masonry with concrete walls and columns, and at intersection of masonry walls and partitions where joint reinforcement is installed.
 - .4 Perimeters of interior door and window frames.
 - .5 Joints at tops of non-load bearing masonry walls at the underside of insitu concrete.
 - .6 Exposed interior control joints in gypsum board.

3.6 Field Quality Control

- .1 Conduct quality control in accordance with Section 01 45 00.
 - .1 Manufacturer's field review to be in accordance with Section 01 45 00.
 - .2 Provide manufacturer's field service consisting of periodic site visits by manufacturer or their distributor representative for observation of joint sealant application.

3.7 Adjusting and Cleaning

- .1 Remove droppings and clean off excess sealant or sealant residue adjacent to sealant joint installations as the work progresses by methods approved by joint sealant manufacturer before material achieves initial set.
- .2 Do not damage adjacent surfaces with harmful removal techniques and protect finished surfaces beyond those that have been masked.
- .3 Remove and replace damaged joint sealants.

Joint Sealants

- .4 Remove temporary coverings and masking protection from adjacent work areas upon completion.

3.8 Protection

- .1 Protect installed sealants during and after final curing from damage resulting during construction.

END OF SECTION

Steel Frames

PART 1 - GENERAL

1.1 Summary

- .1 Section includes:
 - .1 Metal frames (steel frames, transom frames).
 - .2 Metal frames (steel frames for screens, sidelights, window assemblies).

1.2 Administrative Requirements

- .1 Coordination:
 - .1 Coordinate mock-ups of metal frames with the mock-up requirements of flush wood doors specified in Section 08 14 00.
 - .2 Cooperate fully with finish hardware distributor's representative during preparation of shop drawings and execution of shop fabrication.
 - .3 Coordinate installation of doors and frames with installation of hardware specified in Section 08 71 00.

1.3 Submittals

- .1 Submit required submittals in accordance with Section 01 33 00.
- .2 Submit copy of NAAMM-HMMA 840-17 standard.
- .3 *Product* data sheets:
 - .1 Submit manufacturer's *Product* data sheets for *Products* proposed for use in the work of this section.
- .4 Shop drawings:
 - .1 Include details of each frame type, finish hardware types and locations, frame profiles, frame elevations, mitre details, glazing preparation details and anchor details and locations.
 - .2 Include schedule identifying each unit, with door marks and numbers relating to numbering on drawings and in door schedule.
 - .3 Electrified hardware requirements and preparations shall be clearly indicated on shop drawings.

1.4 Quality Assurance

- .1 Qualifications:
 - .1 Manufacturers:
 - .1 *Provide* frames manufactured by a firm specializing in the design and production of hollow metal steel frames.
 - .2 Manufacturer shall be a member in good standing of the Canadian Steel Door Manufacturers Association (CSDMA).
- .2 Mock-up:
 - .1 *Provide* mock-up of door and frame assembly for each door type.

Steel Frames

- .2 Mock-up may be incorporated in the completed work upon acceptance of *Consultant*.

1.5 Delivery, Storage, and Handling

- .1 Inspect materials thoroughly upon receipt and report immediately discrepancies, deficiencies and damages, in writing, to *Supplier*.
- .2 Note damages incurred during shipment on carriers' bill of lading and report immediately, in writing, to *Supplier*.
- .3 Store materials properly on planks, out of water and covered to protect from damage from adverse weather conditions. Remove wet packaging immediately.
- .4 Remove wrappings or coverings from doors upon receipt at the *Place of the Work*, and store in a vertical position, spaced with blocking to permit air circulation between them.

1.6 Warranty

- .1 Warrant work of this section in accordance with Section 01 78 36.
- .2 Extended warranties:
 - .1 System:
 - .1 Labour, materials, and workmanship for work of this section.
 - .2 The warranty is a total system warranty, and includes hardware, sealants, hanging and fitting, and finishing.
 - .3 Duration: 2 years.
 - .2 Glass and glazing: in accordance with Section 08 80 00.

PART 2 - PRODUCTS

2.1 Manufacturers

- .1 All Steel Doors 2000 Ltd.
- .2 Apex Industries Inc.
- .3 Artek Door (1985) Ltd.
- .4 Daybar Industries Ltd.
- .5 Fleming-Baron Door Products.
- .6 M.J. Daley Manufacturing Co. Ltd.
- .7 Trillium Steel Doors Limited.
- .8 Vision Hollow Metal Limited.
- .9 Doors and frames shall function as intended, including but not limited to:
 - .1 Be in true alignment.
 - .2 Operate and swing freely, smoothly, and easily.
 - .3 Remain stationary at any point.
 - .4 Close evenly and tightly against stops without binding.

Steel Frames

- .5 Latch positively when doors are closed with moderate force.

2.2 Materials

- .1 Steel:
 - .1 Fabricated from tensioned levelled steel in accordance with ASTM A924/A924M-22a, galvanized in accordance with ASTM A653/A653M-13, Commercial Steel CS, Type B.
 - .2 Steel shall be free of scale, pitting, coil breaks, surface blemishes, buckles, waves, and other defects.
 - .3 Minimum sheet thickness; uncoated steel sheet: in accordance with Appendix 1 of ANSI/NAAMM HMMA 861-14 "Guide Specifications for Commercial Hollow Metal Doors and Frames".
 - .4 Finish: Minimum Galvanneal coating designation ZF120 (A40).
- .2 Primer: rust inhibitive for touch-up.
- .3 Finishing hardware: in accordance with Section 08 71 00.
- .4 Miscellaneous:
 - .1 Channel glazing stops and glazing trim: formed channel of minimum 0.81 mm (0.032") (20 gauge) steel, 15.9 mm (5/8") high, complete with Torx tamper-proof screws, colour matched to frame.

2.3 Fabrication - General

- .1 Fabricate steel frames, transoms, sidelights and borrowed lights as applicable, to the design and dimensions indicated. Take field measurements where coordination with adjoining work is necessary.
- .2 Fabricate steel frames to be rigid, neat in appearance and free from defects, warp, wave or buckle with all corners square unless otherwise indicated.
- .3 Operating clearances:
 - .1 *Provide* clearance at floor with allowance made for indicated finish flooring materials.
- .4 Drill and tap or reinforce for mortised or surface mounted hardware in accordance with accepted hardware schedule, ANSI A115, NFPA 80-2013, or manufacturers recommendations.
- .5 Countersink exposed fasteners unless otherwise shown. Use flat or oval head screws.
- .6 Reinforce components to resist stresses imposed by hardware in use.
- .7 Allow for anticipated expansion and contraction of frames and supports.
- .8 Fit elements at intersections and joints accurately together, in true planes, and plumb and level.
- .9 Perform welding in accordance with CSA W59-18.
- .10 Mortise, reinforce, drill and tap to receive hardware and security devices using templates provided by respective *Supplier*.

Steel Frames

- .11 Touch up finish damaged during fabrication.
- .12 Prepare frames to receive seals where seals are indicated.

2.4 Fabrication - Steel Frames

- .1 General: Applicable to frames, transom panel frames, sidelights, and window assemblies.
- .2 Interior and non-thermally broken frames; welded:
 - .1 Fabricated from:
 - .1 1.34 mm (0.053") (16 gauge) steel.
 - .2 Supplied set-up and welded (SUW).
- .3 Factory assembled frame product shall be square, free of defects, warps or buckles.
- .4 Set-up and welded corner joints (SUW):
 - .1 Profile welded—punch mitred, continuously welded on inside of the profile faces, rabbets, returns and soffit intersections, with exposed faces filled and ground to a smooth, uniform seamless surface, as defined in the CSDMA - "Recommended Specifications for Commercial Steel Door and Frame Products".
- .5 Set-up and welded joints at mullions, sills and center rails:
 - .1 Coped accurately, butted and tightly fitted.
 - .2 At intersecting flush profile faces, securely weld, fill and grind to flush, smooth, uniform, seamless surface.
 - .3 At intersecting recessed profile faces, securely weld to concealed reinforcements, with exposed hairline face seams.
 - .4 At other intersecting profile elements make exposed face seams to hairline tolerance.
- .6 Where required due to site access, when required for co-ordination or installation, or shipping limitations, frame product shall be fabricated in sections for splicing in the field.
 - .1 Field spliced jambs, heads and sills shall be provided with 1.34 mm (0.053") (16 gauge) steel splice plates securely welded into one section, extending 100 mm (4") minimum each side of splice joint.
 - .2 Field splices at closed sections (mullions or center rails) shall be 1.34 mm (0.053") (16 gauge) steel splice angles securely welded to the abutting member. Face of splice angle shall extend 100 mm (4") minimum into closed sections when assembled.
 - .3 Field splice joints shall be welded, filled and ground to present a smooth uniform surface by the installation company responsible for installation after assembly.
- .7 On factory assembled frame product, provide 2 temporary steel shipping bars welded to the base of the jambs or mullions to maintain alignment during shipping and handling. Remove shipping bars prior to anchoring of frames to floor.
- .8 Each door opening shall be prepared for single stud door silencers. Silencers shall be shipped loose for installation by installer, after finish painting.
 - .1 Single interior doors: 3 at strike jamb.

Steel Frames

- .2 Pair of interior doors: 2 at header.
- .3 Sound, light, or smoke sealed doors: None required.
- .9 Prior to shipment, mark each frame with an identification number as shown on the approved submittal drawings.
- .10 Provide mullions and transom bars of closed construction type. For fixed condition, attach members to frame with butt-welded joints. For removable condition, attach members with removable mullion anchors.
- .11 Conceal fastenings unless otherwise indicated.
- .12 Anchor frames to floor by 1.34 mm (0.053") (16 gauge) thick angle clips, welded to frame and *Provide* with 2 holes for floor anchorage.
- .13 Grind welded corners to a flat plane, fill with metallic paste filler and sand to uniform smooth finish.
- .14 Protect strike and hinge reinforcements using guard boxes welded to frames at masonry construction.
- .15 Reinforce head of frames wider than 1220 mm (48").
- .16 Brace frame units to prevent distortion in shipment and protect finish.

2.5 Hardware Reinforcements and Preparations

- .1 Door and frame product shall be blanked, reinforced, drilled and tapped at the factory for fully templated mortise hardware only, in accordance with the approved hardware schedule and templates provided by the hardware supplier.
- .2 Door and frame products shall be factory blanked and reinforced only for mortised hardware that is not fully templated.
- .3 Where surface mounted hardware, anchor hinges, thrust pivots, pivot reinforced hinges, or non-templated hardware are required frame product shall be reinforced only, with drilling and tapping done by field installation.
- .4 Templated holes 12.7 mm (1/2") diameter and larger shall be factory prepared, except mounting and through bolt holes, which shall be by installation on site. Templated holes less than 12.7 mm (1/2") diameter shall be factory prepared only when required for the function of the device (for knobs, levers, cylinders, thumb or turn pieces) or when these holes over-lap function holes.
- .5 Hinge reinforcements shall be 3.12 mm (0.123") (10 gauge) steel minimum, high frequency type shall be provided.
- .6 Frames shall be prepared for 114 mm (4.5") standard weight hinges minimum unless otherwise indicated.
- .7 Doors and frames in excess of 2450 mm (96") rabbet height shall be prepared for 114 mm (4.5") heavy weight 4.6 mm (0.180") hinges minimum.
- .8 Lock, strike and flush bolt reinforcements shall be 1.34 mm (0.053") (16 gauge) steel minimum, with extruded tapped holes that provide equivalent number of threads as 2.36 mm (0.093") (12 gauge).
- .9 Reinforcements for surface mounted hardware, concealed closers and holders and flush bolts shall be 1.06 mm (0.042") (18 gauge) steel minimum.

Steel Frames

- .10 Reinforcements are not required for surface applied hardware supplied with thru-bolts and spacers or sex-bolts.
- .11 Provide hardware mortises on perimeter frame members to be grouted in masonry or concrete partitions with 0.66 mm (0.026") (22 gauge) steel grout guards.
- .12 Electrified hardware:
 - .1 Where electrically or electronically operated hardware is specified on the schedules or details or the final approved schedule and templates provided by the hardware supplier, hardware enclosures and/or junction boxes, where indicated on the templates, shall be provided and inter-connected with CSA approved 12.7 mm (1/2") diameter conduit and connectors.
 - .2 Refer to electrical documents for general electrical rough-in details. At door locations indicated in electrical documents as requiring rough-in only of electrical (ie. where no electrically or electronically operated hardware is specified in the hardware schedule), provide enclosures, boxes, and conduit to permit future installation of devices without removal of grout, demounting of frames, or installation of exposed conduits.
 - .3 Frames:
 - .1 Frames with electrified devices shall include electrical connection boxes sized to accommodate devices specified in Section 08 71 00. At time of frame manufacture, electrical connection boxes shall be supplied by Divisions 26, 27, and 28 for installation into frame by work of this section.
 - .2 Frame electrical connection boxes shall be positioned flush to edge of frame face return. Clearance shall be maintained to allow wall material to be consistently applied for length of frame member. Frame connection boxes shall be welded in place and positioned to allow necessary clearance for electrical trade to install conduit and connection components, with conduit layout in a manner that takes conduit up to ceiling in an uninterrupted configuration and to accommodate wire installation.

2.6 Frame Anchorage

- .1 Frame products shall be provided with anchorage appropriate to floor, wall and frame construction.
- .2 Each wall anchor shall be located immediately above or below each hinge reinforcement on the hinge jamb and directly opposite on the strike jamb.
- .3 Frame products for installation in new masonry walls shall be provided with steel adjustable wall anchors of the T-strap, stirrup or wire, 1.34 mm (0.053") (16 gauge) minimum or 3.96 mm (0.156") diameter wire. Straps shall be not less than 50 mm (2") x 254 mm (10") in size, corrugated and/or perforated.
- .4 Frame products installed in steel stud and drywall partitions shall be provided with 0.81 mm (0.032") (20 gauge) steel snap-in or "Z" stud type anchors.

Steel Frames

- .5 Jambs of frames in previously placed concrete, masonry or structural steel shall be punched and dimpled to accept machine bolt anchors, 6.4 mm (1/4") diameter, located not more than 150 mm (6") from the top and bottom of each jamb. Anchor preparations and guides shall also be located immediately above or below the intermediate hinge reinforcing and directly opposite on the strike jamb. Each preparation shall be provided with 1.34 mm (0.053") (16 gauge) anchor bolt guides.
- .6 Anchor bolts and expansion shell anchors for the above preparations shall be provided by the installation company.
- .7 Where frame product is installed prior to construction of the adjacent wall, each jamb shall be provided with 1.34 mm (0.053") (16 gauge) steel floor anchors. Each anchor shall be provided with 2 holes for mounting to the floor and shall be securely welded to the inside of the jamb profile.
- .8 On sidelights or windows exceeding 3 m (9'-10") in width, installed in stud partitions, channel extensions shall be provided from the top of the frame assembly to the underside of the structure above. Extensions shall be fabricated from 2.36 mm (0.093") (12 gauge) steel formed channels, mounting angles and adjusting brackets, with mounting angles welded to the inside of frame head. Formed channels, adjusting brackets and fasteners shall be shipped loose. Channels shall be mechanically connected to mounting angles and adjusting brackets with supplied fasteners, on site, by contractor responsible for installation.

2.7 Sizes and Tolerances

- .1 Widths of door openings shall be measured from inside of frame jamb rabbet with a tolerance of ± 1.6 mm (± 0.063 ").
- .2 Heights of door openings shall be measured from the finished floor (exclusive of floor coverings) to the head rabbet of the frame with a tolerance of ± 1.2 mm (± 0.047 ").
- .3 Unless finishing hardware dictates otherwise, doors shall be sized so as to fit the above openings and allow a 3 mm (1/8") clearance at jambs and head. A clearance of 19 mm (3/4") between the bottom of the door and the finished floor (exclusive of floor coverings) shall be provided. Tolerances on door sizes shall be ± 1.2 mm (± 0.047 ").
- .4 Manufacturing tolerances on formed frame profiles shall be ± 0.8 mm (± 0.031 ") for faces, door stop heights and jamb depths. Tolerances for throat openings and door rabbets shall be ± 1.6 mm (± 0.063 ") and ± 0.4 mm (± 0.016 ") respectively. Hardware cut-out dimensions shall be as per template dimensions, ± 0.4 mm (± 0.015 ").

2.8 Hardware Locations

- .1 Hardware preparations in frame product shall be as noted below and locations on doors shall be adjusted for clearances specified in paragraph 2.7 of this section.
- .2 Top of upper hinge preparation for 114.3 mm (4.5") hinges shall be located 180 mm (7.5") down from head, transom mullion or panel as appropriate. The top of the bottom hinge preparation for 114.3 mm (4.5") hinges shall be located 310 mm (12.625") from finished floor as defined in paragraph 2.7 of this section. Intermediate hinge preparations shall be spaced equally between top and bottom cutouts.

Steel Frames

- .3 Centre line of door lever shall be mounted at 915 mm above finished floor. Strike preparations for unit, integral, cylindrical and mortise locks and roller latches shall be centered accordingly. Strikes for deadlocks shall be centered accordingly. Strikes for panic or fire exit hardware shall be located as per device manufacturer's templates.
- .4 Push and/or pulls on doors shall be centered 1070 mm (42") from finished floor.
- .5 Preparations not noted above shall be as per hardware manufacturer's templates.
- .6 Hardware preparation tolerances shall comply with the ANSI A115 standards.

PART 3 - EXECUTION

3.1 Examination

- .1 *Provide* necessary grounds, bracing and strapping for fitting and adequate for securing of the work.
- .2 Cooperate with work of other sections to ensure fastenings set by others are provided and located, their work is installed to their specifications and that those responsible for back priming are notified in sufficient time for them to schedule work.

3.2 Installation - Steel Doors and Frames

- .1 Set frame product plumb, square, aligned, without twist at correct elevation in accordance with NAAMM-HMMA 840-1708 11 13.
- .2 Frame product installation tolerances:
 - .1 Plumbness tolerance, measured through a line from the intersecting corner of vertical members and the head to the floor, shall be ± 1.6 mm ($\pm 1/16$ ").
 - .2 Squareness tolerance, measured through a line 90° from one jamb at the upper corner of the product, to the opposite jamb, shall be ± 1.6 mm ($\pm 1/16$ ").
 - .3 Alignment tolerance, measured on jambs, through a horizontal line parallel to the plane of the wall, shall be ± 1.6 mm ($\pm 1/16$ ").
 - .4 Twist tolerance, measured at face corners of jambs, on parallel lines perpendicular to the plane of the wall, shall be ± 1.6 mm ($\pm 1/16$ ").
- .3 Brace frame product rigidly in position while building-in. Remove temporary steel shipping jamb spreaders. Install temporary wood spreaders at mid-point of frame rabbet height to maintain frame widths. Remove wood spreaders after product has been built-in.
- .4 Provide vertical support at center of head for openings exceeding 1250 mm (48") in width.
- .5 Secure anchorages and connections to adjacent construction.
- .6 Adjust operable parts for correct clearances and function.
- .7 Steel surfaces shall be kept free of grout, tar or other bonding materials or sealers.
- .8 Remove grout or other bonding material from products immediately following installation.

Steel Frames

- .9 *Provide* appropriate anchorage for floor and wall construction. Each wall anchor shall be located immediately above or below each hinge reinforcement on the hinge jamb and directly opposite the strike jamb. On each jamb, install 2 anchors for openings up to and including 1525 mm (60") high and install 1 anchor for each additional height of 760 mm (30") of height or fraction thereof, except as indicated below. Frames placed in previously placed concrete, masonry or structural steel shall be *Provided* with anchors located not more than 150 mm (6") from top and bottom of each jamb, and intermediate anchors at 660 mm (26") on centre maximum.
- .10 Secure frames set in previously constructed concrete or masonry openings by countersunk expansion bolts at same centres as for adjustable Tee wall anchors. Reinforce frame at fastening location to prevent indentation of frame by fastening device.
- .11 Fill and grind smooth "punch and dimpled" frame installations.
- .12 Prior to site touch-up, exposed surfaces of galvaneal steel to be finished shall be cleaned to remove foreign matter. Refer to paint manufacturers recommendations for additional information and requirements of Section 09 91 00.
- .13 Touch-up exposed field welds shall be finished to present a smooth uniform surface and with a rust inhibitive primer.
- .14 Touch-up exposed surfaces that have been scratched or otherwise marred during shipment, installation, and handling shall be with a rust inhibitive primer.
- .15 Finish paint in accordance with Section 09 91 00.
- .16 Install door silencers.
- .17 Properly fasten units and secure in place with concealed fixings wherever possible. Include grounds and furring where required.
- .18 Make allowance for deflection to ensure structural loads are not transmitted to frames.
- .19 Adjust operable parts for correct clearances and function.

3.3 Installation - Finishing Hardware

- .1 Install finishing hardware in accordance with ANSI A115.1G-1994, manufacturers' templates and instructions, and Section 08 71 00.

3.4 Adjusting and Cleaning

- .1 Adjust doors to swing freely, smoothly and easily, to remain stationary at any point, to close evenly and tightly against stops without binding, and to latch positively when doors are closed with moderate force.
- .2 Adjust hardware so that latches and locks operate smoothly and without binding, and closers act positively with the least possible resistance in use. Lubricate hardware if required by *Supplier's* requirements.
- .3 Adjust doors equipped with closers to close doors firmly against anticipated wind and building air pressure, and to enable doors to be readily opened as suitable for function, location, and traffic.
- .4 Clean hardware after installation in accordance with *Supplier's* requirements.

END OF SECTION

Flush Wood Doors

PART 1 - GENERAL

1.1 Summary

- .1 Section includes:
 - .1 Solid core doors with hardboard.

1.2 Administrative Requirements

- .1 Coordination:
 - .1 Coordinate mock-ups of flush wood doors with the mock-up requirements of metal frames specified in Section 08 11 13.
 - .2 Coordinate installation of doors with installation of frames specified in other Sections and hardware specified in Section 08 71 00.
 - .3 Coordinate with hardware mortises in metal frames to verify dimensions and alignment before factory machining.

1.3 Submittals

- .1 Submit required submittals in accordance with Section 01 33 00.
- .2 *Product* data sheets:
 - .1 Submit manufacturer's *Product* data sheets for *Products* proposed for use in the work of this section.
- .3 Shop drawings:
 - .1 Submit shop drawings for the work of this section complying with the North American Architectural Woodwork Standards 4.0 requirements.
 - .2 Indicate door location using numbering system per door schedule, size, and hand of each door, elevation of each door type; undercuts, bevelling, construction type core and edge construction not covered in product data; and special blocking requirements.
 - .3 Indicate dimensions and locations of factory machining criteria for hardware, extent of hardware blocking.
 - .4 Indicate dimensions and locations of cut-outs including trim for openings.
 - .5 Indicate door face finish requirements including paint and stain matching.
 - .6 Indicate fire ratings for fire rated doors.
 - .7 Indicate electrified hardware requirements and preparations.
- .4 Selection samples:
 - .1 Submit 3 sets of samples for initial selection purposes of actual veneers showing full range of grain variation, colour and matching, natural characteristics reflecting wood cut and species, manufacturing characteristics for each wood species specified. Submit samples as many times as required until approved by *Consultant*. First submission to include one set of samples per *Consultant* request plus one set lighter in tone and one set darker in tone.

Flush Wood Doors

.5 Verification samples:

- .1 Submit cut-away sample of each type of door, to show stile and rail construction, core, cross banding, door face finish and edges.

1.4 Quality Assurance

.1 Qualifications:

- .1 Manufacturer shall be a member in good standing of the Architectural Woodwork Institute or the Architectural Woodwork Manufacturers Association of Canada or the Woodwork Institute.

.2 Quality standard:

- .1 Work shall be in accordance with the North American Architectural Woodwork Standards 4.0, Premium Grade, or the highest grade available for performance and appearance characteristics of materials in Sections 3 – 5 used that apply to *Product* fabrication and installation requirements governed by Sections 6 – 12.

1.5 Delivery, Storage, and Handling

- .1 Doors shall be marked with door numbers used on shop drawings in the top hinge cavity created by the machining for hinges.
- .2 Identify doors with labels. Package with resilient packaging.
- .3 Store doors flat at the *Place of the Work* in piles with bottom face on bottom of pile. Protect from moisture by placing water resistant material under skids supporting piles. Cover top of piles and provide air at sides of piles.
- .4 Deliver the wood doors only after the building is closed and dry and HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period. Do not receive the doors in a damp area. Do not drag the doors on the ground, floor or across one another.

1.6 Field Conditions

.1 Environmental conditions:

- .1 During storage and installation: Obtain and comply with wood door manufacturer's instructions for optimum temperature and relative humidity conditions for wood doors during its storage and installation. Do not install wood doors until these conditions have been attained.
- .2 During finishing: Comply with wood door manufacturer's temperature and humidity requirements before, during, and after application of finishes.
- .3 During service life of woodwork: Obtain and comply with wood door manufacturer's advice for optimum temperature and humidity conditions.

1.7 Warranty

- .1 Warrant work of this section in accordance with Section 01 78 36.
- .2 Extended warranties:
- .1 System:

Flush Wood Doors

- .1 Labour, materials, and workmanship for work of this section.
- .2 The warranty is a total system warranty, and includes hardware, sealants, hanging and fitting, and finishing.
- .3 Duration: 2 years.
- .2 Glass and glazing: in accordance with Section 08 80 00.

PART 2 - PRODUCTS

2.1 Manufacturers

- .1 Baillargeon by Masonite Architectural.
- .2 Lambton Doors.
- .3 Masonite Architectural.
- .4 VT Industries.
- .5 Substitutions: in accordance with Section 01 25 00.

2.2 Performance/Design Requirements

- .1 Flush wood doors shall meet the minimum acceptance levels in accordance with the North American Architectural Woodwork Standards 4.0.
- .2 Doors and frames shall function as intended, including but not limited to:
 - .1 Be in true alignment.
 - .2 Operate and swing freely, smoothly, and easily.
 - .3 Remain stationary at any point.
 - .4 Close evenly and tightly against stops without binding.
 - .5 Latch positively when doors are closed with moderate force.
 - .6 No delamination.
 - .7 No telegraphing of core construction in face panels exceeding 0.254 mm (0.01") in a 75 mm (3") span, and warp exceeding 3 mm (1/8") in a 1066 mm (42") x 2133 mm (84") section.

2.3 General

- .1 Single-source manufacturing and fabrication responsibility: Engage a qualified Manufacturer to assume undivided responsibility for wood doors specified in this section, including fabrication and finishing except where site finishing is specified.

2.4 Door Construction

- .1 Door construction, industry abbreviations and types to North American Architectural Woodwork Standards 4.0.
- .2 Performance duty level:
 - .1 Doors shall meet the requirements of ANSI/WDMA I.S. 1A-13 for Extra Heavy Duty Performance Level unless otherwise indicated or scheduled.

Flush Wood Doors

- .3 Solid particleboard core, veneer faced, non fire rated wood door construction:
 - .1 Type PC-5, particle board core to ANSI A208.1-2009 LD-2 (529 kg/m³ - 529 kg/m³ (28 lbs/ft³-33 lbs/ft³) density).
- .4 Solid fire resistant core; veneer faced, door construction:
 - .1 45 minute rated doors: Type FD-5, non-combustible mineral core.
- .5 Grain and pattern direction: Vertical.
- .6 Bonding:
 - .1 Solid cores: Bond stiles and rails to core; abrasive sand core assembly to achieve uniform thickness prior to lamination of door faces.
- .7 Panel edge types:
 - .1 Wood veneer faced doors for transparent finish:
 - .1 For vertical edges (stiles) and exposed horizontal edges (rails). (Exposed horizontal edges are those edges that can be viewed from floors above.):
 - .1 Solid wood edgeband to match face veneer, veneer face edge shows.
- .8 Blocking:
 - .1 *Provide* hardware blocking for doors as follows:
 - .1 Non-rated doors: Structural composite lumber for hardware blocking.
 - .2 HB-1, minimum 125 mm (5") wide, full door width, top-rail blocking for closure devices or flush bolts or for sliding door hardware.
 - .3 HB-2, minimum 125 mm (5") wide, full door width, bottom-rail blocking for doors with protection plates, concealed door seals, automatic bottoms, pivots or floor bolts.
 - .4 HB-4, minimum 125 mm (5") wide x 250 mm (10") high blocking for doors with mortise locks and pockets.
 - .5 HB-5, minimum 125 mm (5") wide x 250 mm (10") high blocking for hinges.
 - .6 HB-6, minimum 125 mm (5") wide, full door width, mid-rail blocking for fire exit devices.
 - .7 HB-7, minimum 125 mm (5") wide, full door height, for doors with continuous type hinges.
- .9 Thickness:
 - .1 45 mm (1-3/4") minimum unless otherwise indicated or scheduled.

2.5 Veneer Faced Doors For Transparent Finish

- .1 Veneer face grade: Allowable wood veneer face grade characteristics shall comply with North American Architectural Woodwork Standards 4.0 referenced grade and referenced standards.
 - .1 A.
- .2 Veneer thickness: Minimum 1.02 mm (0.040") thick after sanding.

Flush Wood Doors

- .3 Veneer species: White Maple.
- .4 Veneer cut: Rift.
- .5 Veneer leaf matching: Random.
- .6 Veneer assembly matching: Running.
- .7 Doors in pairs or sets: *Provide* where applicable and as indicated or scheduled.
 - .1 For openings with more than one door, including doors with mullions, door faces shall be matched as follows:
 - .1 Pair matched.
- .8 Transom and side panels: *Provide* where applicable and as indicated or scheduled.
 - .1 Fabricate matching panels with same construction, exposed surfaces, and finish specified for associated doors.
 - .2 Matching requirements:
 - .1 Continuous match.

2.6 Accessories

- .1 Wood glass stops: Solid hardwood, species to match face finish, and referenced quality standard, *Provide* where applicable and as indicated or scheduled.
- .2 Finishing hardware: in accordance with Section 08 71 00.

2.7 Fabrication

- .1 Align and fit doors in frames with uniform clearances and bevels as indicated below; do not trim stiles and rails in excess of limits set by manufacturer or permitted for fire-rated doors. Seal edges of doors, edges of cutouts, and mortises after fitting and machining.
 - .1 Clearances: Refer to Part 3 for clearance tolerances.
 - .2 Fit doors for automatic door bottoms.
 - .3 Bevel non-fire-rated doors 3-1/2 degrees (1/8 inch in 2 inches) at lock and hinge edges.
- .2 Fabricate doors with hardware blocking as specified in Part 2 of this Section.
- .3 Factory machine doors for finish hardware that is not surface applied. Do not machine for surface hardware. Locate hardware to comply with Door and Hardware Institute (DHI) "Recommended Locations for Architectural Hardware for Flush Wood Doors (latest edition). Comply with final reviewed hardware schedules, door and frame shop drawings and hardware templates.
- .4 Electrified hardware:
 - .1 *Provide* where applicable and as indicated or scheduled.

Flush Wood Doors

- .2 Where electrically or electronically operated hardware is specified on the schedules or details or the final approved schedule and templates provided by the hardware supplier, doors with electrified devices shall be manufactured to include wire raceway in door panel to accommodate electrified devices, such as electric hinge, power transfer units, electrified locks, electrified door closures and electrified exit devices. Construction of raceways shall provide a continuous conduit or channel between entry and exit points to accommodate wire installation after door manufacture.
- .5 Factory cut and trim openings.
- .6 Transom and side panels: *Provide* where applicable and as indicated or scheduled.
 - .1 Fabricate matching panels with same construction, exposed surfaces, and finish as specified for associated doors. Finish bottom edges of transoms and top edges of rabbeted doors same as door stiles.

2.8 Site Finishing

- .1 Semi-transparent finish: in accordance with Section 09 91 00.
- .2 Seal top and bottom door edges.

PART 3 - EXECUTION

3.1 Examination

- .1 *Provide* necessary grounds, bracing and strapping for fitting and adequate for securing of the work.

3.2 Installation - General

- .1 Execute installation and assembly at the *Place of the Work* using skilled forces under supervision of a competent joinery foreperson.
- .2 Install work plumb, level and straight, and fasten it securely to backing to support itself and anticipated superimposed loads.
- .3 Build into construction as indicated, or specified in other sections of this specification, or both.
- .4 Adequately fasten units and secure in place with concealed fixings wherever possible. Include grounds and furring where required.

3.3 Installation - Doors

- .1 Align and fit doors in frames with uniform clearances as indicated below; do not trim stiles and rails in excess of limits set by manufacturer or permitted for fire-rated doors. Machine doors for hardware. Seal edges of doors, edges of cutouts, and mortises after fitting and machining.
 - .1 Clearances:
 - .1 Provide clearances as follows except where more stringent clearance is required or indicated.
 - .2 Provide 3.18 mm (1/8") maximum clearance between door and frame at heads, jams, and between pairs of doors.

Flush Wood Doors

- .3 Provide minimum 6 mm (1/4") clearance from bottom of door and top of floor finish and maximum clearance of 9.5 mm (3/8").
- .4 At door assemblies having fire-protection rating not less than 20-minutes provide clearance not more than 6 mm (1/4") at the bottom and not more than 3 mm (1/8") at the sides and top.
- .2 Seal top and bottom edges of wood doors if they are cut to fit, in accordance with door manufacturer's warranty requirements.
- .3 Pilot drill screw and bolt holes.

3.4 Installation - Finishing Hardware

- .1 Install finishing hardware in accordance with Section 08 71 00.

3.5 Adjusting and Cleaning

- .1 Adjust doors to swing freely, smoothly and easily, to remain stationary at any point, to close evenly and tightly against stops without binding, and to latch positively when doors are closed with moderate force.
- .2 Adjust hardware so that latches and locks operate smoothly and without binding, and closers act positively with the least possible resistance in use. Lubricate hardware if required by *Supplier's* requirements.
- .3 Ensure that doors equipped with closers operate to close doors firmly against anticipated wind and building air pressure, and to enable doors to be readily opened as suitable for function, location and traffic.
- .4 Clean hardware after installation in accordance with *Supplier's* requirements.

END OF SECTION

PART 1 - GENERAL

1.1 Summary

.1 Section includes:

- .1 Supply and off-load to place in a clean, dry, and secure room at the *Place of the Work*, which has been designated for storage of all finish hardware specified including necessary fastening devices.
- .2 Supply all finish hardware required and not supplied under other Sections.
- .3 Check and verify hardware information on door and frame shop drawings, prior to fabrication.
- .4 Packaging, labelling, provision of installation instructions, templates, fixings and similar items, and delivery to the *Work* site.
- .5 Give assistance at the *Place of the Work* to organize hardware storeroom and supply qualified staff to correctly categorize, mark, and arrange each item in groups to enable efficient dispensing in specified hardware groups for each door to installation trades.
- .6 Provide qualified staff at the *Place of the Work* promptly to assist installation trades subsequent to being requested and to ensure that hardware is being correctly installed.
- .7 Upon completion of installation of hardware, hardware *Supplier* shall arrange and conduct, in company of *Consultant* and *Contractor*, inspections to verify that all hardware is installed and functioning satisfactorily, and where necessary shall recommend adjustments of such items as closer arms, valves, door holders and latch and locksets. Report comments in writing to *Consultant* and *Contractor*.
- .8 Supply temporary locking cylinders and keys for construction purposes. Locks used for *Contractor* security shall be keyed as required to conform to building operations' security requirements.

1.2 Administrative Requirements

.1 Coordination:

- .1 Coordinate work of this section to ensure information and material is promptly provided, to ensure orderly and expeditious progress of the *Work*, and to comply with schedule for completion.
- .2 Within 3 weeks of *Contract Award*, submit confirmed orders to manufacturers/*Suppliers* to *Consultant*.
- .3 Assist *Contractor* to organize hardware storeroom and supply qualified staff to correctly categorize, mark, and arrange each item in groups to enable efficient dispensing in specified hardware groups for each door to installation trades.
- .4 Coordinate the work of this section to ensure supplied hardware can function as required and can be installed within the particular details of the door and frame assemblies. Hardware that cannot be installed or will not function as intended will be replaced at no cost to the *Owner*.

Finish Hardware

- .2 Conduct a pre-installation meeting in accordance with Section 01 31 19.

1.3 Submittals

- .1 Submit required submittals in accordance with Section 01 33 00.
- .2 *Product* data sheets:
 - .1 Submit manufacturer's *Product* data sheets for *Products* proposed for use in the work of this section.
- .3 Schedules and samples:
 - .1 Prepare and submit for review, a finish hardware schedule with technical product data sheets for use in the *Work*. List type, selected manufacturer's name and number, location, mounting heights and finish of hardware, and complete cross reference to door schedule.
 - .2 The indication or omission of a hardware component on the hardware schedule does not remove the responsibility of this section to ensure that all hardware can be installed and will function as intended.
 - .3 Submit samples of complete line of hardware and finishes. Identify samples indicating hardware item numbers used in the Finish Hardware Schedule, manufacturer's numbers, names, types, finishes, sizes and indication of door location(s). Approved samples will be retained for comparisons and returned upon completion of the *Work*.
 - .4 Prepare and submit for review, a keying schedule recognizing *Owner* requirements which shall be determined after award of *Contract*.
- .4 Templates:
 - .1 Submit for distribution, 3 copies of templates, template information, installation instructions and details necessary to enable preparation for, and installation of finish hardware in accordance with Door Hardware Institute recommended procedures. Submit templates arranged and marked coincident with specified hardware designations.
 - .2 Submit promptly when requested, the foregoing information in 3-ring plastic hard-covered binders suitably identified.
 - .3 In lieu of 1.3.4.1 arrange for the issue by each hardware manufacturer, the manufacturer's standard book of template drawings, at the option of door and frame manufacturers.
- .5 Jigs:
 - .1 Submit template jigs for each component to be recessed to enable installation trades to prepare doors to preclude misalignment and improper fit.

1.4 Closeout Submittals

- .1 Submit closeout submittals in accordance with Section 01 78 00.
- .2 Operation and maintenance data:
 - .1 Instruct the *Owner's* designated representative in proper care and preventative maintenance of hardware to assure longevity of operation.

Finish Hardware

- .2 Submit maintenance data for cleaning and maintenance of finish hardware.
- .3 Submit to building maintenance staff prior to date of *Substantial Performance of the Work*, two sets of wrenches for door closers, locksets and fire exit hardware.

1.5 Quality Assurance

- .1 Qualifications:
 - .1 *Supplier*:
 - .1 Shall have 5 years' experience, minimum, in *Products*, systems and assemblies specified and with approval of *Product* manufacturers.

1.6 Delivery, Storage, and Handling

- .1 Package each item of hardware individually, complete with trim and necessary fastenings, and accessories, including wrenches, keys, and other appurtenances required to ensure correct installation. Mark each item as to contents and appropriate use in specified groups.
- .2 All items of hardware subject to handling when installed shall be submitted with an easily removable covering to protect against scratches, abrasions, coating with dissimilar finish materials on adjacent surfaces, and tarnishing.

1.7 Warranty

- .1 Warrant work of this section in accordance with Section 01 78 36.
- .2 Extended warranty:
 - .1 Manufacturer's standard extended warranties.
 - .2 System:
 - .1 Labour, materials, and workmanship for work of this section.
 - .2 Duration: 2 years.
 - .3 Duration: 2 years.
 - .1 Electric strikes.
 - .2 Electric locksets.
 - .4 Duration: 3 years.
 - .1 Exit devices.
 - .5 Duration: 5 years.
 - .1 Locksets.
 - .6 Duration: 10 years:
 - .1 Hinges:
 - .2 Closers:

PART 2 - PRODUCTS

2.1 Performance/Design Requirements

- .1 Comply with codes and requirements of governing authorities, and as specified.
- .2 *Provide* hardware items with characteristics to meet specified fire ratings, and conform to exit requirements of governing authorities.

2.2 Materials

- .1 Finish hardware: in accordance with Door Hardware Groups.

PART 3 - EXECUTION

3.1 Examination

- .1 Before furnishing any hardware, carefully check *Contract Documents*, verify door swings, door and frame materials and operating conditions, and assure that hardware will fit work to be attached.
- .2 Check shop drawings and frame and door lists affecting hardware type and installation, and verify to correctness thereof, or advise of required revisions. Check that doors, frames and panels requiring additional support are reinforced.
- .3 Point out special requirements to installer. Make final adjustment of hardware, in particular closer arms, valves and locksets, to work properly.

3.2 Installation

- .1 Install in accordance with manufacturer's written installation requirements. Refer also to installation requirements indicated, and specified in other sections of specifications.
- .2 Accurately locate and adjust hardware to meet manufacturer's written requirements. Use special tools and jigs as recommended.
- .3 Locate door stops to contact doors 75 mm (3") from latch edge.
- .4 Refer to Section 08 14 00 with respect to factory preparation for hardware for wood doors. Install wood doors and applicable hardware, including hinges.
- .5 Take delivery of finishing hardware and install, except hardware specified as part of work of another section. Check each item as received.
- .6 Set, fit and adjust hardware according to manufacturer's directions, at heights later directed by *Consultant*. Hardware shall operate freely. Protect installed hardware from damage and paint spotting.
- .7 Sound and weather seals:
 - .1 Install seals to continuously seal entire perimeter of doors. Secure in place with non-ferrous screws, in accurate alignment.
 - .2 Maintain integrity of seal at head of doors fitted with closers. Adapt seals as required to achieve specified performance.
- .8 Pre-drill kickplates and doors prior to installation of kickplates. Apply with water-resistant adhesive and countersunk stainless steel screws.

Finish Hardware

- .9 Set thresholds on two continuous beads of polyurethane caulking fastened with a minimum of 4 countersunk screws.
- .10 At wood doors, use screw attachment for exit devices and closers except as follows:
 - .1 Use through-bolt attachment for exit devices and closers at mineral core doors.

3.3 Electrified Hardware

- .1 Install electronic components, security components such as magnetic locks, sentronic hold open devices door status switches, card readers, processors, transformers, and other electric devices.
- .2 Power wiring will be supplied and installed by Electrical Divisions 26, 27, and 28 including conduit, boxes and other electrical appurtenances, including connections and terminations. Be responsible for ensuring that all wiring work is done in accordance with the *Suppliers* wiring diagrams and directions.
- .3 Arrange for testing and commissioning of system by the distributor of the system. Submit a copy of reports to the *Consultant*.

3.4 Keying

- .1 Locking hardware shall be supplied with operational cylinders for construction purposes.
- .2 Permanent cylinder: Provided by York University:
 - .1 Permanent cylinders and cut keys shall be supplied and installed by the York University Maintenance Department.
 - .2 The Contractor and Owner shall facilitate the removal of construction cylinders and installation of the permanent cylinders.
- .3 Keys:
 - .1 Permanent keys: Provided by York University
- .4 Construction keying:
 - .1 Construction cylinders shall be keyed alike.
 - .2 Quantity: In addition to the cut keys supplied with each lock, provide the following:
 - .1 Cylinder change keys: By York University.
 - .2 Grand / Master Keys: By York University.
 - .3 Control Master Keys: By York University.
 - .4 12 construction master keys.

3.5 Field Quality Control

- .1 Field tests and inspections:
 - .1 Inspect the installation of finish hardware on an agreed frequency.
 - .2 Advise in writing of work being performed that will prejudice the installation or correct operation of items of hardware.

Finish Hardware

- .3 Ensure items have been installed complete with required trim and accessories, and fastenings are adequately secured and approved. Ensure closer arms, valves, holder devices, locksets and latchsets are correctly adjusted.

3.6 Adjusting and Cleaning

- .1 Adjust doors to swing freely, smoothly and easily, to remain stationary at any point, to close evenly and tightly against stops without binding, and to latch positively when doors are closed with moderate force.
- .2 Adjust hardware so that latches and locks operate smoothly and without binding, and closers act positively with the least possible resistance in use. Lubricate hardware if required by *Supplier's* requirements.
- .3 Ensure that doors equipped with closers operate to close doors firmly against anticipated wind and building air pressure, and to enable doors to be readily opened as suitable for function, location and traffic.
- .4 Clean hardware after installation in accordance with *Supplier's* requirements.

END OF SECTION

Glass and Glazing

PART 1 - GENERAL

1.1 Summary

- .1 Section includes:
 - .1 Glass and glazing.

1.2 Administrative Requirements

- .1 Conduct a pre-installation meeting in accordance with Section 01 31 19.

1.3 Submittals

- .1 Submit required submittals in accordance with Section 01 33 00.
- .2 *Product* data sheets:
 - .1 Submit manufacturer's *Product* data sheets for *Products* proposed for use in the work of this section.
- .3 Shop drawings:
 - .1 Show details of each type of glazing system in conjunction with the framing system indicating type of glass, sizes, shapes, glazing material and quantity. Show details indicating glazing material, glazing thickness, bite on the glass and glass edge clearance.
 - .2 Indicate analysis of glass including maximum deflection and allowable stresses from imposed dead/live loads and thermal loads.
- .4 Samples:
 - .1 Submit 305 mm (12") square samples of each type of glass indicated except for clear monolithic glass products, and 305 mm (12") long samples of each color required, except black, for each type of sealant or gasket exposed to view.
 - .1 Submit 3 control samples for each glass type showing maximum range of visible difference between units for the *Project*.
 - .2 Submit samples of glass showing each type of shape and finish of glass edge for exposed glass edges.
- .5 Test and evaluation reports:
 - .1 Obtain compatibility and adhesion test reports from sealant manufacturer indicating that glazing materials were tested for compatibility and adhesion with glazing sealant as well as other glazing materials including insulating units.
- .6 Manufacturer reports:
 - .1 Submit glass fabricator's product information and structural calculations indicating compliance with glazing standards established by the Glass Association of North America (GANA). Submittal to include thermal stress and structural load analysis of the proposed glass types, configuration and sizes.
- .7 Submit sample glazing warranty.

Glass and Glazing

- .8 Submit letter from insulating glass unit fabricator that insulating glass units supplied will bear the certification mark of IGMAC or IGCC/IGMA.CAN/CGSB 12.8-97

1.4 Closeout Submittals

- .1 Submit closeout submittals in accordance with Section 01 78 00.
- .2 Operation and maintenance data:
 - .1 Submit maintenance and cleaning instructions for glass and glazing for incorporation into the operating and maintenance manuals.

1.5 Quality Assurance

- .1 Qualifications:
 - .1 Installers / applicators / erectors:
 - .1 *Subcontractor:*
 - .1 Shall be thoroughly trained and experienced in skills required.
 - .2 Shall be completely familiar with referenced standards and requirements of the work of this section.
 - .3 Shall personally direct installation performed under this section.
 - .2 Foreperson experience: Shall have 10 years' experience, minimum, as glazing mechanic.
 - .3 Glazing mechanic experience: Shall have 3 years' experience, minimum, as glazers.

1.6 Delivery, Storage, and Handling

- .1 Protect glass from edge damage, dust, and contaminants during handling and storage. For insulating units exposed to substantial altitude changes, comply with insulating glass manufacturers written recommendations for venting and sealing to avoid hermetic seal ruptures.
- .2 Storage and protection: Protect glazing materials according to manufacturer's written requirements and as needed to prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun or other causes.

1.7 Field Conditions

- .1 Ambient Conditions: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by the glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation or other causes.
- .2 Do not install liquid glazing sealants when ambient and substrate temperature conditions are outside limits permitted by glazing sealant manufacturer or below 4.4°C.

1.8 Warranty

- .1 Warrant work of this section in accordance with Section 01 78 36.
- .2 Extended warranty:

Glass and Glazing

- .1 General extended warranty:
 - .1 Labour, materials, and workmanship for work of this section.
 - .2 Duration: 2 years.
- .2 Special product warranty for laminated glass products:
 - .1 Warranty shall cover deterioration due to normal conditions of use and not to handling, installing, and cleaning practices contrary to the glass manufacturer's published instructions. Warranty shall be manufacturer's standard form in which laminated-glass manufacturer agrees to replace laminated-glass units.
 - .2 Duration: 2 years from date of manufacture for laminated glass.
- .3 Special product warranty for tempered glass products:
 - .1 Warrant that tempered glass will not break spontaneously as a result of Nickel Sulfide (NiS) inclusions at a rate exceeding 0.8% (8/1000) for a period of five years from the date of manufacture. Warranty shall be manufacturer's standard form in which tempered-glass manufacturer agrees to replace tempered-glass units.
 - .2 Duration: 2 years from date of manufacture for fully tempered glass.

PART 2 - PRODUCTS

2.1 Performance/Design Requirements

- .1 General:
 - .1 Publications: Comply with recommendations in the publications below, except where more stringent requirements are indicated. Refer to these publications for glazing terms not otherwise defined in this section.
 - .1 GANA Glazing Manual.
 - .2 GANA Engineering Standards Manual.
 - .3 GANA Laminated Glazing Reference Manual.
 - .4 GANA Sealant Manual.
- .2 Regulatory requirements:
 - .1 Fire rated glass:
 - .1 Each lite shall bear permanent, non-removable label by accredited and recognized independent testing agency certifying it for use in tested and rated fire protective assemblies.
- .3 Glass strength:
 - .1 Design glass in conformance with the building code and the following requirements:
 - .1 Minimum thickness of annealed or heat-treated glass products to be selected so the worst case probability of failure does not exceed the following:
 - .1 8 breaks per 1000 for glass installed vertically less than 15 degrees from the vertical plane and under wind action.

Glass and Glazing

- .2 Maximum lateral deflection; insulating glass units:
 - .1 For insulating glass units supported on four edges, limit centre-of-glass deflection at design wind pressure to not more than 1/175 times the long-side length or 19 mm (3/4") maximum.
 - .2 Glass at guards, balustrades, and where glass is likely to be subjected to human impact shall comply with safety glass requirements of CAN/CGSB 12.20-M89 and CAN/CGSB 12.1-M90, DIN EN 14179-1:2005, where applicable, and building code.
 - .3 *Provide* annealed, heat strengthened, and tempered lights where required by the building code, and where required for the various solar exposures on the building.
 - .4 Glass thicknesses and glass types specified, indicated, or scheduled in the *Contract Documents* are minimums required. Modify glass thickness as required to satisfy design and building code requirements, and requirements of authorities having jurisdiction, and any such modifications shall be clearly indicated on shop drawings.
- .4 Provide glass *Products* of uniform appearance, reflectivity, hue, shade, visible light transmittance, and colour when viewed from distance of 3 m (10 ft) to 30 m (100 ft) perpendicular to the glass or from 45 degree angle to the glass.
- .5 Protect laminated glass interlayer from damage or discolouration resulting from contact with deleterious and incompatible sealants, substances, and materials. Comply with manufacturer's recommended installation requirements.

2.2 Glass Manufacturers

- .1 Subject to compliance with the requirements of the *Contract Documents*, provide primary glass by one of the following float glass manufacturers:
 - .1 Cardinal Glass Industries.
 - .2 Guardian Industries, LLC.
 - .3 Pilkington North America.
 - .4 Vitro Architectural Glass.

2.3 Glass Materials

- .1 General:
 - .1 Single source responsibility: *Provide* materials from a single manufacturer or fabricator for each kind and condition of glass indicated and composed of primary glass obtained from a single source and manufacturing plant for each type and class required.
- .2 Heat treated (tempered or heat strengthened) float glass:
 - .1 In accordance with CAN/CGSB 12.1-M90.
 - .2 Minimum thickness: 6 mm (1/4").
 - .3 Fabrication process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.

Glass and Glazing

- .4 For uncoated glass, comply with requirements for Condition A in accordance with ASTM C1048-18.
- .5 For coated vision glass, comply with requirements for Condition C (other coated glass) in accordance with ASTM C1048-18.
- .6 Heat strengthened glass shall have surface compression of 24-52 MPa (3,500-7,500 psi).
- .3 Laminated glass:
 - .1 In accordance with CAN/CGSB 12.1-M90.
 - .2 Construction: Laminate glass with polyvinyl butyral interlayer to comply with interlayer manufacturer's written recommendations. Use materials that have a proven record of no tendency to bubble, discolour, or lose physical and mechanical properties after fabrication and installation.
 - .3 Glass layers minimum 6 mm (1/4") thick unless otherwise indicated.
 - .4 Interlayer thickness: Provide thickness as needed to comply with requirements and not less than the following:
 - .1 Vertical glazing: not less than 0.76 mm (0.030") unless otherwise indicated.
 - .5 Interlayer colour: Clear unless otherwise indicated.
 - .6 Glass type: annealed or heat strengthened or tempered, as required to suit design requirements.
 - .7 Laminated glass products to be fabricated free of foreign substances and air or glass pockets in autoclave with heat plus pressure.

2.4 Fire-Rated Glass

- .1 Fire-resistive rated, impact safety resistant glass, non-wired:
 - .1 In accordance with CAN/ULC S104/106, CPSC 16 CFR 1201 (Cat. I and II).
 - .2 Film faced and non-film faced glazing:
 - .1 Fire-protective-rated and impact safety-rated, transparent glazing material and listed for use in doors, sidelites, transoms, and borrowed lites in both interior and exterior applications, not functioning as a barrier.
 - .2 Surface finish:
 - .1 Premium Grade: transparent glass, polished for superior optical clarity.
 - .3 Acceptable *Product*:
 - .1 Safti First 'SuperLite II-XL'.
 - .2 Saint Gobain 'Keralite Select F'.
 - .3 Schott 'Pyran Platinum F'.
 - .4 Technical Glass Products 'FireLite NT'.
 - .5 Substitutions: in accordance with Section 01 25 00.
 - .3 Non-film faced glazing:

Glass and Glazing

- .1 Fire-protective-rated and impact safety-rated, transparent glazing material with no exposed film facing, and listed for use in doors, sidelites, transoms, and borrowed lites in both interior and exterior applications, not functioning as a barrier to heat.
- .2 Surface finish:
 - .1 Premium Grade: transparent glass, polished for superior optical clarity.
- .3 Acceptable *Product*:
 - .1 Safti First 'SuperLite II-XL'.
 - .2 Saint Gobain 'Keralite Select L'.
 - .3 Schott 'Pyran Platinum L'.
 - .4 Technical Glass Products 'FireLite Plus'.
 - .5 Substitutions: in accordance with Section 01 25 00.

2.5 Glazing Materials (Non-Fire Rated)

- .1 Glazing materials; general: Select glazing sealants, tapes, gaskets and additional glazing materials of proven compatibility with other materials they will contact, including glass products, seals of insulating glass units and glazing channel substrates, under conditions of installation and service, as demonstrated by testing and field experience.
- .2 Glazing gaskets: Moulded or extruded gaskets of profile and hardness required to maintain watertight seal, made from the following:
 - .1 Preformed silicone to ASTM C1115-17(2022).
- .3 Setting blocks: Moulded or extruded material with Shore, Type A Durometer hardness of 85, plus or minus 5, made from the following:
 - .1 Preformed silicone to ASTM C1115-17(2022).
- .4 Spacers: Moulded or extruded blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated made from the following:
 - .1 Preformed silicone to ASTM C1115-17(2022).
- .5 Edge blocks: Moulded or extruded material of hardness needed to limit glass lateral movement (side walking) made from the following:
 - .1 Preformed silicone to ASTM C1115-17(2022).
- .6 Cleaners, primers and sealers: Type recommended by sealant or gasket manufacturer.
- .7 Polyurethane foam glazing tape:
 - .1 High density, closed-cell, flexible, non-extruding tape, adhesive backed one side only; recommended by manufacturer for exterior applications with nominal pressure in glazing channel.
 - .2 Acceptable *Products*: As recommended by manufacturer suitable for conditions of application and use.

Glass and Glazing

2.6 Fire Rated Glazing Accessories

- .1 Glazing tape; fire-rated glass (non-wired):
 - .1 Closed cell polyvinyl chloride (PVC) foam, coiled on release paper over adhesive on two sides, maximum water absorption by volume of 2 percent, designed for compression of 25 percent to effect an air and vapour seal.
- .2 Silicone sealant: One-part neutral curing silicone, medium modulus sealant, to ASTM C920-11, Type S; Grade NS; Class 25 with additional movement capability of 50 percent in both extension and compression (total 100 percent); Use (Exposure) NT; Uses (Substrates) G, A, and O as applicable.
 - .1 Acceptable *Products*:
 - .1 DOWSIL '795'.
 - .2 Momentive 'Silglaze-II 2800'.
 - .3 Tremco 'Spectrem 2'.
 - .4 Substitutions: in accordance with Section 01 25 00.
- .3 Setting blocks: 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.
- .4 Cleaners, primers, and sealers: Type recommended by manufacturer of glass and gaskets.

2.7 Fabrication of Glazing Units

- .1 Fabricate glazing units in sizes required to fit openings, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.
 - .1 Allow for thermal movements from ambient and surface temperature changes acting on glass framing members and glazing components.
- .2 Clean-cut or flat-grind vertical edges of butt-glazed monolithic lites to produce square edges with slight chamfers at junctions of edges and faces.
- .3 Grind smooth and chamfer, and polish exposed glass edges and corners, unless otherwise indicated.

PART 3 - EXECUTION

3.1 Examination

- .1 Examine framing, glazing channels, and stops, with glazing installer present, for compliance with the following:
 - .1 Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
 - .2 Inspect butt and mitre joints in framing. Seal joints found to be open with a compatible sealant prior to glazing.

Glass and Glazing

- .3 Glazing pockets and surfaces are free of dust, construction debris, and contaminants.
 - .4 Presence and functioning of weep systems.
 - .5 Minimum required face and edge clearances as per FGIA and GANA standards.
 - .6 Effective sealing between joints of glass-framing members.
- .2 Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 Preparation

- .1 Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.
- .2 Examine glazing units to locate exterior and interior surfaces. Label or mark units as needed so that exterior and interior surfaces are readily identifiable. Do not use materials that will leave visible marks in the completed work.
- .3 Clean contact surfaces with solvent and apply primers to surfaces to receive tapes and sealants in accordance with the manufacturer's requirements. Ensure surfaces are free of moisture and frost.

3.3 Glazing - General

- .1 Comply with combined written requirements of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.
- .2 Adjust glazing channel dimensions as required by conditions during installation to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.
- .3 Protect glass edges from damage during handling and installation. Remove damaged glass from *Project* site and legally dispose of off *Project* site. Damaged glass is glass with edge damage or other imperfections that, when installed, could weaken glass and impair performance and appearance.
- .4 Clean glazing rebate surfaces of traces of dirt, dust, or other contaminants.
- .5 Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.
- .6 Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.
- .7 Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.
- .8 Provide spacers for glass lites where length plus width is greater than 1270 mm (50").
 - .1 Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.
 - .2 Provide 3.2 mm (1/8") minimum bite of spacers on glass and use thickness equal to sealant width.

Glass and Glazing

- .9 Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel.
- .10 Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.
- .11 Set glass lites with proper orientation so that coatings face exterior or interior as specified.
- .12 Glaze hollow metal frames specified under work of Section 08 11 13 using tape glazing installation.
- .13 Install fire rated glazing in accordance with fire rated glazing *Product* manufacturer's written requirements and with current fire-resistance listing for each *Product*. Field cutting or tampering is not permissible.

3.4 Tape Glazing

- .1 Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.
- .2 Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.
- .3 Cover vertical framing joints by applying tapes to heads and sills first and then to jambs. Cover horizontal framing joints by applying tapes to jambs and then to heads and sills.
- .4 Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.
- .5 Do not remove release paper from tape until right before each glazing unit is installed.
- .6 Centre glass lites in openings on setting blocks and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centres of openings.

3.5 Gasket Glazing (Dry)

- .1 Allow gaskets to relax and cut compression gaskets to lengths recommended by gasket manufacturer to fit openings to suit frame dimensions.
- .2 Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.
- .3 Installation with drive-in wedge gaskets: Centre glass lites in openings on setting blocks and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centres of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.
- .4 Installation with Pressure-Glazing Stops: Centre glass lites in openings on setting blocks and press firmly against soft compression gasket. Install dense compression gaskets and pressure-glazing stops, applying pressure uniformly to compression gaskets. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.
- .5 Install gaskets so they protrude past face of glazing stops.

Glass and Glazing

3.6 Sealant Glazing (Wet)

- .1 Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel and blocking weep systems until sealants cure. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.
- .2 Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.
- .3 Tool exposed surfaces of sealants to provide a substantial wash away from glass.

3.7 Field Quality Control

- .1 Conduct quality control in accordance with Section 01 45 00.

3.8 Adjusting and Cleaning

- .1 Immediately remove sealant and compound droppings from finished surfaces. Remove labels after work is completed.
- .2 Final cleaning of glass in accordance with Section 01 74 00.

END OF SECTION

PART 1 - GENERAL

1.1 Summary

- .1 Section includes:
 - .1 Translucent window film; applied to interior glazing (FLM-1).

1.2 Submittals

- .1 Submit required submittals in accordance with Section 01 33 00.
- .2 *Product* data sheets:
 - .1 Submit manufacturer's *Product* data sheets for *Products* proposed for use in the work of this section.
- .3 Samples:
 - .1 Submit 3 - 200 mm x 200 mm (8" x 8") samples of each specified film type, pattern and colour.

1.3 Closeout Submittals

- .1 Submit closeout submittals in accordance with Section 01 78 00.
- .2 Operation and maintenance data:
 - .1 Submit maintenance and cleaning instructions for incorporation into operating and maintenance manuals.
 - .2 Instruct *Owner's* representative on proper care and maintenance for work of this section.

1.4 Quality Assurance

- .1 Qualifications:
 - .1 *Subcontractor*. Shall have 5 years' experience, minimum, in application of *Products* specified.

1.5 Delivery, Storage, and Handling

- .1 Package materials and identify on attached labels the manufacturer, contents and material specification number.

1.6 Field Conditions

- .1 Conform to manufacturer's written documented temperatures, relative humidity, and substrate moisture content and temperature for application of materials of this section.

1.7 Warranty

- .1 Warrant work of this section in accordance with Section 01 78 36.
- .2 Extended warranty:
 - .1 System:
 - .1 Labour, materials, and workmanship for work of this section.

Applied Films

.2 Duration: 2 years.

PART 2- PRODUCTS

2.1 Performance/Design Requirements

- .1 Applied film shall function as intended, and exhibit none of the following:
 - .1 Bubbling.
 - .2 Cracking.
 - .3 Crazing.
 - .4 Delamination.
 - .5 Discolouration.
 - .6 Peeling.

2.2 Materials

- .1 Applied films; translucent:
 - .1 Acceptable *Products*:
 - .1 In accordance with the Materials and Finishes Schedule.
 - .2 Substitutions: in accordance with Section 01 25 00.

PART 3 - EXECUTION

3.1 Examination

- .1 Examine glass surfaces to receive film and verify that they are free from defects and imperfections which will affect the final appearance of installed film. Correct such deficiencies before starting film application.

3.2 Preparation

- .1 Prepare surfaces for film application in accordance with film manufacturer's written requirements.
- .2 Window and window framing will be cleaned thoroughly with a neutral cleaning solution. Surface of glass shall be bladed with industrial razor to ensure the removal of any foreign contaminants in accordance with film manufacturer's instructions.
- .3 Towelling or other absorbent material shall be placed on the window sill or sash to absorb moisture accumulation generated by the film application.

3.3 Installation

- .1 Applied film; interior application:
 - .1 Apply film to indicated surface of glazing units in accordance with film manufacturer's written requirements, applied plumb, true and level over clean glazing, without air bubbles, wrinkles, blisters, and other defects.

Applied Films

- .2 After installation, applied film shall be flat with no obvious concentrations of moisture, free of creases, free of tears, with no moisture dimples when viewed under normal conditions.
- .3 Film edges shall be cut neatly and square at a uniform distance of 1.5 mm (1/16") to 0.79 mm (1/32") from frame.

3.4 Adjusting and Cleaning

- .1 Clean film and glass surfaces so they are free of foreign matter using cleaners recommended by film manufacturer.

3.5 Protection

- .1 Comply with manufacturer's written requirements respecting protection.

END OF SECTION

Metal Supports for Gypsum Board

PART 1 - GENERAL

1.1 Summary

- .1 Section includes:
 - .1 Metal support systems for interior gypsum board partitions, and interior assemblies.

1.2 Submittals

- .1 Submit required submittals in accordance with Section 01 33 00.
- .2 *Product* data sheets:
 - .1 Submit manufacturer's *Product* data sheets for *Products* proposed for use in the *Work* of this section, including additional data as may be required to demonstrate compliance with the *Contract Documents*.
- .3 Test and evaluation reports:
 - .1 Submit certified test results for each required fire resistance rated assembly for work of this section.

1.3 Quality Assurance

- .1 Qualifications:
 - .1 Installers / applicators / erectors:
 - .1 *Subcontractor*. Shall have 5 years' experience, minimum, in application of *Products*, systems and assemblies specified.

PART 2 - PRODUCTS

2.1 Materials - General

- .1 For sheet metal *Products*: Sheet metal thickness indicated herein pertains to the minimum base steel thickness exclusive of coating.
- .2 Protective coatings for metal supports and framing:
 - .1 Minimum corrosion protection: Z120 (G40) ASTM A653/A653M-13.
- .3 Sheet metal screws shall have a minimum coating thickness of 0.008 mm (0.0003") of zinc. Other coatings providing equal or better corrosion protection may be used, subject to acceptance of *Consultant*.
- .4 Screws:
 - .1 Steel screws shall be equal to or exceed minimum diameter indicated on shop drawings.
 - .2 Penetration beyond joined materials shall be not less than 3 exposed threads.
 - .3 Thread types and drilling capability shall conform to manufacturer's recommendations.

Metal Supports for Gypsum Board

2.2 Partition Support Materials

- .1 Interior non-loadbearing channel stud framing: to ASTM C645-18; roll formed from 0.455 mm (0.0179") minimum thickness unless otherwise indicated or as recommended by gypsum board manufacturer, galvanized steel sheet. Provide service holes starting at 450 mm (18") from bottom, then 914 mm (36") on centre to top of studs.
 - .1 Steel studs; at backer plate locations: 0.836 mm (0.0329") minimum thickness.
 - .2 Steel studs at abuse resistant gypsum board locations: 0.836 mm (0.0329") minimum thickness.
- .2 Interior floor and ceiling tracks (runners): to ASTM C645-18; in widths to suit stud sizes.
 - .1 Metal thickness: to match studs.
 - .2 For openings wider than 914 mm (36"), provide 0.836 mm (0.0329") minimum thickness for header.
- .3 Interior floor and ceiling track (runner) fasteners:
 - .1 To concrete and masonry: Use stub nails or power-driven fasteners.
 - .1 Power actuated fastening systems are not permitted.
 - .2 To suspended acoustic ceiling tile grid: Manufactured to fit applicable ceiling grid profile; CGC 'Partition Clip'.
- .4 Bracing channels: Minimum 19 mm x 10 mm x 1.087 mm (3/4" x 3/8" x 0.0428") cold rolled galvanized steel.

2.3 Ceiling Support Materials and Systems

- .1 General: Size ceiling support components to comply with ASTM C754-20 unless otherwise indicated.
- .2 Main runners: Steel channels, hot or cold rolled; Z180 (G60) galvanized.
- .3 Hanger wire: in accordance with ASTM A641/A641M-19, soft, Class 1 galvanized, minimum 4.064 mm (0.160", 8 AWG).
- .4 Hanger rods and flats: Mild steel with zinc coating, galvanized for exterior applications.
 - .1 General: Size devices for 5 times load imposed by completed system as determined in accordance with ASTM E488/E488M-22.
 - .2 Screws, clips, bolts, concrete inserts or other devices for ceiling hangers whose suitability for use intended has been proven through standard construction practices or by certified test data.
 - .3 Hangers: Comply with ASTM C754-20 for maximum ceiling area and loads to be supported.
 - .4 Interior concrete ceiling anchors:
 - .1 Acceptable *Products*:
 - .1 ITW Ramset/Red Head 'Dynabolt Sleeve Anchor TW-1614' or 'Redi-Drive Tie Drive' or 'Redi-Drive' with angle clip.
 - .2 ITW Ramset/Red Head 'Trubolt' or 'Dynabolt' anchors complete with galvanized angle clip.

Metal Supports for Gypsum Board

- .3 Hilti 'Kwik-Bolt 3' and 'HHDCa 1/4 Ceiling Hangers'.
- .4 Substitutions: in accordance with Section 01 25 00.
- .5 Fasteners exposed to weather, condensation, and corrosion: Zinc-plated or stainless steel fasteners in applicable product lines specified in preceding paragraphs.
- .5 Tie wire: 1.19 mm (0.047", 18 AWG) minimum zinc coated, soft-annealed wire, to ASTM A641/A641M-19.
- .6 Furring anchorages: 1.62 mm (0.0637", 16 AWG) galvanized wire ties, manufacturer's standard wire type clips, bolts, nails or screws as recommended by furring manufacturer and complying with ASTM C754-20.
- .7 Runner (carry) channels: 1.367 mm (0.0538") thick cold rolled steel, primer painted or zinc coated for interior locations, to ASTM C754-20, with minimum 228 MPa yield strength:
 - .1 38 mm x 12.7 mm (1-1/2" x 1/2") where supported at centres of 914 mm (36") maximum.
 - .2 38 mm x 19 mm (1-1/2" x 3/4") where supported at centres of 1220 mm (48") maximum.

2.4 Furring

- .1 Furring channels: 0.455 mm (0.0179") minimum typical thickness, cold rolled steel, wiped coated, nominal size of 22 mm (7/8") depth x 35 mm (1-3/8") face, hat type with knurled face.
- .2 Z-furring members: Galvanized steel z-shaped furring members; ASTM A653/A653M-13, G60, 0.836 mm (0.0329") minimum thickness of base metal, of depth indicated, designed for mechanical attachment of insulation boards or blankets.
- .3 Fasteners for furring members: Type and size recommended by furring manufacturer for substrate and application indicated, load rating and spacing to support materials carried by assembly with factor of safety of 3x per fastener manufacturer data sheets.

2.5 Accessories

- .1 Backer plates:
 - .1 Metal backer plates: Steel, galvanized; minimum 150 mm (6") wide x 0.836 mm (0.0329") minimum x length and width to suit size of items to be attached; fastened to studs for attachment of surface mounted fittings and accessories.
 - .2 Plywood backer plates: Softwood plywood; 19 mm (3/4") minimum x length and width to suit size of items to be attached; fastened to studs for attachment of surface mounted fittings and accessories.
 - .3 Elimination of backer plates or direct attachment of accessories or equipment to studs will not be permitted.

Metal Supports for Gypsum Board

PART 3 - EXECUTION

3.1 Installation General

- .1 Comply with ASTM C754-20 and manufacturer's requirements, except as modified herein. Do not bridge building expansion joints with support system. Frame both sides of joints with furring and other supports as indicated.
- .2 Provide and install studs, framing, shimming, and furring to provide proper support for gypsum board to achieve the following installation tolerances:
 - .1 Do not exceed 3 mm (1/8") in 3 m (10') variation from plumb, level, and plane.
 - .2 Do not exceed 10 mm (3/8") from drawings locations.
 - .3 Do not exceed 1.5 mm (1/16") variation between planes of abutting edges or ends.
 - .4 Install each framing member so fastening surfaces vary not more than 3.2 mm (1/8") from the plane formed by faces of adjacent framing.
 - .5 In double stud walls, do not bridge across studs on opposite sides of wall with gypsum board or metal cross bracing.
- .3 Give complete cooperation and direction to trades erecting framing and furring over which this work is applied. Coordinate finished joint location with framing.
- .4 Coordinate installation and cooperate with mechanical and electrical work to accommodate mechanical electrical items and any other work required to be incorporated into or coordinated with the partitions, ceiling and soffit systems.
 - .1 Where the presence of suspended ductwork or other mechanical or electrical services or devices above ceiling framing conflicts with ceiling framing suspension points from structure above, provide bridging framing below conflicting work as required to support ceiling framing on specified intervals.
 - .2 Do not suspend ceiling framing from mechanical or electrical suspension systems unless agreement is obtained in writing from engineer for *Subcontractor* installing such framing that additional imposed loads are acceptable; obtain *Consultant's* acceptance before proceeding.
- .5 Provide clearances between work of this section and structural elements to prevent transference of structural loads.
- .6 Do not bridge building expansion joints with steel framing or furring members. Independently frame both sides of joints with framing of furring members or as indicated.
- .7 Size framing systems according to manufacturer's engineered load tables, to meet allowable deflection without permanent deformation.
 - .1 Maximum allowable deflection: L/240.

3.2 Blocking

- .1 Attach to framing adequate backer plates to support the load of, and to withstand the withdrawal and shear forces imposed by, items installed upon the work of this section.

Metal Supports for Gypsum Board

3.3 Furring - General

- .1 Furring indicated in *Contract Documents* is schematic. Do not regard as exact or complete. *Provide* all necessary framing and furring to support gypsum board in accordance with manufacturers' specifications.
- .2 Shim furring as required to achieve required installation tolerances.
- .3 Leave finished work rigid, secure, square, level, plumb, curved to detailed radius and erected to maintain finish gypsum board line dimensions and contours. Make allowance for thermal movement.
- .4 Thermally separate metal studs from exterior concrete or masonry.

3.4 Suspended and Furred Ceilings

- .1 Arrange hangers for suspended gypsum board ceilings to provide support independent of walls, columns, pipes, ducts; erect plumb, and securely anchored to structural frame, or embed in concrete slabs.
- .2 Keep lateral braces at hangers back 450 mm (18") minimum unless otherwise noted.
- .3 Space hangers at 914 mm (36") on centre maximum along runner channels, and not more than 150 mm (6") from ends.
- .4 Space runner channels at 1220 mm (48") on centre, maximum, and not more than 150 mm (6") from boundary walls, interruptions of continuity, and changes in direction. Run channels transversely to structural framing members.
- .5 Where splices are necessary, lap members at least 200 mm (8") and wire each end with 2 loops. Avoid clustering or lining up of splices.
- .6 Attach to rod hangers by bending hanger sharply under bottom flange of runner, and securely wiring in place with saddle tie.
- .7 Erect cross furring channels transversely across runner channels at 400 mm (16") on centre maximum, 305 mm (12") on centre at fire rated assemblies, at not more than 150 mm (6") from boundary wall openings, interruptions in ceiling continuity, and changes in direction.
- .8 Secure furring channels to each support with purpose-made slips or wire tie. Splice joints by lapping channels and tying together.
- .9 Level cross furring channels to maximum tolerance of 3 mm in 3 m (1/8" in 10 ft).

3.5 Wall Furring

- .1 Install steel furring for braced walls, free standing walls, walls that are furred out as indicated.
- .2 Frame openings and around built-in equipment, cabinets, access panels, on 4 sides, with channels. Extend furring into reveals. Check clearances with equipment suppliers.
- .3 *Provide* bulkheads and boxed-in duct shafts, for beams, columns, pipes and around exposed services where indicated. Install 19 mm (3/4") channels at corners and at 305 mm (12") on centre.

Metal Supports for Gypsum Board

3.6 Metal Stud Partition Framing

- .1 Provide partition tracks (runners) at floor and underside of structural assembly and as follows:
 - .1 Align accurately and lay out according to partition layout.
 - .2 Secure runners to concrete, access flooring and to concrete slabs, as applicable, with screwed or shot fasteners located 50 mm (2") from each end and spaced at maximum 610 mm (24") on centre.
 - .3 At partition corners, extend one runner to end of corner and butt other runner to it, allowing necessary clearance for gypsum board thickness. Runners should not be mitred.
- .2 Unless otherwise indicated, place interior studs vertically at centres as follows:
 - .1 *Provide* studs at 400 mm (16") on centre, and as specially spaced in accordance with details indicated.
 - .2 *Provide* studs not more than 50 mm (2") from abutting walls, openings and each side of corners.
 - .3 *Provide* freedom for 19 mm (3/4") deflection under beams, structural slabs and the like to avoid transmission of structural loads to studs, or install 50 mm (2") leg ceiling tracks.
- .3 Install studs in tracks at floor and ceiling.
- .4 Where horizontal runs of service lines are scheduled to be installed, arrange with applicable trades and install studs simultaneously with services.
- .5 At openings in stud walls, erect track at head and sills to accommodate intermediate studs. At each end of track, cut out flanges, turn up web, and fasten to studs. Install intermediate studs above and below openings in same manner and spacing as wall studs. Install double studs at each jamb, and double tracks at head of door openings.
- .6 At partitions requiring fire rating, erect in accordance with requirements of listing.
- .7 Size studs, connections, and runners to carry loads according to stud manufacturer's load tables, at 24 kg/m² (5 lb/ft²) live load to meet maximum allowable deflection limits. Where depth of stud is indicated, size metal thickness to meet allowable deflection limits.
- .8 *Provide* three studs at corner and intermediate intersections of partitions.
- .9 Coordinate work with others installing horizontal runs of service lines so that work is done simultaneously. Where standard holes are too small for installed services, notch studs, and splice notched flanges with splice pieces 305 mm (12") longer than notches, each fastened with 2 screws.
- .10 Coordinate simultaneous erection of studs with installation of service lines. When erecting studs ensure web openings are aligned.
- .11 Coordinate erection of studs with installation of door/window frames and special supports or anchorage for work specified in other sections.
- .12 Unless otherwise indicated, partitions, together with gypsum board facings, shall extend above ceilings to underside of structure above.
- .13 Chase walls:

Metal Supports for Gypsum Board

- .1 *Provide* chase walls consisting of two parallel steel stud partitions.
- .2 *Provide* cross bracing consisting of metal furring, located at quarter points on each pair of studs. Attach cross bracing to studs with metal screws.
- .14 Lateral support bracing channels:
 - .1 Stiffen partitions over 3 m (10') in vertical span, at mid-height to maximum vertical spacing of 2440 mm (8') on centre, with at least one 19 mm (3/4") horizontal bracing channel, extending full length of partition, overlapping at least two stud spaces at ends of bracing channels.
 - .2 Stiffen partitions at not more than 150 mm (6") from the top and bottom of openings and across two full stud spaces at each side of openings with horizontal bracing channel.

3.7 Control Joints

- .1 Control joints: in accordance with Section 09 29 00.

3.8 Concrete Anchors

- .1 Provide anchors and anchorage points in reinforced concrete floor slab underside in accordance with gypsum board manufacturer's suspension requirements. Drill holes with carbide-tipped drill bits conforming to ANSI B212.15-1994 (R2000).
- .2 *Provide* anchors; minimum installation depth, and method of expansion as recommended by the anchor manufacturer.

3.9 Field Quality Control

- .1 Conduct quality control in accordance with Section 01 45 00.

END OF SECTION

Gypsum Board

PART 1 - GENERAL

1.1 Summary

- .1 Section includes:
 - .1 Gypsum board; paper-faced (GWB-1).
 - .2 Gypsum board; fire-rated, paper-faced (GWB-2).
 - .3 Gypsum board; abuse resistant (GWB-4).
 - .4 Gypsum board accessories and miscellaneous related materials.

1.2 Submittals

- .1 Submit required submittals in accordance with Section 01 33 00.
- .2 *Product* data sheets:
 - .1 Submit manufacturer's *Product* data sheets for *Products* proposed for use in the work of this section.
- .3 Fire-rated assembly listings and STC assembly ratings:
 - .1 Submit fire-rated assembly listings for each required fire resistance rated assembly for work of this section.
 - .2 Submit STC assembly ratings for each required STC rated assembly for work of this section.

1.3 Quality Assurance

- .1 Qualifications:
 - .1 *Subcontractor*. Shall have 10 years' experience, minimum, in successful installation of work of type and quality indicated and specified.

1.4 Field Conditions

- .1 Comply with requirements of referenced gypsum board application standards and recommendations of gypsum board manufacturer, for environmental conditions before, during and after application of gypsum boards.
- .2 Install paper-faced gypsum panels after installation areas are enclosed and conditioned.
- .3 Panels that are wet, moisture damaged, or mould damaged shall not be installed.
 - .1 Indications that panels are wet or moisture damaged include, but are not limited to, discolouration, sagging, or irregular shape.
 - .2 Indications that panels are mould damaged include, but are not limited to, fuzzy or splotchy surface contamination and discolouration.

Gypsum Board

PART 2 - PRODUCTS

2.1 Performance/Design Requirements

- .1 Single source responsibility: Obtain gypsum and cement board products from a single manufacturer.
- .2 Fire resistance rating:
 - .1 Construct fire resistance rated assemblies in accordance with listing and CAN/ULC S101-14.
- .3 Paper-faced gypsum board: in accordance with ASTM C1396/C1396M-17.
- .4 Glass scrim gypsum board: in accordance with ASTM C1658/C1658M-13.
- .5 Fire rated in accordance with listed assemblies where indicated: Type X or Type C.

2.2 Gypsum Board Panels

- .1 GWB-1; Gypsum board; paper faced:
 - .1 *Acceptable Products:*
 - .1 CertainTeed 'Regular Gypsum Board'.
 - .2 CGC 'Sheetrock Brand Gypsum Panel'.
 - .3 Georgia-Pacific 'ToughRock Gypsum Board'.
 - .4 National Gypsum 'Gold Bond Gypsum Board'.
 - .5 Substitutions: in accordance with Section 01 25 00.
- .2 GWB-2; Gypsum board; fire-rated, paper faced:
 - .1 *Acceptable Products:*
 - .1 CertainTeed 'Type X and Type C'.
 - .2 CGC 'SHEETROCK Brand Firecode X and Firecode C'.
 - .3 Georgia-Pacific 'ToughRock Fireguard X Gypsum Board and ToughRock Fireguard C Gypsum Board'.
 - .4 National Gypsum 'Gold Bond Brand Fire-Shield Gypsum Board and Gold Bond Fire Shield C Gypsum Board'.
 - .5 PABCO Gypsum 'QuietRock ES'.
 - .6 Substitutions: in accordance with Section 01 25 00.
- .3 GWB-4; Gypsum board; abuse resistant:
 - .1 Mould and moisture resistant: in accordance with ASTM D3273-16, with a panel score of 10.
 - .2 Abuse resistance performance:

Gypsum Board

- .1 Surface abrasion surface damage: in accordance with ASTM D4977/D4977M-03(2013)e1, Level 3.
- .2 Surface indentation surface damage: in accordance with ASTM D5420-16, Level 1.
- .3 Soft-body impact penetration: in accordance with ASTM E695-03(2015)e1, Level 2.
- .4 Hard Body Impact resistance: in accordance with ASTM C1629/C1629M-18, App.1, Level 1.
- .3 Paper faced:
 - .1 Acceptable *Products*:
 - .1 CertainTeed 'Air-Renew Extreme Abuse Resistant' Gypsum Board.
 - .2 CertainTeed 'Extreme Abuse' Gypsum Board.
 - .3 CGC 'Sheetrock Brand Panels Mold Tough AR Firecode X'.
 - .4 National Gypsum 'Hi-Abuse XP Gypsum Board'.
 - .5 Substitutions: in accordance with Section 01 25 00.

2.3 Attachment Materials

- .1 Screws; for gypsum board: bugle head, fine thread, self-tapping, Type W or S or S-12 point to suit framing type and metal gauge, with corrosion resistant finish in accordance with ASTM C1002-07/ASTM C954-11.
 - .1 Screw sizing:
 - .1 #6 x 25 mm (1") for single thickness board fastening.
 - .2 #6 x 32 mm (1-1/4") for single thickness 15.9 mm (5/8") board fastening.
 - .3 #7 x 41 mm (1 5/8") for double thickness board fastening.
 - .2 Tie wire: 1.6 mm (0.063") diameter galvanized soft annealed steel wire.

2.4 Accessories

- .1 Accessories: in accordance with ASTM C1047-19 unless otherwise indicated, maximum length pieces per location. Flanges shall be free from dirt, grease, or other material that adversely affects the bond of joint treatment or decoration.
- .2 Trims:
 - .1 Material: Galvanized or aluminum-coated steel sheet, rolled zinc, plastic, or paper-faced galvanized-steel sheet.
 - .1 Shapes:
 - .1 Corner bead.

Gypsum Board

- .1 Mechanically fastened corner beads at impact resistant gypsum walls.
 - .2 "L" or "LC" beads.
 - .3 Reveal trims.
 - .4 Control joints, certified by manufacturer for use at fire resistance rated assemblies as required.
- .3 Aluminum trims: extruded accessories of profiles and dimensions as indicated.
- .1 Alloy and temper with not less than the strength and durability properties of ASTM B221 (ASTM B221M), Alloy 6063-T5.
 - .2 Shapes:
 - .1 Z reveal.
 - .2 Reveals and moldings at round columns.
 - .3 Acceptable manufacturers:
 - .1 Fry Reglet.
 - .2 Gordon Interior Specialties.
 - .3 Substitutions: in accordance with Section 01 25 00.
- .4 Aluminum gypsum board trim:
- .1 Extruded alloy 6063-T5 to ANSI H35.1/H35.1M-2017 consisting of fin, tapered, grooved, and prepunched for screw attachment and bonding agent.
 - .1 Acceptable manufacturers:
 - .1 Fry Reglet.
 - .2 Gordon, Inc.
 - .3 Softforms.
 - .4 Substitutions: in accordance with Section 01 25 00.

2.5 Related Support Assemblies and Backer Plates

- .1 Metal support systems and backer plates at interior assemblies: in accordance with Section 09 22 00.

2.6 Joint Treatment Materials

- .1 General: Comply with ASTM C475/C475M-17(2022).
- .2 Joint tape: in accordance with manufacturer's written requirements.
- .3 Joint compound for interior gypsum board: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.

Gypsum Board

- .1 Prefilling: Use setting-type compound as recommended by panel board manufacturer.
- .2 Embedding and first coat: Use setting-type or taping compound as recommended by panel board and trim accessory manufacturers.
- .3 Fill and finish coats: Use sanding type setting-type or taping compound as recommended by panel board manufacturer.

2.7 Acoustic Wall Assembly Materials

- .1 Acoustic sealant; concealed locations: to meet material requirements as listed in Part 9 of ASTM C919-22, including ASTM C834-10 or ASTM C920-14:
 - .1 Acceptable *Products*:
 - .1 Hilti Canada Corp 'CS-S SA Light'.
 - .2 Owens Corning 'QuietZone Acoustic Sealant'.
 - .3 Pecora 'BA-98'.
 - .4 Pecora 'AC-20'.
 - .5 Tremco 'Tremflex 834'.
 - .6 Substitutions: in accordance with Section 01 25 00.
 - .2 Acoustic sealant; exposed locations, acrylic:
 - .1 Acrylic/latex acoustic sealant, Type S, Grade NS, Class 12.5 to ASTM C920-14, maximum VOC content 60 g/L, non-hardening or ASTM C834-10, Type OP, Grade -18° C.
 - .2 For exposed sealants use paintable sealant products, do use non-skinning type products where they are exposed to view or where sealant products may deteriorate (stain or bleed into) into painted surfaces.
 - .3 Acceptable *Products*:
 - .1 Hilti Canada Corp 'CS-S SA Light'.
 - .2 Master Builders Solutions Canada 'MasterSeal NP 520'.
 - .3 Owens Corning 'QuietZone Acoustic Sealant'.
 - .4 Pecora 'AC20'.
 - .5 Tremco 'Tremflex 834'.
 - .6 Substitutions: in accordance with Section 01 25 00.
 - .3 Smoke and acoustic sealant; concealed locations, non-fire-rated acoustic assemblies:
 - .1 Acrylic smoke and acoustic sealant, in accordance with ASTM C834-10 maximum VOC content 60 g/L, paintable, Flame Spread Value of maximum 25 to CAN/ULC-S102-10.

Gypsum Board

- .2 Sealant shall not deteriorate (stain or bleed into) painted surfaces.
- .3 Acceptable *Products*:
 - .1 Hilti Canada Corp 'CS-S SA Light'.
 - .2 Tremco 'Tremstop Smoke & Sound Sealant'.
 - .3 Substitutions: in accordance with Section 01 25 00.
- .4 Acoustic sealant for plenum locations: Smoke-seal sealant with flame-spread not more than 25 and smoke developed classification not more than 50 to CAN/ULC-S102-10, in accordance with Section 07 84 00.
- .5 Acoustic compound: premixed perlite plaster.
- .6 Acoustic (sound attenuation) insulation:
 - .1 Mineral-fibre sound attenuation batts: in accordance with CAN/ULC S702-14, Type 1, fire resistant and non-combustible to CAN/ULC-S114-05, high density for sag-free, tight fitting installation.
 - .1 Density: minimum 40 kg/m³ (2.5 lbs/ft³).
 - .2 Acceptable *Products*:
 - .1 Johns Manville 'MinWool Sound Attenuation Fire Batts'.
 - .2 Owens-Corning 'Thermafiber SAFB'.
 - .3 Rockwool 'AFB'.
 - .4 Substitutions: in accordance with Section 01 25 00.
 - .2 Fasteners: use mechanical fasteners where required to secure insulation into position in accordance with insulation manufacturer.

PART 3 - EXECUTION

3.1 Installation

- .1 General:
 - .1 Comply with ASTM C840-18b, GA 216-21, GA 600-21, and manufacturer's written requirements, except as otherwise indicated.
 - .2 Do not bridge building expansion joints with support system.
 - .3 Frame both sides of joints with furring and other supports as indicated.
- .2 Install exposed gypsum board with face side out. Do not install imperfect, damaged or damp boards. Butt boards together for a light contact at edges and ends with not more than 1.6 mm (1/16") open space between boards. Do not force into place.

Gypsum Board

- .3 Cover both faces of stud partition framing with gypsum board in concealed spaces (above ceiling, and the like) unless otherwise indicated, except in chase walls which are properly braced internally.
- .4 Attach gypsum board to supplementary framing and blocking provided for additional support at openings and cut-outs.
- .5 Apply components of fire-rated assemblies in conformance with indicated designs.
- .6 Do not apply gypsum board in close proximity to hot pipes or heating ducts.
- .7 Install materials with the minimum number of joints. Tightly butt joints, without force, and neatly align them.
- .8 Frame openings on every side. Provide clearances with services.
- .9 Work shall include bulkheads over doors, frames, screens, and changes in ceiling levels, pipe space and as indicated.
- .10 Provide clearances between work of this section and structural elements to prevent transference of structural loads in accordance with Section 09 22 00.
- .11 Tolerances:
 - .1 Do not exceed 3 mm (1/8") in 3 m (10') variation from plumb, level, and plane in exposed surfaces, except at end joint between gypsum board panels.
 - .2 Do not exceed 10 mm (3/8") from indicated location.
 - .3 Do not exceed 1.5 mm (1/16") variation between planes of abutting edges or ends.
 - .4 Surface flatness shall not exceed 1.5 mm (1/16") within 305 mm (12") straight edge. For non-tapered-edge end joints between boards, measure flatness tolerance with end of straight end at centreline of joint.

3.2 Accessories

- .1 At external corners install corner trim secured to framing at 230 mm (9-1/16") on centre on both flanges with screw fasteners or clinch tool.
- .2 Secure casing trim at board edges where exposed to view, where board butts against other materials with no trim to conceal junction, at perimeter of ceiling surfaces at tops of partitions where they stop against continuous ceiling surfaces, and where indicated.
- .3 Erect accessories straight, plumb or level, rigid and at proper plane.
- .4 Use full length pieces.
- .5 Make joints tight, accurately aligned and rigidly secured. Mitre and fit corners, free from rough edges. Secure in accordance with manufacturer's specifications unless otherwise required.
- .6 Installation tolerances:
 - .1 Alignment with board panels shall not exceed tolerances specified above.

Gypsum Board

- .2 End joints shall be flush aligned to maximum offset of 0.5 mm (0.020").

3.3 Board Application - General

- .1 Before installation of board commences, ensure that internal services have been installed, tested, and approved; conduits, pipes, cables, and outlets are plugged, capped, or covered; and that fastenings and supports installed by others are in place.
- .2 Extend board into door, window, and other openings, reveals, behind fitments, and other applied items and on metal stud partitions to structure above unless indicated otherwise.
- .3 Apply board with long dimension perpendicular to supports, unless otherwise indicated.
- .4 Locate joints on opposite sides of partitions on different studs, and at least 305 mm (12") from opening jambs.
- .5 Install board to minimize joints, and align end joints to be the least objectionable (where they are unavoidable), according to the indicated lighting design. Locate joints in ceilings where least prominently discerned, and never line them up with opening edges.
- .6 Form smooth joints at ends and at field cut edges of board panels.
- .7 Fasten board to metal support members by metal gypsum board screws, 9.5 mm (0.374") minimum to, and 12.7 mm (1/2") maximum from, centre of joints.
 - .1 Space screws:
 - .1 At fire rated board as per fire-rated assembly.
 - .2 At typical board walls at 400 mm (16") on centre at edges and field unless otherwise required.
- .8 Offset gypsum board joints 150 mm (6") minimum from corners of openings.
- .9 Locate gypsum panel product joints so that no joint will align with the edge of an opening unless control joints are to be installed at these locations.
- .10 Replace damaged or weathered sheathing boards.

3.4 Abuse Resistant Board Application

- .1 Install abuse resistance gypsum board in accordance with gypsum board manufacturer's written requirements.
- .2 Where both abuse resistant gypsum panels and plain gypsum board are used together on the same surface plane adjacent to one another, a smooth transition between the two types of boards is required. Finish the work in a manner such that the transition provides an inconspicuous joint when viewed by a person at normal viewing angles while standing in front of the boards from a distance of not less than 1000 mm (39").

3.5 Acoustic Wall Assemblies

- .1 Acoustical sealant and plaster:

Gypsum Board

- .1 Apply acoustical sealant to seal gaps in accordance with ASTM C919-22 and in accordance with the STC rated assembly.
- .2 Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C919-22 and with manufacturer's written requirements for locating edge trim and closing off sound-flanking paths around or through assemblies, including sealing partitions above acoustical ceilings.
- .3 Clean substrate, remove debris and deleterious substances.
- .4 Apply sealant to close voids; no leaks around track and gypsum board.
- .2 Sound attenuation insulation:
 - .1 Install sound attenuation insulation to fill cavity unless otherwise indicated.
 - .2 Trim insulation to provide close-fit contact to framing assemblies and fill the partition cavity or acoustic insulation assemblies to thicknesses specified or indicated.
 - .3 Maintain air space between backs of sound attenuation insulation and back of opposite partition face layer, as applicable.
 - .4 Cut insulation to provide close-fit contact around electrical boxes, pipes, and other obstructions and penetrations through and within acoustic assemblies.
 - .5 Extend acoustic partition assemblies to underside of structure. Incorporate approved provision to prevent transmittance of structural deflection to partition assembly.
 - .6 Staple sound attenuation insulation where required by manufacturer's installation requirements.
 - .7 Where studs are not faced with gypsum board on both sides, mechanically fasten wire mesh to non-faced side of stud to retain insulation.
 - .8 Mechanically attach sound attenuation insulation in wall assemblies where cavity of wall assembly is greater than 150 mm (6").
 - .9 Secure insulation in such a manner that it will not sag or settle away from required locations.
- .3 Sound flanking paths:
 - .1 Where sound rated partition walls intersect non rated gypsum board partition walls, extend sound rated construction to completely close sound flanking paths through non rated construction.
 - .2 Seal joints between face layers at vertical interior angles of intersecting partitions.

Gypsum Board

3.6 Finishing

- .1 Provide levels of gypsum board finish for locations as follows, in accordance with GA 214-21.
 - .1 Level 1: Ceiling plenum areas and concealed areas, except provide higher level of finish as required to comply with fire resistance ratings and acoustical ratings.
 - .2 Level 2: Gypsum board substrate at applied hard surfaces, except remove tool marks and ridges.
 - .3 Level 3: Skimming of existing drywall at new commercial grade vinyl wallcovering.
 - .4 Level 4: Exposed gypsum board surfaces, except where another finish level is indicated.
- .2 Interior gypsum board:
 - .1 Prefill:
 - .1 Use setting-type joint compound. Mix joint compound according to manufacturer's written requirements.
 - .2 Fill joints between boards flush to top of eased or beveled edge.
 - .3 Fill joints of gypsum board above suspended ceilings in fire rated partitions.
 - .4 Wipe off excess compound and allow compound to harden.
 - .5 Prefill joint gaps not greater than 3.2 mm (1/8") with either ready-mix or setting type joint compound; prefill joint gaps greater than 3.2 mm (1/8") with setting-type joint compound.
 - .2 Taping (Level 1):
 - .1 Butter taping compound into inside corners and joints.
 - .2 Centre tape over joints and press down into fresh compound.
 - .3 Remove excess compound.
 - .4 Tape joints of gypsum board above suspended ceilings.
 - .3 First coat (Level 2):
 - .1 Use taping or all-purpose drying-type compound.
 - .2 Immediately after bedding tape, apply skim coat of compound and allow to dry completely in accordance with manufacturer's written requirements.
 - .3 Apply first coat of compound over flanges of trim and accessories, and over exposed fastener heads and finish level with board surface.
 - .4 Cover fastener heads and accessories with 1 coat of joint compound.

Gypsum Board

- .4 Second coat (Level 3): After first coat treatment is dried, apply second coat of compound over tape and trim, feathering compound 50 mm (2") beyond edge of first coat.
 - .1 Cover fastener heads and accessories with total of 2 separate coats of joint compound.
- .5 Third coat (Level 4):
 - .1 After second coat has dried, sand surface lightly and apply thin finish coat to joints, fasteners and trim, feathering compound 50 mm (2") beyond edge of second coat.
 - .2 Allow third coat to dry. Apply additional compound, and touch-up and sand, to provide surface free of visual defects, tool marks, and ridges, and ready for application of finish.
 - .3 Finished joints will be accepted with a camber not greater than 1 mm (1/32") and shall be seamless, plumb, true and flush and with square, neat corners.
 - .4 Cover fastener heads and accessories with total of 3 separate coats of joint compound.
 - .5 Where new partitions align with existing gypsum board, apply required amount of skim coats to make transition inconspicuous from a distance of 914 mm (36").
 - .6 Completed installation at interface between new and existing construction shall provide an inconspicuous joint.
- .6 Skim coat (Level 5):
 - .1 After the fourth coat has dried, apply skim coat over exposed surfaces of gypsum board in accordance with manufacturer's written requirements.
 - .2 After skim coat has dried, touch-up and sand to provide surface free of visual defects, tool marks, and ridges, and ready for application of finish.
- .3 Joint compound:
 - .1 Apply finish coat of compound feathering 75 to 100 mm (3" to 4") beyond tape edges.
 - .2 Feather coats onto adjoining surfaces so that camber is maximum 0.79 mm (1/32").
- .4 Trim:
 - .1 Use same fasteners to anchor trim accessory flanges as required to fasten gypsum board to supports, unless otherwise recommended by trim manufacturer.
 - .2 Install metal corner beads at external corners.

Gypsum Board

- .3 Install metal casing bead trim whenever edge of gypsum base would otherwise be exposed or semi exposed, and where gypsum base terminates against dissimilar material.
- .4 Erect beads plumb or level, with minimum joints.
- .5 Control joints:
 - .1 Provide control joints set in board facing. Support control joints with studs or furring channels on both sides of joint.
 - .2 Provide control joints in required locations.
 - .1 Review control joint locations with *Consultant* prior to installation.
 - .3 Install control joints where a partition, wall, or ceiling traverses a construction joint (expansion, seismic or building control element) in the building structure.
 - .4 Install control joints where a wall or partition runs in an uninterrupted straight plane exceeding 9100 mm (30 linear feet).
 - .5 Install control joints in interior ceilings:
 - .1 With perimeter relief:
 - .1 Linear dimensions between control joints shall not exceed 15000 mm (50 ft) and total area between control joints shall not exceed 230 m² (2500 ft²).
 - .2 Without perimeter relief:
 - .1 Linear dimensions between control joints shall not exceed 9100 mm (30 ft) and total area between control joints shall not exceed 84 m² (900 ft²).
- .6 Install control joints where ceiling framing members change direction.
- .7 Where a control joint occurs in an acoustical or fire-rated system, provide blocking behind the control joint by using a backing material such as 16 mm (5/8") Type X gypsum panel products, mineral fibre, or other tested equivalent. Construct through-wall control joints at fire-rated assemblies in accordance with assembly listing requirements.
- .8 Line up control joints with joints in other construction or with centre lines of mullions, columns, piers, or similar building elements, where accepted by *Consultant*.
- .9 Install control joints straight and true.
- .10 Ceiling height door frames may be used as control joints. Less than ceiling height frames shall have control joints extending to the ceiling from both corners. If control joints are not used, additional reinforcement is required at corners to distribute concentrated stresses.

Gypsum Board

- .11 Locate board joints so that no joint will align with the edge of an opening unless control joints are to be installed at these locations.

3.7 Fire Separations

- .1 Install fire-rated assemblies in accordance with assembly listing requirements in order to obtain fire ratings indicated and as required by authorities having jurisdiction.
- .2 Vertical bulkheads in ceiling spaces over fire rated partitions, doors and the like shall have same fire rating as the partition over which they occur. Such bulkheads shall be of gypsum board construction unless otherwise indicated.
- .3 Use fire rated gypsum wallboard as specified.
- .4 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.
- .5 Where fire hose cabinets or other fixtures or equipment are recessed in fire rated walls or partitions, provide gypsum board enclosure or backing to maintain required fire rating, unless otherwise detailed.

3.8 Adjusting and Cleaning

- .1 Clean up and remove surplus materials and rubbish resulting from the work of this section upon completion.
- .2 Clean off beads, casings, joint compound droppings and the like, leave the work of this section ready for painting trades.

END OF SECTION

Acoustical Tile Ceiling Systems

PART 1 - GENERAL

1.1 Summary

- .1 Section includes:
 - .1 Acoustical tile ceiling systems (ACT-1).

1.2 Administrative Requirements

- .1 Coordination:
 - .1 Cooperate with mechanical and electrical *Subcontractors*.
 - .2 Coordinate layout and installation of acoustic ceiling units and suspension systems components with other work supported by or penetrating through ceilings, including light fixtures, HVAC equipment, partition system, fire suppression system components and other work required to be incorporated in or coordinated with the ceiling system.
- .2 Conduct a pre-installation meeting in accordance with Section 01 31 19.
 - .1 Independent inspection and testing company shall attend the pre-installation meeting.

1.3 Submittals

- .1 Submit required submittals in accordance with Section 01 33 00.
- .2 *Product* data sheets:
 - .1 Submit manufacturer's *Product* data sheets for *Products* proposed for use in the work of this section.
- .3 Shop drawings:
 - .1 Submit manufacturer's standard details.
 - .2 Indicate lay-out, insert and hanger spacing and fastening details, splicing method for main and cross runners, location of access splines, and acoustical unit support at ceiling fixture.
 - .3 Submit reflected ceiling plans for special grid patterns as indicated.
- .4 Samples:
 - .1 Submit sample of each component of ceiling system. Samples shall fully represent materials to be supplied in colour, texture, finish and construction.
 - .2 Submit samples, load test data and design tables for each type of insert to be used in the *Work* for hanger supports.
- .5 Certificates:
 - .1 Submit certificate of compliance stating that the suspension system provided, including materials and installation, comply with the requirements of the *Contract Documents*.

Acoustical Tile Ceiling Systems

1.4 Closeout Submittals

- .1 Submit closeout submittals in accordance with Section 01 78 00.
- .2 Maintenance data:
 - .1 Submit maintenance and cleaning instructions for acoustical ceiling systems for incorporation into the maintenance manuals.
- .3 Maintenance materials:
 - .1 Deliver for maintenance use, 2% of each type and colour of suspension components and acoustical tiles used in the *Work*.
 - .2 Pack panels in suitable containers, clearly dated and identified as to type and location of installation in the *Work*, and store where directed by *Owner*.

1.5 Quality Assurance

- .1 Qualifications:
 - .1 Installers / applicators / erectors:
 - .1 Installers: Shall have 5 years' experience, minimum, in application of *Products*, systems and assemblies specified.
- .2 Mock-ups:
 - .1 Construct in locations acceptable to *Consultant* a typical sample ceiling installation 10 m² (108 ft²) in area, complete with perimeter wall trim. Modify sample as directed and as required to obtain approval. Upon acceptance retain sample as standard of quality for acoustical ceiling.
 - .2 Do not begin fabrication and erection of remainder of ceiling system until sample installation has been reviewed and accepted. Accepted sample may become a part of the final *Work*, subject of approval of *Consultant*.

1.6 Delivery, Storage, and Handling

- .1 Ship exposed members and mouldings in rigid crates to avoid damage. Bent or deformed material shall be rejected. Baked enamelled members shall be suitably wrapped and protected against damage.
- .2 Deliver acoustical ceiling units to the *Place of the Work* in original, unopened packages and store in a fully enclosed space where they will be protected against damage from moisture, direct sunlight, surface contamination, and other causes.
- .3 Before installing acoustical ceiling units, permit them to reach room temperature and stabilized moisture content.
- .4 Handle acoustical ceiling units carefully to avoid chipping edges or damaging units.

1.7 Field Conditions

- .1 Commence installation after building is enclosed with windows and exterior doors in place and glazed, and roof watertight.

Acoustical Tile Ceiling Systems

- .2 Interior temperature of building to range from 15°C to 30°C and relative humidity of not more than 70% before and during installation. Maintain uniform temperatures for 72 hours prior to commencement of the work of this section and maintain temperature until completion of the work of this section.

1.8 Warranty

- .1 Warrant work of this section in accordance with Section 01 78 36.
- .2 Extended warranties:
 - .1 System:
 - .1 Labour, materials, and workmanship for work of this section.
 - .2 Duration: 2 years.
 - .2 Manufacturer's *Product* warranty for the following:
 - .1 Acoustical tiles:
 - .1 Duration: 30 years.
 - .2 Suspension systems:
 - .1 Duration: 10 years.

PART 2 - PRODUCTS

2.1 Performance/Design Requirements

- .1 Design suspension systems for a maximum mid-span deflection not exceeding L/360 in accordance with ASTM C635/C635M-22 deflection test.
- .2 Design suspension system to support safely, and without distortion, the superimposed loads of:
 - .1 Air supply diffusers and return grilles.
 - .2 Lighting fixtures.

2.2 General

- .1 Single source responsibility: Obtain each type of acoustical ceiling unit and suspension system from a single source with resources to provide products of consistent quality in appearance and physical properties without delaying progress of the *Work*. Products installed as part of the work of this section shall be from same production run.

2.3 Acoustical Tiles

- .1 Lay-in acoustical tiles:
 - .1 Classification: Type _IV, Form 2, Pattern E in accordance with ASTM E1264-22.
 - .2 Size: 610 mm x 1220 mm (24" x 48").
 - .3 Suspension system: 15/16".
 - .4 NRC: 0.85.
 - .5 Material: Mineral fibre.

Acoustical Tile Ceiling Systems

- .6 Surface texture: Smooth.
- .7 Edge: Square lay-in.
- .8 Colour: White.
- .9 Flame spread:
 - .1 Maximum values in accordance with CAN/ULC-S102-10:
 - .1 Flame Spread Value (FSV): 25.
 - .2 Smoke Developed Value (SDV): 50.
- .10 Acceptable *Products*:
 - .1 In accordance with the Materials and Finishes Schedule.
 - .2 Substitutions: in accordance with Section 01 25 00.

2.4 Metal Suspension Systems

- .1 Hanger anchorage devices: Screws, clips, bolts, concrete inserts or other devices applicable to the indicated method of structural anchorage for ceiling hangers and whose suitability for use intended has been proven through standard construction practices or by certified test data. Size devices for 3 x calculated load supported except size direct pull-out concrete inserts for 5 x calculated loads.
- .2 Concrete hanger anchors; post installed: Steel eye bolts and nuts to suit ceiling hangers with capability to sustain, without failure, a load equal to 4 times that imposed by ceiling construction, as determined by testing per ASTM E488/E488M-22, conducted by a qualified independent testing laboratory.
 - .1 Dynabolt Sleeve Anchor 'TW-1614' or Rendi-Tie-Drive 'TD4-112' tie wire anchor by ITW Ramset/Red Head.
 - .2 Kwik-Bolt III 'HHDCA 1/4' tie wire anchor by Hilti Corporation.
 - .3 Fasteners exposed to weather, condensation, and corrosion: Zinc-plated or stainless steel fasteners in applicable product lines specified in preceding paragraphs.
- .3 Hangers and tie wire: Galvanized wire, recommended by manufacturer of suspension system, minimum 2.66 mm (0.1") (12 gauge).
- .4 Suspension system accessories:
 - .1 Splices, clips, and perimeter moulding, of manufacturer's standard type to suit the applicable conditions unless special conditions and access area are shown or specified.
 - .2 Angle wall mouldings; hemmed with prefinished exposed flanges:
 - .1 For 24 mm (15/16") grid applications; angle moulding with exposed bottom flange of 22 mm (7/8").
 - .1 Armstrong '7803'.
 - .2 Substitutions: in accordance with Section 01 25 00.

Acoustical Tile Ceiling Systems

- .5 Standard suspension system, non fire-rated:
 - .1 Intermediate duty in accordance with ASTM C635/C635M-22, 24 mm (15/16") interlocking tee system, designed to support acoustical panels in patterns indicated with deflection of main tees less than L/360, consisting of main tees and cross tees. The system shall provide lock joint intersections of cross and main tees.
 - .2 Acceptable *Products*:
 - .1 Armstrong 'Prelude XL 15/16" Exposed Tee Systems'.
 - .2 Substitutions: in accordance with Section 01 25 00.

2.5 Metal Finish

- .1 Metal exposed in finished work shall have a pre-coated baked enamel finish in non-yellowing colour. Submit paint formulation of grid system to lighting fixture, speaker grille, sprinkler and diffuser manufacturers to ensure consistency of colour, sheen and texture of all exposed metal components in the ceiling assemblies.
 - .1 Colour: Flat white.

PART 3 - EXECUTION

3.1 Installation - General

- .1 Install ceiling panels and metal suspension system in accordance with manufacturer's directions. Where manufacturer's directions are at variance with *Contract Documents*, notify *Consultant* before proceeding with installation.
- .2 Do not commence installation until all work above suspended ceiling has been completed, inspected and accepted.

3.2 Installation - Suspension System

- .1 Attach hangers to structure with inserts and hanger supports. Do not use powder activated fasteners.
- .2 Support hangers for suspended ceiling grid independent of walls, columns, pipes and ducts.
- .3 Space hangers for ceilings at maximum 1220 mm (48") on centre in both directions. Provide additional hangers as required to comply with manufacturer's written installation requirements.
- .4 Locate hangers at not more than 150 mm (6") from ends of main tee members.
- .5 Install exposed tee members to pattern indicated. Securely attach hangers to main tee members.
- .6 Exposed tees shall be as long as possible to minimize joints. Make joints square, tight, flush and reinforce with splines. Distribute joints to prevent clustering in one area.
- .7 Space tee bars to suit ceiling panels and as detailed, and to accommodate lighting fixtures, diffusers and return grilles.
- .8 Cooperate in the installation of ceiling systems, making adjustments where required to ensure that the lighting fixtures, supply diffusers, exhaust grilles and other built-in items properly fit into ceiling module and finish flush with rest of ceiling.

Acoustical Tile Ceiling Systems

- .9 Restrict creep inside module panels so that in all cases strips are centred on module lines.
- .10 Install edge moulding as detailed where ceiling abuts vertical surfaces. Lap corners, use maximum lengths to minimize joints. Make joints square, tight and flush.
 - .1 Screw attach mouldings to substrates at intervals not more than 400 mm (16") on centre and not more than 210 mm (8") from ends, levelling with suspension system. Lap corners accurately and connect securely.

3.3 Installation - Tiles

- .1 Take precautions during installation to ensure tile edges are not chipped or otherwise damaged.
- .2 Minimize field cutting. Rectify cut tile edges of tile to match factory cut edge profile and colour.
- .3 Install acoustical tiles to form horizontal and level ceiling with all parts flush and joints butted tightly to hairline appearance.
- .4 Distribute variations in colour and texture of panels to obtain a uniform appearance.

3.4 Installation - Tolerances

- .1 Allowable tolerances: in accordance with ASTM C636/C636M-19.
- .2 Install suspension systems level to tolerance of 1:1200.
- .3 Install edge mouldings level to tolerance of 3 mm in 3660 mm (1/8" in 12'-0").

3.5 Field Quality Control

- .1 Conduct quality control in accordance with Section 01 45 00 and as follows:
 - .1 Field tests and inspections:
 - .1 Independent inspection and testing company shall perform random load tests for ceiling anchor installation.

3.6 Adjusting and Cleaning

- .1 Replace uneven, defective or damaged materials and finishes, eliminate waves, remove soiled or stained areas.
- .2 Clean dirty and discoloured surfaces of acoustical units and suspension system according to manufacturer's recommendations.

END OF SECTION

PART 1- GENERAL

1.1 Summary

- .1 Section includes:
 - .1 Tactile attention indicators located at building interiors (TC-2).

1.2 Administrative Requirements

- .1 Conduct a pre-installation meeting in accordance with Section 01 31 19.
 - .1 Independent inspection and testing company shall attend the pre-installation meeting.

1.3 Submittals

- .1 Submit required submittals in accordance with Section 01 33 00.
- .2 *Product* data sheets:
 - .1 Submit manufacturer's *Product* data sheets for *Products* proposed for use in the work of this section.
- .3 Shop drawings:
 - .1 Submit shop drawings showing placement pattern and installation methods and coordination with work of other sections.
- .4 Samples:
 - .1 Submit full size samples of each type and colour of surfacing.
- .5 Test and evaluation reports:
 - .1 *Product* data sheets shall include material test reports from qualified independent testing laboratories, current within a 24 month period preceding date of installation, indicating that materials proposed for use in the *Work* are in compliance with the requirements of the *Contract Documents*, and meet the properties specified or indicated.

1.4 Closeout Submittals

- .1 Submit closeout submittals in accordance with Section 01 78 00.
- .2 Operation and maintenance data:
 - .1 Submit manufacturer's operation and maintenance instructions for inclusion in the operation and maintenance manuals.
- .3 Maintenance materials:
 - .1 Deliver 2% of each type of material installed in the *Work* for maintenance use. Store where directed. Clearly identify each box.
 - .2 Maintenance materials to be same production run as installed materials.

1.5 Quality Assurance

- .1 Qualifications:

Tactile Attention Indicators

.1 Installers:

- .1 Shall have 3 years' experience, minimum, in application of *Products*, systems and assemblies specified, and with approval and training of *Product* manufacturers.

.2 Mock-ups:

- .1 *Provide* a mock-up of each type of tactile attention indicators specified.
- .2 Locate at the *Place of the Work* as part of final installation.
- .3 Location of installation shall be determined by *Consultant*.

1.6 Warranty

- .1 Warrant work of this section in accordance with Section 01 78 36.
- .2 Extended warranty:
- .1 Labour, materials, and workmanship for work of this section.
- .2 Duration: 5 years.

PART 2 - PRODUCTS

2.1 Performance/Design Requirements

- .1 Conform to sentence (2) and Clauses 4.1.1 and 4.1.2 of ISO 23599, "Assistive Products for Blind and Vision-Impaired Persons – Tactile Walking Surface Indicators.

2.2 Stainless Steel Tactile Stud Indicators

- .1 Slip resistance: greater than 0.80 wet in accordance with ASTM C1028-07e1.
- .2 Stainless steel tactile indicators:
- .1 Fabricated from Type 316 stainless steel.
- .2 Dome size: in accordance with CSA/CSA B651-12.
- .3 Acceptable *Product*:
- .1 Kinesik 'Advantage One'.
- .2 Urban Access Solutions 'UAS-SS2218'.
- .3 Substitutions: in accordance with Section 01 25 00.

PART 3 - EXECUTION

3.1 Installation

- .1 Install in accordance with manufacturer's written requirements, or authorities having jurisdiction requirements, and in accordance with reviewed shop drawings.
- .2 Do not install surfacing over expansion joints or control joints.

3.2 Field Quality Control

- .1 Conduct quality control in accordance with Section 01 45 00.

Tactile Attention Indicators

- .2 Manufacturer's field review to be in accordance with Section 01 45 00.

3.3 Adjusting and Cleaning

- .1 Clean installed exposed surfaces by method recommended by product manufacturer.

3.4 Protection

- .1 Protect installation against damage during construction period in accordance with the tile manufacturer's requirements.

END OF SECTION

PART 1 - GENERAL

1.1 Summary

- .1 Section includes:
 - .1 Resilient base (B-2).
 - .2 Resilient floor reducer trims (B-3).

1.2 Administrative Requirements

- .1 Conduct a pre-installation meeting in accordance with Section 01 31 19.
 - .1 Independent inspection and testing company shall attend the pre-installation meeting.

1.3 Submittals

- .1 Submit required submittals in accordance with Section 01 33 00.
- .2 *Product* data sheets:
 - .1 Submit manufacturer's *Product* data sheets for *Products* proposed for use in the work of this section.
- .3 Samples:
 - .1 Selection samples:
 - .1 Submit manufacturer's range of pattern and colours available for *Consultant's* selection.
 - .2 Samples for verification: Submit 3 samples of the following:
 - .1 305 mm (12") long samples of each colour and type of base material. Include sample of outside corner of base.
 - .2 100 mm (4") long samples of each colour and type of floor reducer trims.
- .4 Manufacturer's instructions:
 - .1 Submit manufacturer's installation instructions for *Products* proposed for use in the work of this section.

1.4 Closeout Submittals

- .1 Submit closeout submittals in accordance with Section 01 78 00.
- .2 Operation and maintenance data:
 - .1 Submit manufacturer's operation and maintenance instructions for inclusion in the operation and maintenance manuals.
- .3 Maintenance materials:
 - .1 Provide minimum 2% of each colour, pattern and type of resilient base required for this project.
 - .2 Maintenance materials to be same production run as installed materials.

Resilient Base, Reducers, and Accessories

- .3 Suitably package for protection and storage, each identified with name of manufacturer and material.
- .4 Tag and store where directed by *Owner*.

1.5 Quality Assurance

- .1 Qualifications:
 - .1 Installers:
 - .1 Shall have 5 years' experience, minimum, in application of *Products*, systems and assemblies specified.
 - .2 Mock-up:
 - .1 Resilient base mock-up shall include at least one inside corner, one outside corner plus 20 m (65'-0") of straight run.
 - .2 Locate at the *Place of the Work* as part of final installation.
 - .3 Location of installation shall be determined by *Consultant*.

1.6 Field Conditions

- .1 Ambient conditions:
 - .1 Install materials of this section only when surfaces and air temperatures have been maintained between 21°C and 29.4°C for 7 days preceding installation, and will be so maintained during installation and for 48 hours thereafter. Maintain a minimum temperature of 13°C after above period.
 - .2 Verify that adequate ventilation is provided during installation and curing of materials of this section.
 - .3 Applications exposed to intense or direct sunlight, protect *Products* during the conditioning, installation, and adhesive curing periods, by covering the light source.
 - .4 Allow coiled material to lay flat for at least 24 hours at 18°C prior to installation, and maintain this temperature during installation.

1.7 Warranty

- .1 Warrant work of this section in accordance with Section 01 78 36.
- .2 Extended warranty:
 - .1 Labour, materials, and workmanship for work of this section.
 - .2 Duration: 2 years.

PART 2 - PRODUCTS

2.1 General

- .1 Single source responsibility: Obtain each type of resilient *Product* from a single source with resources to provide products of consistent quality in appearance and physical properties without delaying progress of the *Work*. Products installed as part of the work of this section shall be from same production run.

Resilient Base, Reducers, and Accessories

2.2 Resilient Base (B-2)

- .1 Rubber base types:
 - .1 Manufactured from thermoplastic rubber formulation meeting ASTM F1861-21, Type TS, Group 1 (Solid).
 - .2 Acceptable manufacturers:
 - .1 Mannington.
 - .2 Roppe.
 - .3 Tarkett.
 - .4 Substitutions: in accordance with Section 01 25 00.
 - .3 Rubber base; wall base:
 - .1 Acceptable *Products*:
 - .1 Tarkett 'Baseworks Rubber Wall Base', 3.2 mm (1/8") thick, complete with preformed inside and outside corners with 100 mm (4") returns.
 - .1 Profile: Coved.
 - .2 Height: 100 mm (4") high.
 - .3 Colour: In accordance with Materials and Finishes Schedule.
 - .2 Substitutions: in accordance with Section 01 25 00.

2.3 Resilient Floor Reducer Trims (B-3)

- .1 Rubber reducer:
 - .1 Material: PVC.
 - .2 Colour: In accordance with Materials and Finishes Schedule.
 - .3 Acceptable *Product*:
 - .1 Tarkett 'SS4-40-B'.
 - .2 Substitutions: in accordance with Section 01 25 00.

2.4 Accessories

- .1 Block wall filler: Filler type as recommended by resilient base manufacturer to suit substrate and compatible with materials.
- .2 Primers and adhesives: Types as recommended by resilient product manufacturer compatible with materials and to suit substrate types.
- .3 Sealant:
 - .1 Medium-modulus, neutral-curing silicone sealant; complying with ASTM C920-14, Type S, Grade NS.
 - .2 Colour: Clear.
 - .3 Acceptable manufacturers:
 - .1 Dowsil.

Resilient Base, Reducers, and Accessories

- .2 Momentive.
- .3 Tremco.
- .4 Substitutions: in accordance with Section 01 25 00.

PART 3 - EXECUTION

3.1 Examination

- .1 Verify that field conditions have been provided as requested and specified.
- .2 Substrates shall be firm, structurally sound, sufficiently porous, and dry.
- .3 Examine substrate to ensure clean lines, correct level and freedom from cracks, ridges, dusting, scaling and carbonation.
- .4 Examine substrates in advance of application of products to ensure that substrates are protected against entry of water and moisture.
- .5 Report conditions contrary to requirements preventing proper installation. Do not proceed with the installation until unsatisfactory conditions have been corrected.
- .6 Failure to call attention to defects or imperfections will be construed as acceptance and approval of the substrate. Installation indicates acceptance of substrates with regard to conditions existing at the time of installation.
- .7 Defective work resulting from application to unsatisfactory surfaces will be considered the responsibility of those performing the work of this section.

3.2 Preparation

- .1 Substrates shall be free of deleterious material that may inhibit bond strength or act as a bond breaker. Remove such contaminants and deleterious material using mechanical methods recommended by manufacturer. Do not use chemical abatement methods.
- .2 Fill gaps, voids, and cracks, and remove ridges, or other defects which will ghost or telegraph through finished product installation.
- .3 Expansion joints, isolation joints, and other movement joints in substrates shall not be filled with patching or levelling compound.
- .4 Notify *Consultant* of any substrate or levelling compound defects or installation conditions that may result in unsatisfactory performance.
- .5 Do not install products until they are same temperature as space where they are to be installed.
- .6 Sweep and vacuum clean substrates to be covered by floor coverings immediately before installation. Do not use sweeping compounds.
- .7 Where flooring adjoins thicker floor materials, apply levelling screed, feather out to make up difference in level between materials.
- .8 Spray paints, permanent markers and other indelible ink markers shall not be used to write on the back of the resilient material or used to mark the substrate as they could bleed through and permanently stain the resilient material. If such contaminants are present on the substrate they shall be mechanically removed prior to the installation of the resilient material.

3.3 Installation of Resilient Base

- .1 Spread adhesive to ribbed surface (back) of wall base with a 3 mm (1/8") square-notched trowel; allow slight set-up, then bring base into contact with substrate. Ensure full adhesion of base to substrate. Adhesive should cover 80% of back surface. Leave a 6 mm (1/4") uncovered space at the top of the wall base to prevent the adhesive from oozing onto the wall above the base when installed.
- .2 Position wall base on wall surface and roll with hand roller. Always roll back to starting point to prevent stretching the wall base.
- .3 Set base to ensure installation over finished flooring material is free of gaps.
- .4 Install base in longest lengths possible, minimum 2440 mm (8'). Adhere toe of base to substrate, and ensure edge of toe is straight.
- .5 Scribe and fit to door frames and other obstructions.
- .6 Joints shall be tightly fitted, straight and vertical, and not less than 610 mm (24") from corners.
- .7 *Provide* joints in base over substrate control joints.
- .8 Install factory preformed inside corners.
- .9 Install factory preformed outside corners.

3.4 Installation – Reducer Trims

- .1 Coordinate reducers with work of other sections and install reducer trim to transitions between different flooring types.
- .2 Installation of reducer trims in accordance with manufacturer's written requirements.

3.5 Installation Tolerances

- .1 Resilient base: Install straight and level to variation of 3 mm (1/8") over 3 m (10'-0").
- .2 Reducer trim: Install straight to variation of 3 mm (1/8") over 3 m (10'-0").

3.6 Field Quality Control

- .1 Conduct quality control in accordance with Section 01 45 00.
- .2 Manufacturer's field review to be in accordance with Section 01 45 00.

3.7 Adjusting and Cleaning

- .1 Remove adhesive from surfaces as work progresses in manner described by manufacturer.
- .2 Thoroughly clean surfaces in accordance with manufacturer's written requirements.

END OF SECTION

Vinyl Sheet Flooring

PART 1 - GENERAL

1.1 Summary

- .1 Section includes:
 - .1 Vinyl sheet flooring (FL-1, FL-2).
 - .2 Cove base with cove former (B-1).
 - .3 Floor threshold (TH-1, TH-2).

1.2 Administrative Requirements

- .1 Conduct a pre-installation meeting in accordance with Section 01 31 19.
 - .1 Independent inspection and testing company shall attend the pre-installation meeting.

1.3 Submittals

- .1 Submit required submittals in accordance with Section 01 33 00.
- .2 *Product* data sheets:
 - .1 Submit manufacturer's *Product* data sheets for *Products* proposed for use in the work of this section.
- .3 Shop drawings:
 - .1 Show sheet flooring roll and width layout as related to *Consultant's* floor pattern including borders and accents including where flooring materials meet other floor materials.
 - .2 Show locations of seams, floor drains, floor plates, and where flooring meets other flooring.
- .4 Samples:
 - .1 Selection samples:
 - .1 Submit manufacturer's range of pattern and colours available for *Consultant's* selection.
 - .2 Samples for verification:
 - .1 Submit sample of vinyl sheet flooring, minimum 150 mm (6") x 150 mm (6") of each different colour and pattern of vinyl sheet flooring.
 - .2 Submit sample of heat-welding bead, minimum 150 mm (6") length of each colour.
 - .3 Submit seam samples for each vinyl sheet flooring product and colour with heat-welded seam. Sample shall be a minimum of 150 mm (6") x 254 mm (10") and shall be adhered to a rigid backing material with the seam running lengthwise and in the center of the sample.
 - .4 Submit sample of fillet support at integral site formed flash cove bases,

Test and evaluation reports:

Vinyl Sheet Flooring

- .3 Submit moisture, alkalinity, and adhesive bond test results.

1.4 Closeout Submittals

- .1 Submit closeout submittals in accordance with Section 01 78 00.
- .2 Operation and maintenance data:
 - .1 Submit manufacturer's operation and maintenance instructions for inclusion in the operation and maintenance manuals.
- .3 Maintenance materials:
 - .1 Submit width of material x 2% of each colour in full running length, pattern and type flooring material required for this project for maintenance use.
 - .2 Maintenance materials to be same production run as installed materials.
 - .3 Suitably package for protection and storage, each identified with name of manufacturer and flooring material.
 - .4 Tag and store where directed by *Owner*.

1.5 Quality Assurance

- .1 Qualifications:
 - .1 Installers:
 - .1 Shall have 5 years' experience, minimum, in application of *Products*, systems and assemblies specified.
- .2 Mock-ups:
 - .1 Prior to commencing flooring installation for this section, prepare full room mock-up (room size at least 10 m² (100 ft²) in area) for acceptance by the *Consultant*.
 - .2 Mock-up shall include flooring showing edge treatment and relationships to adjoining surfaces.
 - .3 Location of installation shall be determined by *Consultant*.
 - .4 Do not proceed with flooring specified in this section until mock-up has been accepted by *Contractor* and *Consultant*.

1.6 Delivery, Storage, and Handling

- .1 Package flooring materials and identify contents of each package.
- .2 Store materials for a minimum of 24 hours immediately before installation to comply with temperatures specified under Field Conditions.
- .3 Store flooring rolls on end.

1.7 Field Conditions

- .1 Ambient conditions:

Vinyl Sheet Flooring

- .1 Install materials of this section only when surfaces and air temperatures have been maintained between 18.4°C and 29.4°C for 48 hours preceding installation, and will be so maintained during installation and for 48 hours thereafter. Maintain a minimum temperature of 13°C after above period. Relative humidity shall be 50 +/- 10%.
- .2 Ensure that adequate ventilation is provided during installation and curing of materials of this section.
- .3 In areas that are exposed to intense or direct sunlight, *Products* shall be protected during the conditioning, installation, and adhesive curing periods, by covering the light source.
- .4 Allow products to acclimatize in installation area for a minimum 24 hour prior to installation.

1.8 Warranty

- .1 Warrant work of this section in accordance with Section 01 78 36.
- .2 Extended warranty:
 - .1 Labour, materials, and workmanship for work of this section.
 - .2 Duration: 5 years.

PART 2 - PRODUCTS

2.1 Performance/Design Requirements

- .1 Slip resistance: Floors shall have a wet Dynamic Coefficient of Friction (DCOF) of 0.42 or greater in accordance with ANSI A326.3.
- .2 Vinyl sheet flooring shall not:
 - .1 Become stained or discoloured due to slab markings.
 - .2 Delaminate from substrates.
 - .3 Have welded seams which separate.

2.2 General

- .1 Single source responsibility: Obtain each *Product* from a single source with resources to provide products of consistent quality in appearance and physical properties, same production run. Products installed as part of the work of this section shall be from same production run.

2.3 Vinyl Sheet Flooring; FL-1, FL-2

- .1 Vinyl sheet flooring; without backing:
 - .1 In accordance with ASTM F1913-04(2014).
 - .2 Thickness: 2 mm (0.08").
 - .3 Colour/pattern:
 - .1 FL-1: In accordance with Materials and Finishes Schedule.
 - .2 FL-2: In accordance with Materials and Finishes Schedule.

Vinyl Sheet Flooring

- .4 Floor requires a PUR coating which shall be polish and sealer-free for the life of the floor as published by the manufacturer.
- .5 Physical properties:
 - .1 Chemical resistance: Pass, in accordance with ASTM F925.
- .6 Acceptable *Product*:
 - .1 Polyflor 'Palettone PUR'.
 - .2 Substitutions: in accordance with Section 01 25 00.

2.4 Cove Base; B-1

- .1 Cove base with cove former:
 - .1 Colour/pattern: In accordance with Materials and Finishes Schedule.
 - .2 Acceptable manufacturer:
 - .1 Polyflor.
 - .2 Substitutions: in accordance with Section 01 25 00.

2.5 Thresholds; TH-1, TH-2

- .1 TH-1; transition from vinyl flooring to concrete topping:
 - .1 Acceptable *Product*:
 - .1 Tarkett 'SSR-40-B 63', colour Burnt Umber.
 - .2 Substitutions: in accordance with Section 01 25 00.
- .2 TH-2:
 - .1 Acceptable *Product*:
 - .1 Schluter 'VINPRO-T VPTL 3/14 ATGB'.
 - .2 Substitutions: in accordance with Section 01 25 00.

2.6 Miscellaneous Materials

- .1 Seam construction:
 - .1 Hot welded joints, provide welding rod matched to floor pattern/colour selected.
 - .2 Colours: To later selection by *Consultant* from full colour range.
- .2 Primer/adhesives:
 - .1 Types as recommended by resilient flooring manufacturer compatible with materials and to suit substrate types and to comply with warranty requirements.
- .3 Patching and levelling compound:
 - .1 Trowel applied Portland cement based, moisture, mildew, and alkali-resistant.
 - .2 Minimum compressive strength after 28 days shall be minimum 3,500 psi when tested in accordance with ASTM C109/C109M-21 or ASTM C472.
 - .3 Gypsum based compounds are not acceptable.

Vinyl Sheet Flooring

- .4 Acceptable manufacturers:
 - .1 Ardex.
 - .2 Mapei.
 - .3 Substitutions: in accordance with Section 01 25 00.
- .5 Acceptable *Product*: type as recommended by flooring manufacturer.
- .4 Cleaning solution:
 - .1 Acceptable *Products*: type as recommended by flooring manufacturer.
- .5 Site fabricated flash cove base accessories:
 - .1 Resilient cove cap: at top of base.
 - .1 Acceptable *Product*:
 - .1 Schluter 'VINPRO-S VPS 30 ATG', brushed Nickel anodized aluminum trim.
 - .2 Substitutions: in accordance with Section 01 25 00.
 - .2 Plastic filler:
 - .1 Filler shall be used for sealing joints between top of integral cove wall base or integral cove cap and irregular wall surfaces.
 - .2 Filler shall be type as recommended by vinyl sheet flooring manufacturer.
 - .3 Fillet cove support strip:
 - .1 Minimum radius of 38 mm (1-1/2").
 - .2 Plastic fillet support shall be approved by vinyl sheet flooring manufacturer and approved by *Consultant*.
 - .3 Supply in product manufacture's longest lengths available.
- .6 Floor transition strips:
 - .1 Resilient transition trims (rubber reducer):
 - .1 Material: PVC.
 - .2 Colour: Burnt Umber.
 - .3 Acceptable *Product*:
 - .1 Tarkett 'SS4-40-B'.
 - .2 Substitutions: in accordance with Section 01 25 00.
- .7 Sealant: Mildew resistant sealant in accordance with Section 07 92 00.

PART 3 - EXECUTION

3.1 Examination

- .1 Verify that field conditions have been provided as requested and specified.

Vinyl Sheet Flooring

- .2 Verify that substrates have been provided as specified without holes, protrusions, cracks greater than 1.6 mm (0.06") wide, unfilled control joints, depressions greater than 3 mm (1/8") deep, or other major defects.
- .3 Substrates shall be firm, structurally sound, sufficiently porous, and dry.
- .4 Examine substrate to ensure clean lines, correct level and freedom from cracks, ridges, dusting, scaling and carbonation.
- .5 Examine floors in advance of application of flooring to ensure that floors are protected against entry of water and moisture. Perform compatibility test with primer/adhesive and substrate.
- .6 Report conditions contrary to requirements preventing proper installation. Do not proceed with the installation until unsatisfactory conditions have been corrected.
- .7 Failure to call attention to defects or imperfections will be construed as acceptance and approval of the substrate. Installation indicates acceptance of substrates with regard to conditions existing at the time of installation.
- .8 Defective work resulting from application to unsatisfactory surfaces will be considered the responsibility of those performing the work of this section.

3.2 Preparation

- .1 Comply with recommendations of ASTM F710-22.
- .2 Substrates shall be free of wax, oil, silicone, soap, grease, dust, solvents, sealers, curing compounds, hardeners, alkaline salts, excessive carbonation or laitance, mould, mildew, paints, varnish, asphalt, residual adhesives, adhesive removers, or other contaminants or deleterious material that may inhibit bond strength or act as a bond breaker. Remove such contaminants and deleterious material using mechanical methods recommended by manufacturer. Do not use chemical abatement methods.
- .3 Concrete substrates that are loose, sandy, scaly, or have a white powdery surface are not acceptable. Substrates shall be mechanically prepared.
- .4 Flooring substrates shall be smooth and level within a tolerance of 3 mm (1/8") in a 3 m (10'-0") radius.
- .5 Fill surface cracks, holes, score marks, depressions, and grooves, and repair surface spalls with Portland cement patching or levelling compound.
- .6 At door opening locations where finished flooring is adjacent to weather-stripping or automatic door bottoms provide trowel-applied levelling compound to provide full contact between finished flooring and weather-stripping or automatic door bottoms. Taper trowel-applied levelling compound to transition with adjacent flooring substrate to provide smooth and seamless transition at maximum slope of 3:1000 (height to distance) ratio.
- .7 Expansion joints, isolation joints, and other movement joints in substrates shall not be filled with patching or levelling compound.
- .8 Remove bumps, high spots, peaks and ridges to produce a uniform and smooth substrate.
- .9 Prepare substrates so that installation of flooring shall not show telegraphing of substrate.
- .10 Remove chalking and dusting and loose material from concrete surfaces with wire brushed or by scraping.

Vinyl Sheet Flooring

- .11 Sweep and vacuum clean substrates minimum 24 hours prior to alkalinity, moisture, and adhesion testing. Do not use sweeping compounds.
- .12 Notify *Consultant* of any substrate or levelling compound defects or installation conditions that may result in unsatisfactory performance.
- .13 Prepared concrete substrate shall have a finish equivalent to a magnesium trowel finish. Shiny, slick, non-porous, or overly porous substrates are not acceptable and shall require additional preparation prior to installation of flooring products. Prepared concrete substrates shall have a Concrete Surface Profile #3 to #5 in accordance with International Concrete Repair Institute (ICRI).
 - .1 Substrate to be approved in writing by flooring manufacturer prior to application of flooring.
 - .2 Submit written report to *Consultant* following procedures for manufacturer's field review in accordance with Section 01 45 00.
- .14 Alkalinity, moisture, and adhesion bond testing:
 - .1 Test substrates in accordance with paragraph 3.6 Field Quality Control after mechanically preparing subfloor or applying patching and levelling compounds.
 - .2 Proceed with installation only after substrates pass testing. Document tests performed and submit in writing to *Consultant*.
- .15 Do not install floor coverings until they are same temperature as space where they are to be installed.
 - .1 Move floor coverings and installation materials to acclimatize in spaces where they will be installed at least 48 hours in advance of installation.
- .16 Sweep and vacuum clean substrates to be covered by floor coverings immediately before installation. Do not use sweeping compounds.
- .17 Where flooring adjoins thicker floor materials, apply levelling screed, feather out to make up difference in level between materials to achieve flush floor finish between adjacent flooring materials unless otherwise indicated.
- .18 Spray paints, permanent markers and other indelible ink markers shall not be used to write on the back of the flooring material or used to mark the substrate as they could bleed through and permanently stain the flooring material. If such contaminants are present on the substrate they shall be mechanically removed prior to the installation of the flooring material.

3.3 Flooring Installation

- .1 Verify product type, size, thickness, and colour prior to commencing installation. Do not install flooring with visual imperfections, colour variations or apparent defects.
- .2 Allow material to relax unrolled overnight, minimum 12 hours in installation areas.
- .3 Install rolls and cuts in sequence following manufacturer's installation requirements/diagrams.
 - .1 Lay flooring with joints parallel to building lines to produce symmetrical pattern and minimum joints.

Vinyl Sheet Flooring

- .2 Place seams in inconspicuous and low-traffic areas, at least 150 mm (6") away from parallel joints in levelling underlayment, concrete joints, saw cuts and other type of joints.
- .3 Avoid cross seams.
- .4 Lay sheet flooring centered in corridors, with equal sized sheet to either side of center sheet.
- .5 Mitre intersections at corridors typically. "T" type corridors shall be butt type installation.
- .6 Terminate flooring at centerline of door in openings where adjacent floor finish or colour is dissimilar.
- .7 Layout seaming uniformly, using full length flooring typically, minimum flooring size of not less than roll width. Limit quantity of less than full length floor pieces at corridors to maximum of 1.
- .8 Layout flooring to match reviewed shop drawings floor pattern including borders and accents.
- .9 Match edges of floor coverings for colour shading at seams.
- .4 Cutting and fitting sheets:
 - .1 Cut pieces to length allowing approximately 75 mm (3") to 150 mm (6") excess for trimming.
 - .2 Remove 12.7 mm (1/2") off the factory seam edge using an edge trimmer or straight edge and knife.
 - .3 Cut sheet and fit neatly around fixed objects without gaps.
 - .4 Position remaining sheets so that the top sheet overlaps the previous sheet by 12.7 mm (1/2") to 19 mm (3/4").
 - .5 Install one sheet at a time in wet adhesive.
 - .6 Roll the flooring immediately in both directions using 45 kg (100 lb) three-section roller.
 - .7 After the material has been laid and rolled in wet adhesive, underscribe the seam using the short scribes with a scribed pin right away.
 - .8 Cut the material along the scribe line using a hooked blade knife and holding it at an angle so to slightly undercut the material.
 - .9 Roll the seam with a hand roller.
 - .10 Cross seams:
 - .1 Straight edge and undercut at an angle the end of the first sheet.
 - .2 Spread adhesive and lay in wet adhesive.
 - .3 Roll the flooring immediately in both directions using 45 kg (100 lb) three-section roller.
 - .4 Overlap the second sheet at butt seam approximately 25 mm (1").

Vinyl Sheet Flooring

- .5 Adhere second sheet except for last 450 mm (18") of butt seam; wait 20 – 30 minutes.
- .6 Spread the adhesive for the last 450 mm (18"), lay in material, underscribe the seam to a neat, fit cut, and roll flooring immediately in both directions using 45 kg (100 lb) three-section roller.
- .5 Install drain clamping rings.
- .6 As installation progresses, roll flooring with 45 kg (100 lb) three-section roller to ensure full adhesion, remove adhesive ridges, and entrapped air.
- .7 Where cove base is not required, seal joint at wall with manufacturer's approved sealant.
- .8 Apply adhesive uniformly and at spreading rates in accordance with adhesive manufacturer's requirements. Do not spread more adhesive than can be covered by flooring before initial set takes place.
- .9 Obtain 100% adhesive coverage to flooring backing.
- .10 Install flooring to entire area indicated or scheduled, including coverplates occurring within finished floor areas. Maintain overall continuity of colour and pattern with pieces of flooring installed on cover plates. Tightly butt edges to perimeter of floor around cover plates and to cover plates. Cut flooring to floor drains occurring within finished floor areas.
- .11 Heat-welded seams:
 - .1 Weld seams in accordance with ASTM F1516-13(2018).
 - .2 Wait minimum of 24 hours after flooring installation before grooving and heat welding seams.
 - .3 Prepare, weld, and trim seams to produce flat surfaces flush with adjoining floor covering surfaces.
 - .4 Rout joints to approximately 2/3 of the thickness of the material and use welding bead to permanently fuse sections into a seamless floor covering. Groove shall be between 3 mm (0.118") and 3.5 mm (0.138") wide.
 - .5 Using a weld plate and skiving knife to make first cut and allow weld rod to fully cure to room temperature.
 - .6 Using a skiving knife only, finish the trimming of the remainder of the weld. The finish should be smooth and on the same level as the flooring.
 - .7 Trimming of welded joint while warm is not permitted unless final trimming is performed after weld has cooled to flooring temperature. Excess weld shall be removed using a heated standard putty knife.
 - .8 Roll the seam area with 45 kg (100 lb) three-section roller.
 - .9 Maximum variation of welds from plane or from straight: 6 mm (1/4") in 3 m (10 ft) length using a 3 m (10 ft) straight edge.
- .12 Flooring installation shall not show telegraphing of substrate. Flooring installation shall be homogenous free of substrate lines, pockets, bumps and unevenness.

Vinyl Sheet Flooring

3.4 Prefabricated Flash Cove Base Installation

- .1 Butt joints to be square cut; inside and outside corners to be mitre cut on site using appropriate power mitre saw. Joints to be seam welded according to manufacturer's requirements.
- .2 Seal ends of cove, where the cove meets a doorframe, walls, and other surfaces with colour matched sealant.
- .3 Scribe and fit to door frames and other obstructions.
- .4 Joints shall be tightly fitted, straight and vertical, and not less than 610 mm (24") from corners.
- .5 *Provide joints in base over substrate control joints.*

3.5 Installation - Transition Trim

- .1 Protect exposed edges of flooring, where finished and unfinished areas adjoining, by means of a transition trim butting to and flush with the finished surface of the flooring covering material and securely adhered to the substrate material.
- .2 Coordinate transitions with work of other sections.
- .3 Allow coiled vinyl material to lay flat for at least 24 hours at ambient temperatures specified above prior to installation.
- .4 Set to ensure installation is free of gaps.
- .5 Install in longest lengths possible.
- .6 Install straight to maximum allowable variation of 3 mm (1/8") over 3 m (10'-0").
- .7 Scribe and fit to obstructions.
- .8 Fit joints tightly, straight and vertical as applicable and not less than 610 mm (24") from corners.
- .9 Mitre corners.

3.6 Field Quality Control

- .1 Conduct quality control in accordance with Section 01 45 00.
 - .1 Field tests and inspections:
 - .1 Moisture and alkalinity:
 - .1 Test for moisture vapour transmission in accordance with ASTM F710-22 and ASTM F1869-22 or ASTM F2170-19a in accordance with manufacturer's written flooring installation requirements. Results must not exceed 170 µg/m² (3 lb per 1,000 ft²) in 24 hours when tested to ASTM F1869-22, or exceed 75% when tested to ASTM F2170-19a.
 - .2 Test for surface pH. Levels of pH shall not exceed the written recommendations of the flooring manufacturer and adhesive manufacturer. Test in accordance with ASTM F710-22.
 - .3 For each test type: Conduct 3 tests for flooring applications up to 93 m² (1000 ft²) in area, and 1 additional test for each additional 93 m² (1000 ft²) of flooring area.

Vinyl Sheet Flooring

- .4 Testing shall be conducted by independent inspection and testing company and in accordance with Section 01 45 00.
- .2 Adhesion bond test:
 - .1 Proceed with bond test after substrates have been prepared and alkalinity and moisture test have been completed.
 - .2 Select six substrate test areas, each 915 mm (3'-0") x 915 mm (3'-0") in size. Test areas shall be spaced a minimum 1220 mm (48") apart.
 - .3 Cut 915 mm (3'-0") x 915 mm (3'-0") panels from specified material.
 - .4 Using the specified adhesive, glue down each panel using adhesive manufacturer's recommended trowel.
 - .5 After 72 hours, attempt to remove the panels of flooring by pulling up from the corners.
 - .6 Testing shall be conducted by independent inspection and testing company and in accordance with Section 01 45 00.
- .2 Manufacturer's field review to be in accordance with Section 01 45 00.

3.7 Adjusting and Cleaning

- .1 Remove excess adhesive from surfaces of the sheet flooring and base as work progresses.
- .2 Thoroughly clean surfaces in accordance with manufacturer's recommendations.

3.8 Protection

- .1 Prohibit foot traffic on installed flooring for a period of 24 hours after installation. No heavy traffic, rolling loads, or furniture placement are permitted for a minimum of 72 hours after installation.
- .2 Protect new floors from time of final set of adhesive until final inspection.
- .3 Install floor protection in areas where work, repairs and installation of equipment, and foot traffic will occur.

3.9 Maintenance

- .1 Perform initial maintenance according to the manufacturer's written requirements.
- .2 Allow flooring to dry prior to applying protection.

END OF SECTION

Epoxy Terrazzo

PART 1 - GENERAL

1.1 Summary

- .1 Section includes:
 - .1 Epoxy terrazzo floor to match existing (FL-5).
 - .2 Epoxy terrazzo coved base to match existing (B-4).
 - .3 Epoxy flash coved base (B-5).
 - .4 Patch, repair and make good existing terrazzo flooring and coved base to match existing.

1.2 Administrative Requirements

- .1 Conduct a pre-installation meeting in accordance with Section 01 31 19.

1.3 Submittals

- .1 Submit required submittals in accordance with Section 01 33 00.
- .2 *Product* data sheets:
 - .1 Submit manufacturer's *Product* data sheets for *Products* proposed for use in the work of this section.
- .3 Shop drawings:
 - .1 Submit shop drawings showing proposed location of divider, termination and transition strips. Indicate control joint locations and coordinate locations with slab control joints. Lay out divider strips symmetrically in rooms and as indicated.
- .4 Samples:
 - .1 Submit three - 200 mm x 300 mm (8" x 12") samples, on rigid backing, of each specified material and system, in each specified colour, for *Consultant* acceptance.
- .5 Certificates:
 - .1 Manufacturer's representative shall inspect surfaces and substrate preparations prior to material installation and submit written confirmation that substrates have been prepared in a manner which will not affect *Product* performance or warranty.
 - .2 Floor coating system manufacturer shall submit certificate of acceptance that installation meets their requirements.

1.4 Closeout Submittals

- .1 Submit closeout submittals in accordance with Section 01 78 00.
- .2 Operation and maintenance data:
 - .1 Submit manufacturer's operation and maintenance instructions for inclusion in the operation and maintenance manuals.

1.5 Quality Assurance

- .1 Qualifications:

Epoxy Terrazzo

- .1 Manufacturer qualifications:
 - .1 Company specializing in manufacturing the *Products* specified in this section, with 10 years' experience, minimum.
 - .2 Manufacturer shall be a member in good standing with the Terrazzo, Tile and Marble Association of Canada, providing materials meeting the industry standards of TTMAC.
- .2 Installers / applicators / erectors:
 - .1 A contractor Member of TTMAC whose work has resulted in construction with a record of successful in-service performance.
 - .1 Installer shall have completed terrazzo installations within the past 5 years of scale and complexity similar to the proposed installation.
 - .2 *Subcontractor* must be approved by the flooring system manufacturer. Submit *Subcontractor's* certification letter prepared by the flooring system manufacturer.
 - .3 Execute work of this section only under full time supervision of qualified *Subcontractor's* site supervisor.
- .2 Mock-up:
 - .1 Construct mock-up panel, 5 m² (53.8 ft²) minimum area, of each type of floor coating system, on-site as part of final installation for approval, location to be determined by *Consultant*.
 - .2 Mock-up will serve as a benchmark for installation of the flooring systems for the *Project*.
 - .3 Install a mock up at the cove base and transition to flush door frames.

1.6 Field Conditions

- .1 Maintain ambient temperature of not less than 13°C and below 29°C, and a floor temperature of not less than 16°C from 7 days before installation to at least 48 hours after completion of work of this section. Maintain relative humidity of not higher than 40% during same period.
- .2 Verify that substrate is sound, dry, free of dust, dirt, paint, grease, oil or other foreign substances that may adversely affect adhesion.
- .3 Protect adjacent surfaces from damage resulting from work of this section.
- .4 Commencement of installation implies acceptance of concrete surface as suitable to receive coating system.
- .5 Conduct the tests in accordance with ASTM F710-22 and the following:
 - .1 Test for moisture vapour transmission in accordance with ASTM F710-22 and ASTM F1869-22 or ASTM F2170-19a in accordance with manufacturer's written flooring installation requirements. Results must not exceed 170 µg/m² (3 pounds per 1,000 square feet) in 24 hours when tested to ASTM F1869-22, or exceed 75% when tested to ASTM F2170-19a.

Epoxy Terrazzo

- .2 Test for surface pH. Levels of pH shall not exceed the written recommendations of the flooring manufacturer and adhesive manufacturer. Test in accordance with ASTM F710-22.
- .3 For each test type: Conduct 3 tests for flooring applications up to 93 m² (1000 square feet) in area, and 1 additional test for each additional 93 m² (1000 square feet) of flooring area.

1.7 Warranty

- .1 Warrant work of this section in accordance with Section 01 78 36.
- .2 Extended warranty:
 - .1 Labour, materials, and workmanship for work of this section.
 - .2 Duration: 2 years.

PART 2 - PRODUCTS

2.1 Performance/Design Requirements

- .1 Terrazzo standards: Terrazzo Contractor shall furnish materials and install terrazzo according to TTMAC's "Terrazzo Specification Guide 09 66 00 - 2007" and with written recommendations for terrazzo type indicated unless more stringent requirements are specified.
- .2 Specification guides:
 - .1 Terrazzo, Tile and Marble Association of Canada (TTMAC) - Terrazzo Specification Guide 09 66 00 - 2007.
- .3 Material compatibility: Provide materials that are compatible with one another under conditions of service and application required, as demonstrated by manufacturer based on testing and field experience.
- .4 Slip resistance: Floors shall have a wet Dynamic Coefficient of Friction (DCOF) of 0.42 or greater in accordance with ANSI A326.3.

2.2 General

- .1 Source limitations for aggregates: Terrazzo *Subcontractor* shall obtain each colour, grade, type, and variety of granular materials from sources capable of providing materials of consistent quality in appearance and physical properties.
- .2 Components and *Products* of the epoxy matrix terrazzo system shall be manufactured and supplied by a single manufacturer.
- .3 Sealants: in accordance with Section 07 92 00.

2.3 Acceptable *Products*

- .1 General Polymers 'Epoxy Terrazzo 1100'.
- .2 Master Builders Solutions Canada 'Novaclad'.
- .3 Sika 'Sikafloor Terrazzo'.
- .4 Terrazzo & Marble Supply Company 'Terroxy Resin Systems'.

Epoxy Terrazzo

- .5 Substitutions: in accordance with Section 01 25 00.

2.4 Materials

- .1 Epoxy terrazzo flooring system, consisting of primer, 2 component solvent-free epoxy resin binder, aggregate filled topping, grout coat and sealer.
 - .1 Primer (if required by pre-job meetings): as recommended by epoxy resin manufacturer.
- .2 Marble chips:
 - .1 Size: Grade chips in accordance with TTMAC gradation standards.
 - .2 Abrasion and impact resistance: Not more than 40 percent loss when tested in accordance with ASTM C131/C131M-14.
 - .3 Chips shall contain no deleterious or foreign matter.
- .4 Terrazzo cleaner:
 - .1 Ph factor between 7 and 10, where applicable.
 - .2 Biodegradable and phosphate free.
- .5 Sealer:
 - .1 Ph factor between 7 and 10, where applicable.
 - .2 Shall not discolour or amber.
 - .3 Flash point; ASTM D-56, 80F minimum, where applicable.
 - .4 Finish: Slip Resistant.
- .3 Levelling; epoxy mortar filler and primer:
 - .1 Primer: Type as recommended by epoxy terrazzo manufacturer compatible with concrete substrate and epoxy mortar filler.
 - .2 Epoxy terrazzo manufacturers recommend mortar filler for levelling floor, patching, filling gaps, and holes.
- .4 Divider strips: to match existing grid pattern, depth to match flooring system thickness, to locations as indicated.
- .5 Termination strips: White alloy zinc, 'L' shaped, depth to match flooring system thickness, to locations as indicated.
- .6 Transition strips:
 - .1 *Acceptable Product:*
 - .1 Schluter 'Schiene-AE'.
 - .2 Substitutions: in accordance with Section 01 25 00.
- .7 B-5; Epoxy flash cove base:
 - .1 *Acceptable Product:*
 - .1 Schluter Schiene AE20 Edge Trim 3/32", aluminum satin finish.
- .8 Control joints: Back to back white alloy zinc strips with black neoprene filler.

Epoxy Terrazzo

- .9 Crack isolation membrane: 100% solids polyurethane, 500 microns (20 mils) DFT, as recommended by epoxy resin manufacturer.
- .10 Joint filler as recommended by floor system manufacturer.
 - .1 Substitutions: in accordance with Section 01 25 00.

2.5 Mixes

- .1 Terrazzo mix: To match existing and approved mock-up.
- .2 Proportions:
 - .1 Epoxy mortar fill: Mix design as recommended by epoxy terrazzo manufacturer.
 - .2 Terrazzo topping: Epoxy/marble mix as per manufacturer's installation requirements, colour pigment if scheduled, and sufficient potable water to produce a workable mix.
- .3 Mixing:
 - .1 Epoxy mortar fill: Mix in accordance with epoxy terrazzo manufacturer's written requirements.
 - .2 Terrazzo topping:
 - .1 Charge and mix marble chips, epoxy, and colour pigment if scheduled.
 - .2 Add water and mix to a uniform workable consistency.

PART 3 - EXECUTION

3.1 General

- .1 Prepare substrate and install epoxy terrazzo to provide durable flooring system free of defects and short and long term delamination.

3.2 Examination

- .1 Verify that specified environmental conditions are ensured before commencing work of this section.
- .2 Ensure that surfaces to receive floor coatings have been *Provided* as specified in the work of other sections, that they will not adversely affect execution, permanence, or quality of work of this section, and that they can be put into acceptable condition by means of preparation specified in this section.
- .3 Examine concrete slab surfaces for slope to drain irregularities which could create non-sloping or ponding conditions on the flooring system surface.
- .4 Notification
 - .1 If any substrate deficiency is apparent, notify *Contractor* in writing prior to commencing work of this section.

3.3 Preparation

- .1 After acceptance of surfaces, prepare them as required by the work of this section. Remove projections and other conditions that may affect the installation of the flooring system.

Epoxy Terrazzo

- .2 Fill open control joints, and other cracks and voids with sealant material compatible with floor coating materials.
- .3 Prepare surfaces by mechanical method of steel shotblast, sandblast, or other method approved by coating manufacturer in accordance with International Concrete Repair Institute (ICRI) recommendations to achieve a CSP 3 profile. Thoroughly vacuum clean floors upon completion of blast operation. Substrate to be approved in writing by manufacturer prior to application of coating.
 - .1 Submit written report to *Consultant* following procedures for manufacturer's field review in accordance with Section 01 45 00.
- .4 Cover or mask surfaces adjacent to those receiving floor coating to protect work of others and property from damage and soil.

3.4 Floor Levelling and Patching

- .1 Install in accordance with manufacturers and TTMAC's recommendations and guidelines.
- .2 Epoxy mortar filler and primer:
 - .1 Once surface preparation has been completed and accepted, primer shall be applied over entire area to receive epoxy mortar filler.
 - .2 Apply primer at recommended spreading rates and with recommended equipment.
 - .3 Allow primer to cure for recommended time period prior to applying epoxy mortar filler.
 - .4 Apply and screed mixed epoxy mortar onto substrate to desired compacted thickness.
 - .5 Allow to cure overnight.
 - .6 Fill voids with primer. Apply primer with manufacturer's recommended equipment and back roll to fill voids in surface. Coverage rates shall vary depending on porosity of surface.
 - .7 Allow to cure minimum 8 hours.

3.5 Installation

- .1 General:
 - .1 Apply coatings with care to ensure that no laps, voids, or other marks or irregularities are visible, and with an appearance of uniform colour, sheen and texture, all within limitations of materials and areas concerned.
 - .2 Match colours and textures of approved samples.
 - .3 Make clean true junctions with no visible overlap between adjoining applications of coatings.
 - .4 Place cloths and other disposable coating materials, that are a fire hazard, in closed metal containers and remove from building every night.
 - .5 Erect barriers to prevent the entry and presence of personnel not performing work of this section during application of coatings, and for 48 hours following completion of application.

Epoxy Terrazzo

- .6 Install flooring to entire area indicated or scheduled, including coverplates occurring within finished floor areas. Maintain overall continuity of colour and pattern with pieces of flooring installed on cover plates. Tightly butt edges to perimeter of floor around cover plates and to cover plates. Do not install flooring to floor drains occurring within finished floor areas.
- .2 *Provide* termination strips between dissimilar flooring materials and fill with sealant.
- .3 Carefully prepare and mix materials used in flooring work in compliance with flooring manufacturer's written requirements.
- .4 Flooring Application: Apply each component of flooring system in compliance with flooring manufacturer's directions to produce a smooth and uniform monolithic wearing surface of 9.5 mm (3/8") total dry film thickness, uninterrupted except at divider strips, or other types of joints, indicated or required.
 - .1 Primer coat: Apply primer over prepared substrate, at flooring manufacturer's recommended spread rate, with timing of application coordinated with subsequent application of topping mix to ensure optimum adhesion between flooring materials and substrates.
 - .2 Aggregate topping mix: Trowel apply aggregate topping mix over tacky primer and at spread rates required to produce minimum thickness specified. Allow topping to harden at least 24 hours prior to initiating grouting operations.
 - .3 Finishing: Rough grind with fine grit stones or with comparable diamond plates.
 - .4 Grout coat: Apply grout coat to fill surface voids. Allow to cure before washing and application of sealer.
 - .5 Fine grinding: Grind with fine grit stones until all grout is removed from surface.
 - .6 Finish overall terrazzo and strip surface shall be smooth, flush, and imperfections shall be indiscernible when viewed from distance of 762 mm (30").
 - .7 Cleaning and sealing: Wash all surfaces with a neutral cleaner. Rise with water and allow surface to dry. Apply 2 coats of sealer in accordance with flooring manufacturer's directions.
- .5 *Provide* termination strips at cove base and where epoxy terrazzo meets different flooring types. *Provide* grout on adjacent flooring surfaces suitable for level transition to epoxy terrazzo divider strip. *Provide* transition strips where indicated.
- .6 Match approved samples in sheen, colour and texture.
- .7 Joints: Where substrate is interrupted by expansion or control joints, *Provide* joint in flooring to comply with details indicated, or if not indicated, as recommended by flooring manufacturer.

3.6 Field Quality Control

- .1 Conduct quality control in accordance with Section 01 45 00.
- .2 Manufacturer's field review to be in accordance with Section 01 45 00.

3.7 Adjusting and Cleaning

- .1 Touch up and refinish minor defective work of this section. Refinish entire coated surface areas where finish is damaged or otherwise unacceptable.

Epoxy Terrazzo

- .2 Remove promptly, as work progresses, spilled or spattered coating materials from surfaces of work performed under other sections. Clean uncured flooring materials from surfaces in accordance with flooring manufacturer's written requirements. Removal of cured materials requires scraping, chipping, or grinding. Do not mar surfaces while removing. Clean floors on completion of work.
- .3 Leave storage and mixing areas in same condition as equivalent spaces in *Work*. Clean flooring just prior to final acceptance using materials and procedures recommended by flooring manufacturer.
- .4 Final cleaning is specified in Section 01 74 00.

END OF SECTION

Fluid-Applied Floor Coatings

Section revised by Addendum No. 02

PART 1 - GENERAL

1.1 Summary

- .1 Section includes:
 - .1 Fluid-applied (epoxy) flooring (FL-3, FL-4).

1.2 Administrative Requirements

- .1 Coordination:
 - .1 Advise other trades of fixtures and fittings not to be installed until floor coating materials are cured, such as: radiators, painting, decorating, floor-supported equipment or cabinetwork, caulking, plumbing, fixtures, and the like.
- .2 Conduct a pre-installation meeting in accordance with Section 01 31 19.
 - .1 Independent inspection and testing company shall attend the pre-installation meeting.

1.3 Submittals

- .1 Submit required submittals in accordance with Section 01 33 00.
- .2 *Product* data sheets:
 - .1 Submit manufacturer's *Product* data sheets for *Products* proposed for use in the work of this section.
- .3 Shop drawings:
 - .1 Submit shop drawings showing proposed divider strips and start / stop installation lines. Coordinate locations with slab control joints. Lay out divider strips symmetrically in rooms.
- .4 Samples:
 - .1 Submit 305 mm x 305 mm (12" x 12") samples of each specified material, in each specified colour to show successive applications of each coat for *Consultant's* approval.
 - .2 Submit 305 mm x 305 mm (12" x 12") sample of completed system on rigid backing, demonstrating texture and broadcast aggregate, colour, and sheen, for *Consultant's* approval.
- .5 Manufacturers' instructions:
 - .1 Submit substrate preparation guidelines, installation instructions, and general recommendations.
- .6 Submit for approval a list of the floor coating materials intended for use in the *Work* for each substrate condition before installation commences.
- .7 Include sample of warranty customized for this Project.
- .8 Submit list of recent projects completed by installation crew(s) proposed for work of this section available for viewing by *Consultant* and independent inspection and testing company.

Fluid-Applied Floor Coatings

Section revised by Addendum No. 02

1.4 Closeout Submittals

- .1 Submit closeout submittals in accordance with Section 01 78 00.
- .2 Operation and maintenance data:
 - .1 Submit manufacturer's operation and maintenance instructions for inclusion in the operation and maintenance manuals.

1.5 Quality Assurance

- .1 Qualifications:
 - .1 Manufacturers:
 - .1 Company specializing in manufacturing the *Products* specified in this section, with 10 years' experience, minimum.
 - .2 Installers / applicators / erectors:
 - .1 Applicators: Shall have 5 years' experience, minimum, in application of *Products* and systems specified and with approval and training of *Product* manufacturers.
 - .2 *Subcontractor* must be approved by the flooring system manufacturer. Submit *Subcontractor's* certification letter prepared by the flooring system manufacturer.
 - .3 Execute work of this section only under full time supervision of qualified *Subcontractor's* site supervisor.
- .2 Mock-ups:
 - .1 *Provide* mock-up panel 5 m² (53.8 ft²) minimum area, of coating system at the *Place of the Work* as part of final installation for approval by *Consultant*, location to be determined by *Consultant*. Mock-up will serve as a benchmark for installation of the system for the *Work*.

1.6 Field Conditions

- .1 Ambient conditions:
 - .1 Unless required otherwise by manufacturer's installation requirements maintain ambient temperature of not less than 13°C and below 32°C, and a floor temperature of not less than 16°C from 24 hours before installation to at least 72 hours after installation. Maintain relative humidity of not higher than 80% during same period.
 - .2 Ensure that adequate ventilation is provided during installation and curing of materials of this section.

1.7 Delivery, Storage, and Handling

- .1 Deliver materials to the *Place of the Work* in sealed undamaged containers clearly labelled with name and batch number.

Fluid-Applied Floor Coatings

Section revised by Addendum No. 02

1.8 Warranty

- .1 Warrant work of this section in accordance with Section 01 78 36.
- .2 Extended warranty:
 - .1 Labour, materials, and workmanship for work of this section.
 - .2 Duration: 2 years.

PART 2 - PRODUCTS

2.1 Performance/Design Requirements

- .1 Material compatibility: Provide materials that are compatible with one another under conditions of service and application required, as demonstrated by manufacturer based on testing and field experience.
- .2 Slip resistance: Floors shall have a wet Dynamic Coefficient of Friction (DCOF) of 0.32 or greater in accordance with ANSI A326.3.
- .3 Floors and wall coatings shall not show spalling, cracking, or delamination.

2.2 General

- .1 Installation of systems specified in this section to be by a single *Subcontractor*.
- .2 Materials shall be sourced from one manufacturer unless otherwise specified.

2.3 Epoxy Flooring System (FL-3, FL-4)

- .1 Solid colour, high solids, self-priming, glossy epoxy resin coating.
 - .1 Colours:
 - .1 FL-3: In accordance with Materials and Finishes Schedule.
 - .2 FL-4: In accordance with Materials and Finishes Schedule.
 - .3 FL-4b: In accordance with Materials and Finishes Schedule.
 - .2 Sheen: Glossy.
 - .3 Surface texture: Slip resistant, for dry and wet conditions.
 - .1 FL4b; anti-slip aggregate:
 - .1 Acceptable *Product*:
 - .1 Sika 'Sikafloor -4 Texture'.
 - .2 Substitutions: in accordance with Section 01 25 00.
 - .4 Physical requirements:
 - .1 Compressive strength: 56 MPa (8122 psi), in accordance with ASTM D675-15.
 - .2 Tensile strength: 7.4 MPa (1073 psi), in accordance with ASTM 638-22.
 - .3 Hardness: 76, ASTM D2240/Shore D Durometer.
 - .4 VOC Content: 50 g/L maximum.

Fluid-Applied Floor Coatings

Section revised by Addendum No. 02

.5 Abrasion Resistance: 0.10 g max. weight loss, in accordance with ASTM D4060-14, Taber Abrader CS-17 wheel, 1000 g load, 1000 cycles.

.6 Flammability:

.1 Flame spread:

.1 Not greater than 0, in accordance with CAN/ULC S102.2-10.

.5 Thickness: 2-3 mm.

.2 Acceptable *Products* and Manufacturers:

.1 Sika 'Sikafloor -261CA'.

.2 Substitutions: in accordance with Section 01 25 00.

PART 3 - EXECUTION

3.1 Examination

- .1 Verify that specified field conditions are ensured before commencing the work of this section.
- .2 Examine surfaces to receive floor and wall coatings. Surfaces shall be smooth, sound, dry, and free from conditions that will adversely affect execution, permanence, or quality of work.
- .3 Verify that surfaces to receive coatings can be put into acceptable condition by means of preparation specified in this section.
- .4 Floor surfaces to receive coating shall be equivalent to a light steel trowel finish for new or patched concrete surface.
- .5 Examine floor surfaces to be coated for slope to drain irregularities which could create non-sloping or ponding conditions on the epoxy coating surface.
- .6 Verify that floor drains are installed flush with top of floor slabs.
- .7 Defective work resulting from application to unsatisfactory surfaces will be considered the responsibility of those performing the work of this section.
- .8 Commencement of installation implies acceptance of surfaces as suitable to receive coating system.

3.2 Preparation

- .1 After acceptance of surfaces, prepare them as required to receive the work of this section. Remove projections and other conditions that may affect the installation of the flooring system.
- .2 Concrete slabs shall have sound surface free of dust, chemicals, grease, oil, laitance and curing agents.
- .3 Remove curing compounds, surface hardeners, existing flooring adhesives, and epoxy flooring coatings in accordance with manufacturer's written recommendations.
- .4 Fill open control joints, and other cracks and voids with sealant material compatible with floor coating materials.

Fluid-Applied Floor Coatings

Section revised by Addendum No. 02

- .5 Remove projections and other conditions which may affect installation of the coating.
- .6 Repair surface spalls and imperfections with patching compound approved by manufacturer.
- .7 Test surfaces for moisture content to verify that they are suitable for application, and fully cured. Check moisture content of concrete using a Delmhorst moisture meter. Moisture content shall be within the limits set by the coating manufacturer prior to commencing work.
- .8 Prepare concrete surfaces by mechanical method of steel shotblast, sandblast, or other method approved by coating manufacturer in accordance with International Concrete Repair Institute (ICRI) recommendations to achieve a CSP 3 profile. Thoroughly vacuum clean floors upon completion of blast operation. Substrate to be approved in writing by manufacturer prior to application of coating.
 - .1 Submit written report to *Consultant* following procedures for manufacturer's field review in accordance with Section 01 45 00.
- .9 Cover or mask surfaces adjacent to those receiving coating to protect work of others and property from damage and soil.

3.3 Installation

- .1 General:
 - .1 Apply coatings with care to ensure that no laps, voids, or other marks or irregularities are visible, and with an appearance of uniform colour, sheen and texture, all within limitations of materials and areas concerned.
 - .2 Match colours and textures of approved samples.
 - .3 Make clean true junctions with no visible overlap between adjoining applications of coatings.
 - .4 Install flooring to entire area indicated or scheduled, including coverplates occurring within finished floor areas. Maintain overall continuity of colour and pattern with pieces of flooring installed on cover plates. Tightly butt edges to perimeter of floor around cover plates and to cover plates. Do not install flooring to floor drains occurring within finished floor areas.
 - .5 Place cloths and other disposable coating materials, that are a fire hazard, in closed metal containers and remove from building every night.
 - .6 Verify that spark-proof electrical equipment is used in area where inflammable materials are being applied.
 - .7 Erect barriers to prevent the entry and presence of personnel not performing work of this section during application of coatings, and for 48 hours following completion of application.
 - .8 Apply coating system in compliance with coating manufacturer's directions to produce a pinhole free surface that also provides a positive slope to drains in flooring system.
 - .9 Apply coatings in continuous manner, starting and stopping in straight lines centre at doorways or other building lines; haphazard installation continuation lines will not be permitted.

Fluid-Applied Floor Coatings

Section revised by Addendum No. 02

.2 Application; flooring system:

- .1 Terminate flooring in straight lines at centreline of door in openings where adjacent floor finish or colour is dissimilar.
 - .2 Trowelled or broadcast installation shall not show telegraphing of substrate or trowel or toolmarks.
 - .3 Trowelled or broadcast installation shall be homogenous free of substrate lines, pockets, bumps and unevenness greater than 1.5 mm (1/16") in 300 mm (12"), not including texture.
 - .4 Prime coat: mix components and apply primer over prepared substrate at manufacturer's recommended spreading rate, with timing of application coordinated with subsequent application of topping mix to ensure optimum adhesion between flooring materials and substrate.
 - .5 Body coat: mix components and trowel apply body coats over tacky primer at spreading rates as recommended by manufacturer. Broadcast aggregate into wet body coat. Build up flooring system as required to provide positive slope to drains.
 - .6 Clean surface prior to application of finish coat for approval by *Consultant*.
 - .7 Finish coats: Squeegee apply finish coats over tacky primer at spreading rates as recommended by manufacturer.
 - .8 Provide zinc termination strips, of appropriate thickness, where flooring system meets different flooring types.
- .3 Use saw cut and chip method at termination locations unless otherwise indicated.
- .4 Joints: Where substrate is interrupted by expansion or control joints, provide joint in coating system to comply with details indicated, or if not indicated, as recommended by coating system manufacturer. Fill joints with specified compounds.
- .5 Match approved samples in sheen, colour and texture.

3.4 Field Quality Control

- .1 Conduct quality control in accordance with Section 01 45 00 and as follows:
 - .1 Field tests and inspections:
 - .1 Moisture and alkalinity:
 - .1 Test for moisture vapour transmission in accordance with ASTM F1869-22 in accordance with manufacturer's written installation requirements. Maximum percentage of moisture acceptable is 1.8 kg/93 m² (4 lb/1000 ft²) in a 24 hour period, unless otherwise specified by manufacturer's printed literature.
 - .2 Test for surface pH. Levels of pH shall not exceed the written recommendations of the flooring manufacturer and adhesive manufacturer. Test in accordance with ASTM F710-22.
 - .3 For each test type: Perform 3 tests for flooring applications less than 186 m² (2000 square feet) in area, and 1 test per additional 93 m² (1000 square feet).

Fluid-Applied Floor Coatings

Section revised by Addendum No. 02

- .4 Testing shall be by independent inspection and testing company and in accordance with Section 01 45 00.
- .2 Coating thickness:
 - .1 Verify to Tooke thickness gauge, and in the presence of *Consultant* and manufacturer's representative, that thicknesses of completed coatings meet specified requirements.
 - .2 Perform cut through/coring tests where selected by *Consultant* 1 per 93 m² (1000 ft²) in finished areas to determine thicknesses and finishes of epoxy coatings.
 - .3 *Contractor* shall repair areas as a result of inspection and testing work.
- .3 Manufacturer's field review to be in accordance with Section 01 45 00.

3.5 Adjusting and Cleaning

- .1 Touch up and refinish minor defective work. Refinish entire coated surface areas where finish is damaged or otherwise unacceptable.
- .2 Remove promptly as work progresses spilled or spattered coating materials from surfaces of work performed under other sections. Clean surfaces on completion of work. Do not mar surfaces while removing.
- .3 Leave storage and mixing areas in same condition as equivalent spaces in project. Clean flooring just prior to final acceptance using materials and procedures recommended by flooring manufacturer.
- .4 Final cleaning is specified in section 01 74 00.

END OF SECTION

Acoustic Wall Panels

PART 1 - GENERAL

1.1 Summary

- .1 Section includes:
 - .1 Acoustic wall panels (AP-1, AP-2, AP-3, AP-4).

1.2 Administrative Requirements

- .1 Coordination:
 - .1 Coordination of work: coordinate layout and installation of acoustic wall panels and support systems components with other work supported by or penetrating through acoustic wall panel systems.
- .2 Conduct a pre-installation meeting in accordance with Section 01 31 19.

1.3 Submittals

- .1 Submit required submittals in accordance with Section 01 33 00.
- .2 *Product* data:
 - .1 Submit *Product* data sheets for work of this section, complete with required anchors.
- .3 Shop drawings:
 - .1 Submit shop drawings, indicating panel layout and system components, for each panel system.
 - .2 Include plans, elevations, sections and large scale details, and indicate components and methods of assembly, materials and their characteristics, fastenings, finishes, and other fabrication information required for the work of this section. Indicate assembly joint lines.
 - .3 Submit coordination drawings indicating locations of concealed grounds, cutouts, plates, and other required fabrications.
 - .4 Show relation to adjoining construction, details of outside and inside corners and door openings.
- .4 Samples:
 - .1 Submit 2 - 300 mm x 300 mm (12" x 12") samples of each component of panel system to *Consultant* for review.
 - .2 Samples shall fully represent materials to be supplied in colour, texture, finish and construction.
- .5 Acoustic data:
 - .1 Submit acoustic data verifying that *Products* meet specified acoustic design requirements.

Acoustic Wall Panels

- .2 Acoustic data shall include detailed descriptions of both mounting method and test method used to calculate acoustical performance, complete with references to codes and standards used in such calculations.
- .3 Acoustic data submitted shall be from a certified acoustic testing agency.

1.4 Closeout Submittals

- .1 Submit closeout submittals in accordance with Section 01 78 00.
- .2 Operation and maintenance data:
 - .1 Submit manufacturer's operation and maintenance instructions for inclusion in the operation and maintenance manuals.
- .3 Maintenance materials:
 - .1 Maintenance materials: At completion, hand over to the *Owner* an additional 1% of each type of fabric installed in the *Work*.

1.5 Quality Assurance

- .1 Qualifications:
 - .1 Installers:
 - .1 Shall have 5 years' experience, minimum, in application of *Products*, systems and assemblies specified and with approval and training of *Product* manufacturers.
- .2 Mock-ups:
 - .1 Submit 300 mm x 300 mm (12" x 12") mock-up of each acoustical wall panel system, for review and acceptance by *Consultant*.
 - .2 Install at the *Place of the Work* a pre-selected mock-up of full size panel system.
 - .3 Obtain *Consultant's* acceptance of surface, finish and workmanship as a standard by which remainder of the *Project* will be judged. Apply material in accordance with manufacturer's written application requirements. Mock-up must be approved and accepted prior to start of system application. Maintain mock-up during construction for workmanship comparison. Do not alter, move or destroy mock-up until the work is completed and approved by *Consultant*.

1.6 Delivery, Storage, and Handling

- .1 Ship panels in rigid crates to avoid damage. Bent or deformed material shall be rejected.
- .2 Deliver panels and system components to the *Place of the Work* in original, unopened packages and store in a fully enclosed space where they will be protected against damage from moisture, direct sunlight, surface contamination, and other causes.
- .3 Before installing panels, permit them to reach room temperature and stabilized moisture content. Acclimatization period shall be 24 hours, minimum, longer as recommended by panel manufacturer.
- .4 Handle panels carefully to avoid chipping edges or damaging units in any way.

Acoustic Wall Panels

1.7 Warranty

- .1 Warrant work of this section in accordance with Section 01 78 36.
- .2 Extended warranty:
 - .1 Labour, materials, and workmanship for work of this section.
 - .2 Duration: 2 years.

PART 2 - PRODUCTS

2.1 General

- .1 Single source responsibility: Obtain system components for each panel system type from a single source with resources to provide *Products* of consistent quality in appearance and physical properties without delaying progress of the *Work*.
- .2 Flammability
 - .1 Fabric must conform to a flamespread rating of 25 or under in accordance with CAN/ULC-S102-10.
 - .2 Fabrics that do not meet the CAN/ULC-S102-10 test requirements will be flame treated to meet NFPA 701-2010 Small or Large Scale Vertical Burn tests unless inherently flame retardant.

2.2 Acoustic Panels (AP-1, AP-4)

- .1 Materials:
 - .1 Core: Resin edge-hardened 96 kg/m³ (6 lb/ft³) fibreglass, 25.4 mm (1") thick.
 - .2 Fabric:
 - .1 Colours: as indicated or scheduled.
 - .1 AP-1: Silver Papier 538.
 - .2 AP-4: Lime 721.
 - .2 Acceptable *Product*:
 - .1 Guildford of Maine 'FR701 2100'.
 - .2 Substitutions: in accordance with Section 01 25 00.
 - .3 Finish: Defense antimicrobial treatment.
 - .1 Acceptable *Product*:
 - .1 Duvaltex 'Defense Antimicrobial Finish Treatment'.
 - .2 Substitutions: in accordance with Section 01 25 00.
- .2 Acoustical performance: NRC 0.85 minimum.
- .3 Edge option: square edge.
- .4 Shapes: as indicated.
- .5 Panel widths: as indicated.

Acoustic Wall Panels

.6 Flammability

- .1 Fabric must conform to a flamespread rating of 25 or under in accordance with CAN/ULC-S102-10.
- .2 Fabrics that do not meet the CAN/ULC-S102-10 test requirements will be flame treated to meet NFPA 701-2010 Small or Large Scale Vertical Burn tests unless inherently flame retardant.

.7 Basis of design:

- .1 Decoustics (Certainteed) Acoustic Wall Panels AP.

.8 Subject to compliance with requirements of the Contract Documents, *Products* from the following manufacturers may be acceptable on written approval of the *Consultant*:

- .1 Akouo Acoustics.
- .2 Substitutions: in accordance with Section 01 25 00.

2.3 Acoustic Panels - Impact Resistant (AP-2, AP-3)

.1 Materials:

- .1 Core: Resin edge-hardened 96 kg/m³ (6 lb/ft³) fibreglass, 28 mm (1-1/8") thick, with 3.2 mm (1/8") thick high density 288 kg/m³ (18 lb/ft³) acoustically transparent component bonded to fibreglass.
- .2 Fabric:
 - .1 Colours: as indicated or scheduled.
 - .1 AP-2: Silver Papier 538.
 - .2 AP-3: Sky 740.
 - .2 Acceptable *Product*:
 - .1 Guildford of Maine 'FR701 2100'.
 - .2 Substitutions: in accordance with Section 01 25 00.
- .3 Pro panel and HIT panel.
- .4 Finish:
 - .1 Acceptable *Product*:
 - .1 Duvaltex 'Defense Antimicrobial Finish Treatment'.
 - .2 Substitutions: in accordance with Section 01 25 00.

.2 Acoustical performance: NRC 0.90 minimum.

.3 Edge option: square.

.4 Corner: as indicated.

.5 Shapes: as indicated.

.6 Panels widths shall be as indicated.

.7 Flammability

Acoustic Wall Panels

- .1 Fabric must conform to a flamespread rating of 25 or under in accordance with CAN/ULC-S102-10.
- .2 Fabrics that do not meet the CAN/ULC-S102-10 test requirements will be flame treated to meet NFPA 701-2010 Small or Large Scale Vertical Burn tests unless inherently flame retardant.
- .8 Acceptable *Product*:
 - .1 Decoustics (Certaineed) High Impact Resistant/Tackable H.I.R #1.
 - .2 Substitutions: in accordance with Section 01 25 00.

PART 3 - EXECUTION

3.1 Examination

- .1 Gypsum board assemblies shall be taped and sanded by Section 09 29 00 and painted in accordance with Section 09 91 00 and shall not permit any air leakage through wall.
- .2 Concrete masonry unit walls shall have flush joints and painted in accordance with Section 09 91 00 and shall not permit any air leakage through wall.
- .3 Do not proceed with installation until unsatisfactory conditions have been corrected. Beginning of installation indicates acceptance of existing substrate conditions.
- .4 Do not start installation until exterior glazing has been completed and exterior openings are closed in. Ensure wet work is completed and dried out to a degree acceptable to panel manufacturer before installation is commenced. Maintain uniform temperatures of at least 16°C for 72 hours prior to commencement of the work of this section and maintain temperature until completion of the work of this section.
- .5 Do not commence installation until work of other sections behind panels has been completed, inspected and accepted by *Consultant*.

3.2 Installation - Panels

- .1 Install acoustical panels to clean, dry and firm substrates in accordance with manufacturer's written requirements.
- .2 Install system in accordance with manufacturer's written installation requirements.
- .3 Panel arrangements as indicated. Maintain dimensions and contours as indicated. Coordinate layout with *Consultant* prior to commencing installation.
- .4 Make allowance for thermal movement.
- .5 Panels shall have no visible fastenings.
- .6 Install fabric systems with matching grain patterns and textures, level, plumb and true free from wrinkles, sags, blisters, waves, and ripples. Installed fabric shall not puddle or dent when touched or leaned upon. Installed fabric shall be self-healing when pushed, punched, or hit and shall revert back to original finished condition.
- .7 Seaming of fabric by sewing is not permitted.
- .8 Mounting methods:
 - .1 Shop built panels:

Acoustic Wall Panels

- .1 Direct mounted with concealed slide and engage z-clips and wall clips above 1830 mm (72") only.
- .2 Where corner of substrate wall is not 90° and panels butt in corner, cut one panel with bevelled edge so panels butt and no gap is exposed.
- .3 Provide 3 mm (0.12") vertical reveal between panels and 20 mm (0.8") horizontal reveal at 2124 mm (83.6") above finished floor.

3.3 Installation Tolerances

- .1 Install panels plumb, level, tight, rigid, and secured.
- .2 Comply with the following maximum tolerances:
 - .1 Plumb and level: 3 mm (1/8").
 - .2 Variation from indicated position: plus/minus 3 mm (1/8").
 - .3 Maximum variation of reveal widths: plus/minus 1.5 mm (1/16").
 - .4 Maximum variation of surfaces intended to be flush: plus/minus 1.5 mm (1/16").

3.4 Adjusting and Cleaning

- .1 Examine work of this section on completion and replace uneven or defective materials, eliminate all waves, remedy damaged exposed finished surfaces and remove soiled or stained areas.

END OF SECTION

Wall Protection

PART 1 - GENERAL

1.1 Summary

- .1 Section includes:
 - .1 Wall protection system (WP-1).

1.2 Administrative Requirements

- .1 Coordination:
 - .1 Coordination of work: coordinate layout, penetrations and installation of work of this section with work of other sections.
- .2 Conduct a pre-installation meeting in accordance with Section 01 31 19.

1.3 Submittals

- .1 Submit required submittals in accordance with Section 01 33 00.
- .2 *Product* data:
 - .1 Submit *Product* data sheets for *Products* proposed for use in the work of this section.
- .3 Shop drawings:
 - .1 Submit shop drawings to show layout, treatment at walls, and other objects. Indicated details of proposed treatment where materials meet other materials.
- .4 Samples:
 - .1 Submit sample panels in triplicate on 305 mm x 305 mm (12"x 12") showing each finish and colour.
 - .2 Submit samples of each accessory type product specified.
 - .3 Identify each sample as to project, finish, colour name, number.

1.4 Closeout Submittals

- .1 Submit closeout submittals in accordance with Section 01 78 00.
- .2 Operation and maintenance data:
 - .1 Submit manufacturer's operation and maintenance instructions for inclusion in the operation and maintenance manuals.

1.5 Quality Assurance

- .1 Qualifications:
 - .1 Installers: Shall have 5 years' experience, minimum, in application of *Products*, systems and assemblies specified and with approval and training of *Product* manufacturers.
- .2 Mock-ups:

Wall Protection

- .1 *Provide full size panel system mock-up of each panel system, for review and acceptance by Consultant. Locate at the Place of the Work where directed by the Consultant.*

1.6 Field Conditions

- .1 Install hygienic wall system only when surfaces and air temperatures have been maintained between 18°C and 26°C for twenty four (24) hours preceding installation, and will be so maintained during installation and for forty eight (48) hours thereafter.
- .2 Commence installation after building has been enclosed and dust generating activities have been completed.
- .3 Ensure that adequate ventilation is provided during installation and curing of adhesive.

1.7 Delivery, Storage and Handling

- .1 Package materials and identify contents of each package.
- .2 Store materials for a minimum of 8 hours before installation on a solid flat surface and preconditioned for approximating the operating environment of the finished room.

1.8 Warranty

- .1 Warrant work of this section in accordance with Section 01 78 36.
- .2 Extended warranty:
 - .1 System:
 - .1 Labour, materials, and workmanship for work of this section.
 - .2 Duration: 2 years.

PART 2 - PRODUCTS

2.1 Performance/Design Requirements

- .1 Flame spread:
 - .1 Maximum values in accordance with CAN/ULC-S102-10:
 - .1 Flame Spread Value (FSV): 15.
 - .2 Smoke Developed Value (SDV): 200.

2.2 Wall Protection System (WP-1)

- .1 Description:
 - .1 Impact resistant, water-resistant, low VOC, antimicrobial, PVC wall system.
 - .2 Surface: smooth.
 - .3 Antimicrobial: HACCP certified.
 - .4 Impact resistance: in accordance with ASTM D5420-21, exceeds 160 inch lbs.
 - .5 Fungi resistance: zero, in accordance with ASTM G21-15(2021)e1.
 - .6 Mold resistance: 10, in accordance with ASTM D3273-21.

Wall Protection

- .7 Finish: in accordance with Materials and Finishes Schedule.
- .8 Colour: in accordance with Materials and Finishes Schedule.
- .9 Acceptable *Product*:
 - .1 Altro 'Whiterock', as distributed by Compass.
 - .2 Substitutions: in accordance with Section 01 25 00.
- .2 Panel fixing method: As recommended by panel manufacturer.
- .3 Sealant: as recommended by panel manufacturer.
- .4 Adhesives: as recommended by panel manufacturer.
- .5 Panel cleaning materials: as recommended by panel manufacturer.

PART 3 - EXECUTION

3.1 Examination

- .1 Examine surfaces to receive wall panel system. Report unsatisfactory conditions immediately to *Consultant*. The work of this section shall not proceed until unsatisfactory conditions have been corrected.
- .2 Substrate surface shall be straight to tolerance of ± 3 mm (± 0.12 ") over 3000 mm (118").
- .3 Ensure that environmental conditions have been provided as requested and specified.
- .4 Defective *Work* resulting from application to unsatisfactory surfaces will be considered the responsibility of those performing the *Work* of this section.

3.2 Installation - General

- .1 Install in accordance with wall panel manufacturer's written recommendations.

3.3 Field Quality Control

- .1 Manufacturer's field review to be in accordance with Section 01 45 00.

3.4 Adjusting and Cleaning

- .1 Remove the protective film from the panels, clean panels with an anti-static solution.
- .2 Wash with water or a diluted neutral soap/detergent solution. Do not use materials containing abrasives or solvents.

3.5 Protection

- .1 After materials have set, and until completion, co-ordinate *Work* to ensure that panels are not damaged by traffic or adjacent work.
- .2 At completion of panel installation, install protection in areas where finishing *Work*, repairs and installation of equipment will occur.

END OF SECTION

Painting

PART 1 - GENERAL

1.1 Summary

- .1 Section includes:
 - .1 Painting of interior paintable surfaces.
- .2 Paintable and non-paintable surfaces:
 - .1 Paint and finish paintable surfaces included in the *Work*, except where excluded by the *Contract Documents*.
 - .2 The following surfaces are considered non-paintable, except as otherwise indicated or scheduled:
 - .1 Material and equipment furnished prime and finish painted.
 - .2 Internal surfaces of steel tanks and stacks.
 - .3 Sprayed fire-resistive materials.
 - .4 Cast-in-place concrete.
 - .5 Stainless steel, weathering steel, copper, bronze, chromium plate, nickel, anodized or lacquered or mill finished aluminum, Monel metal.
 - .6 Insulation, glass.
 - .7 Metallic and mastic insulation finishes.
 - .8 Abrasive material finishes on floors, stair treads, stair nosing and landings.
 - .9 Insulated electric cables.
 - .10 Machined parts of machinery and equipment.
 - .11 Concealed surfaces.
 - .12 Manufactured finish materials.

1.2 Administrative Requirements

- .1 Conduct a pre-installation meeting in accordance with Section 01 31 19.

1.3 Submittals

- .1 Submit required submittals in accordance with Section 01 33 00.
- .2 *Product* data sheets:
 - .1 Submit manufacturer's *Product* data sheets and list of *Products* proposed for use in the work of this section as identified in 'Approved Product List' section of the MPI Architectural Painting Specification Manual. Correlate *Products* to Schedule furnished by *Consultant*.
- .3 Samples:
 - .1 Samples for initial paint colour and finish selection:

Painting

- .1 Submit manufacturer's colour charts showing full range of colours available, including light and deep dark tones, for each type of finish material indicated for colour selection by *Consultant*.
- .2 *Consultant* shall have complete freedom in choice of colours in compiling colour schedule and will not necessarily select colours from standard colour charts of manufacturer of *Products* specified.
- .3 Submit 3 drawdowns of each selected colour for review by *Consultant* and resubmit to *Consultant* as required to obtain approval. Drawdown to be of specified colour, sheen, and paint formula for applicable surface.
- .2 Samples for verification:
 - .1 Submit 3 samples on 200 mm x 305 mm (8"x 12") material of same type as that on which coating is to be applied, for *Consultant's* approval, at least 30 days before materials are required.
 - .2 Identify each sample as to *Project*, finish, formula, colour name, number, gloss name and number, date and name of *Contractor* and painting *Subcontractor*.
 - .3 Resubmit as required until colours and gloss value are approved.
- .4 MPI Manual:
 - .1 Provide and pay for 1 year subscription for *Consultant* for access to MPI manual.

1.4 Closeout Submittals

- .1 Submit closeout submittals in accordance with Section 01 78 00.
- .2 Operation and maintenance data:
 - .1 Submit manufacturer's operation and maintenance instructions for inclusion in the operation and maintenance manuals.
- .3 Maintenance materials:
 - .1 Provide 2 sealed containers, each of 4 litres (1 gallon) capacity of each paint product in each colour used in the *Work* for *Owner's* maintenance use. Containers shall be new, clearly labelled with manufacturer's name, type of paint, colour and colour number. Store at *Place of the Work* where directed by *Owner*.

1.5 Quality Assurance

- .1 Qualifications
 - .1 Manufacturers:
 - .1 Paint manufacturers and *Products* used shall be as listed under the Approved Product List section of the MPI Painting Manual.
 - .2 Installers / applicators / erectors:
 - .1 Applicators: Shall have minimum 5 years proven satisfactory painting experience of projects of similar size and class subject to *Consultant's* approval.

Painting

- .2 Only qualified journeymen who have a "Tradesman Qualification Certificate of Proficiency" shall be engaged in painting work. Apprentices shall work under the direct supervision of a qualified journeyman in accordance with trade regulations.
- .2 Mock-ups:
 - .1 Provide mock-ups of each paint system for indicated surfaces of each colour and finish selected to verify preliminary paint selections made under Sample submittals.
 - .2 Mock-ups shall be located to areas as directed by *Consultant* under lighting conditions matching final area lighting, for acceptance by *Consultant*.
 - .3 Mock-ups shall demonstrate aesthetic effects of paint colour and sheen and shall set quality standards for material and execution of the *Work*. Final approval of colour and finish selections shall be based on mock-ups. If colour selections are not approved, apply additional mock-ups of additional colours selected by *Consultant* at no added cost to the *Owner*.
 - .4 Do not proceed with work, including ordering of paint *Products*, until mock-ups of each paint colour and finish and paint system for indicated surfaces have been reviewed and accepted by *Consultant*.
 - .5 Provide the following mock-ups:
 - .1 Concrete block, concrete and gypsum board: 9.3 m² (100 ft²) of vertical surfaces and 9.3 m² (100 ft²) of horizontal surfaces.
 - .2 Hollow metal doors and frames: 1 door and frame for each finish specified.
 - .3 Painted wood base.
 - .4 Radiators.
 - .5 Acoustic ceiling panels at Vanier Lecture Hall 135.
 - .6 Upon completion and approval, mock-ups shall serve as a standard for the balance of the work of this section. Subsequent work carried out and not in the *Consultant's* opinion equal to standard shall be repainted without charge.

1.6 Delivery, Storage, and Handling

- .1 Deliver painting materials in sealed, original labelled containers bearing manufacturer's name, brand name, type of paint or coating and colour designation, standard compliance, materials content as well as mixing and/or reducing and application requirements.
- .2 Store paint *Products* and materials in original labelled containers in secure (lockable), dry, heated and well ventilated single designated area meeting minimum requirements of both paint manufacturer and authorities having jurisdiction, and at a minimum ambient temperature of 7°C.
- .3 Protect floor and wall surfaces of storage area. Protect floors with sheets or clean plywood or metal pans where mixing is being carried out.

1.7 Field Conditions

- .1 Ambient conditions:

Painting

- .1 Comply with environmental requirements of MPI Manual.
- .2 Perform no painting work when ambient air and substrate temperatures are below 10°C for both interior and exterior work, unless suitable weatherproof covering and sufficient heating and ventilation facilities are in place in accordance with MPI Manual.
- .3 Perform no painting work when relative humidity is above 85% or when dew point is less than 3°C (5°F) variance between air/surface temperature.

1.8 Warranty

- .1 Warrant work of this section in accordance with Section 01 78 36.
- .2 Extended warranties:
 - .1 System:
 - .1 Labour, materials, and workmanship for work of this section.
 - .2 Duration: 2 years.

PART 2 - PRODUCTS

2.1 Performance/Design Requirements

- .1 Except where more stringent requirements are specified, the following reference standard shall govern the work of this section:
 - .1 Master Painters Institute (MPI) Architectural Painting Specification Manual (MPI Manual), including Identifiers, Evaluation, Systems, Preparation and Approved Product List, latest edition, and referenced herein as the MPI Manual, as issued by the local MPI Accredited Quality Assurance Association having jurisdiction.
- .2 Materials, preparation and workmanship shall conform to requirements of latest edition of Architectural Painting Specification Manual by the Master Painters Institute (MPI) (hereafter referred to as the MPI Painting Manual) as issued by the local MPI Accredited Quality Assurance Association having jurisdiction.
- .3 Painting systems:
 - .1 Shall remain free from failure due to causes including: material failure; surface preparation less than that specified; and paint film thickness less than that specified, or when not specified, less than that coverage recommended by manufacturer.
 - .2 Presence of any of following shall constitute failure: visible corrosion; film peeling, blistering, checking, scaling, embrittling or general film disintegration; and poor adhesion as determined by tape "peel-off" test procedures.

2.2 Materials

- .1 *Products* listed in MPI Manual shall be used in the *Work*, unless specified otherwise.
- .2 Paint and materials (primers, paints, coatings, varnishes, stains, lacquers, fillers, thinners, solvents, and the like) shall be in accordance with the MPI Manual "Approved Product" listing and shall be from a single manufacturer for each system used.

Painting

- .3 Other paint materials, such as linseed oil, shellac, and the like, shall be highest quality *Products* of an approved manufacturer listed in the MPI Manual and shall be compatible with other coating materials as required.
- .4 Paint materials shall have good flowing and brushing properties and shall dry or cure free of blemishes or sags.
- .5 Where required, paints and coatings shall meet flame spread and smoke developed ratings designated by building code requirements and/or authorities having jurisdiction.

2.3 Equipment

- .1 Painting and coating equipment in accordance with written requirements of MPI Manual.

2.4 Mixing and Tinting

- .1 Unless otherwise specified, paints shall be ready-mixed. Re-mix prior to application to ensure colour and gloss uniformity.
- .2 Paste, powder or catalysed paint mixes shall be mixed in accordance with manufacturer's written requirements.
- .3 Perform colour tinting operations prior to delivery of paint to *Place of the Work*.
- .4 Where thinner is used, addition shall not exceed paint manufacturer's recommendations.

2.5 Colours and Gloss Levels

- .1 Paint colours and gloss levels shall be as selected by the *Consultant*. Locations as indicated or scheduled.
- .2 Colours and glosses: in accordance with Paint Schedule.
- .3 Paint gloss shall be defined as the sheen rating of applied paint, in accordance with the following MPI values:

Gloss Level	Description	Units @ 60 degrees	Units @ 85 degrees
G1	Matte or Flat finish	0 to 5	10 maximum
G2	Velvet finish	0 to 10	10 to 35
G3	Eggshell finish	10 to 25	10 to 35
G4	Satin finish	20 to 35	35 minimum
G5	Semi-gloss finish	35 to 70	
G6	Gloss finish	70 to 85	
G7	High-Gloss finish	> 85	

PART 3 - EXECUTION

3.1 Examination

- .1 Prior to commencement of work of this section, thoroughly examine surfaces scheduled to be painted.
- .2 Check moisture content and alkalinity of surfaces to be painted in accordance with paragraph above titled Field Conditions.

Painting

- .3 Inspect surfaces to be coated for gouges, marks, nibs, and other defects and properly prepare patching, filling, smoothing or other surface preparation necessary to ensure satisfactory finish.
- .4 Report in writing any condition adversely affecting work of this section.
- .5 Proceed with work only when surfaces and conditions are satisfactory. Remove dust, grease, rust, scale and extraneous matter, tool and machine marks and insects from surfaces which could be detrimental to a satisfactory and acceptable finish.

3.2 Preparation

- .1 Comply with manufacturer's written requirements and recommendations in "MPI Architectural 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, mildew, grease, and incompatible paints, encapsulants, and other deleterious materials.
- .4 Paint surfaces when moisture content or alkalinity of surfaces to be painted comply with paragraph 3.5 Field Quality Control / Standard of Acceptance.
- .5 Shop-primed steel substrates: Clean field welds, bolted connections, and areas where shop paint is abraded. Paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.
- .6 ZF75 and ZF120 galvanized-metal substrates: Remove grease and oil residue from galvanized sheet metal by methods to produce clean surfaces that promote adhesion of subsequently applied paints.
- .7 Z275 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.
- .8 Aluminum substrates: Remove loose surface oxidation.
- .9 Wood substrates for paint finish:
 - .1 Scrape and clean knots, and apply coat of knot sealer before applying primer.
 - .2 Sand surfaces that will be exposed to view, and dust off.
 - .3 Prime edges, ends, faces, undersides, and backsides of wood.
 - .4 After priming, fill holes and imperfections in the finish surfaces with putty or plastic wood filler. Sand smooth when dried.
- .10 Existing painted substrates:
 - .1 Clean substrates as indicated above.
 - .2 Sound existing paint surfaces and remove paint surfaces that are not sound, loose or are otherwise stained, cracked, wrinkled, peeling, or defective.

Painting

- .3 Dull hard or glossy surfaces by sanding or other abrasive methods prior to finishing.
- .4 Apply tie-coat primer product that compatible with substrate as recommended by paint coatings manufacturer.
- .5 Follow with paint finish coats as specified for like substrate materials specified herein.
- .11 Wood doors:
 - .1 Doors shall be painted as soon as possible after delivery to site and before installation.
 - .2 Prior to finishing, handling marks or effects of exposure to moisture removed with a thorough final sanding over surfaces of the exposed portions, using appropriate grit sandpaper, and shall be cleaned prior to applying sealer or finish.
 - .3 Sand and dust sides and top and bottom edges of doors prior to first coat of primer/sealer to ensure smooth uniform finish.
 - .4 Sanding shall be completed just prior to stain or finishing application.
 - .5 Sand and dust between each coat to provide anchor for next coat.
 - .6 Seal faces of door including top and bottom door edges.

3.3 Installation

- .1 Do not paint unless substrates are acceptable and/or until Field Conditions (heating, ventilation, lighting and completion of work of other sections) are acceptable for applications of *Products*.
- .2 Apply primer, paint or stain in accordance with MPI Manual Premium Grade finish requirements.
- .3 Apply paint and coatings within an appropriate time frame after cleaning when Field Conditions encourage flash-rusting, rusting, contamination or manufacturer's paint specifications require earlier applications.
- .4 Painting coats specified are intended to cover surfaces satisfactorily when applied at proper consistency and in accordance with manufacturer's recommendations.
- .5 Tint each coat of paint progressively lighter to enable confirmation of number of coats.
- .6 Unless otherwise approved by *Consultant*, apply a minimum of 4 coats of paint where deep or bright colours are used to achieve satisfactory results.
- .7 Sand and dust between each coat to provide an anchor for next coat and to remove defects visible from a distance up to 1000 mm (39").
- .8 Do not apply finishes on surfaces that are not sufficiently dry. Unless manufacturer's directions state otherwise, each coat shall be sufficiently dry and hard before a following coat is applied.
- .9 Prime coat of stain or varnish finishes may be reduced in accordance with manufacturer's directions.

Painting

- .10 Paint finish shall continue through behind wall-mounted items (i.e. chalk and tack boards) and exposed/ visible in complete work including interiors of cupboards and closets, tops of doors, trim, and the like, whether in sight line or not, including behind surface mounted fixtures and heating units.
- .11 *Consultant* shall have right to make changes in colour tone of finishes prior to final coat to obtain desired results without additional cost to *Owner*.
- .12 Access doors, prime coated butts and other prime painted hardware, registers, radiators and covers, exposed piping and electrical panels shall be painted to match adjacent surfaces in terms of colour, texture and sheen, unless otherwise indicated.

3.4 Mechanical and Electrical Items

- .1 Finish paint primed mechanical and electrical items with 2 coats of paint. Include for the following list unless otherwise indicated:
 - .1 Air handling units.
 - .2 Convectors.
 - .3 Conduit.
 - .4 Diffusers.
 - .5 Ductwork.
 - .6 Grilles.
 - .7 Hangers.
 - .8 Heaters.
 - .9 Electrical panels.
 - .10 Fire hose cabinets.
 - .11 Fire extinguisher cabinets.
 - .12 Louvres.
 - .13 Radiators.
 - .14 Stacks.
 - .15 Vents.
- .2 Prime and paint exposed insulated and bare pipes. Prime and paint exposed conduits and electrical raceways, fittings, outlet boxes, junction boxes, pull boxes and similar items. Use heat resistant epoxy paint on pipes and surfaces where operating surface temperature exceeds 65°C.
- .3 Coordinate the painting of pipes, and coverings with mechanical contractor applying colour banding, flow arrows and pipe identification after the painting of pipes and coverings.
- .4 Paint work to match adjacent walls and ceilings unless directed otherwise.
- .5 Paint interior surfaces of air ducts and pipe trenches including heating pipes and elements that are visible through grilles and louvres with one coat of flat metal paint to limit of sight-line. Paint to be black or white as directed by *Consultant*.
- .6 Gas pipes, whether concealed or exposed, shall be painted in accordance with gas code.

Painting

- .7 Paint and finish wall surfaces behind convectors. Walls to be finished prior to installation of convector covers. Touch up walls after covers are installed as necessary to make good installation damage.
- .8 Air diffusers shall be primed and finished with 2 coats of paint of same colour and sheen as ducts and/or ceiling.

3.5 Field Quality Control / Standard of Acceptance

- .1 Conduct quality control in accordance with Section 01 45 00.
 - .1 Field tests and inspections:
 - .1 Paint and Coating Quality Assurance Inspections:
 - .1 Field quality control shall be in accordance with Section 01 45 00.
 - .2 Moisture and alkalinity testing:
 - .1 Check moisture content of surfaces to be painted using properly calibrated electronic moisture meter approved by paint manufacturer, and *Consultant*, or other approved method. Maximum moisture contents shall be in accordance with manufacturer's recommendations and as follows:
 - .1 Concrete and concrete masonry (clay and concrete brick/block): Maximum 12%.
 - .2 Gypsum board and plaster: Maximum 12%.
 - .3 Wood: Maximum 15%.
 - .2 Conduct moisture tests on concrete floors using cover patch test method.
 - .3 Test concrete, masonry and plaster surfaces for alkalinity.
 - .3 Painted interior surfaces shall be considered to lack uniformity and soundness if any of the following defects are apparent to the *Consultant*:
 - .1 Brush / roller marks, streaks, laps, runs, sags, drips, heavy stippling, hiding or shadowing by inefficient application methods, skipped or missed areas, and foreign materials in paint coatings.
 - .2 Evidence of poor coverage at rivet heads, plate edges, lap joints, crevices, pockets, corners and re-entrant angles.
 - .3 Damage due to touching before paint is sufficiently dry or any other contributory cause.
 - .4 Damage due to application on moist surfaces or caused by inadequate protection from weather.
 - .5 Damage and/or contamination of paint due to blown contaminants (dust, spray paint, etc.).
 - .4 Painted surfaces shall be considered unacceptable if any of the following are evident under natural lighting source for exterior surfaces and final lighting source (including daylight) for interior surfaces to the *Consultant*:
 - .1 Visible defects are evident on vertical and horizontal surfaces when viewed at normal viewing angles from a distance of not less than 1000 mm (39").

Painting

- .2 Visible defects are evident on ceiling, soffit and other overhead surfaces when viewed at normal viewing angles.
- .3 When final coat on any surface exhibits a lack of uniformity of colour, sheen, texture, and hiding across full surface area.
- .5 Painted surfaces rejected by the *Consultant* shall be made good at the expense of the *Subcontractor*. Small affected areas may be touched up; large affected areas or areas without sufficient dry film thickness of paint shall be repainted. Runs, sags of damaged paint shall be removed by scraper or by sanding prior to application of paint.
- .6 Painting *Subcontractor* shall obtain from *Contractor* written confirmation of specific surface preparation procedures and primers used for fabricated steel items from the fabricator/*Supplier* to ascertain appropriate and manufacturer compatible finish coat materials to be used before painting any such work.

3.6 Adjusting and Cleaning

- .1 Promptly as work proceeds and on completion of *Work*, remove paint where spilled, splashed or spattered during the progress of the *Work*. Keep the premises free from unnecessary accumulation of tools, equipment, surplus materials and debris; at the conclusion of the work leave the premises clean.

3.7 Interior Paint Systems

- .1 System references listed are based on MPI Manual and are Premium Grade, High Performance Architectural, unless otherwise indicated:
 - .1 Semi-transparent wood stain:
 - .1 In accordance with Paint Schedule.
 - .2 Galvanized metal: (doors, frames, misc. steel, pipes, overhead decking, ducts, etc.)
 - .1 INT 5.3M High performance architectural latex (over water based galvanized primer).
 - .3 Plaster and gypsum board: (gypsum wallboard, drywall and textured finishes)
 - .1 INT 9.2B High performance architectural latex finish (over latex primer/sealer):
 - .1 Use high-hide primer sealer type at glass mat finished gypsum board.

END OF SECTION

PART 1 - GENERAL

1.1 Summary

- .1 Section includes:
 - .1 Hard surface laminate board (WB-1).
 - .2 Whiteboards (WB-2).
 - .3 Related trim, adhesives, and fastenings.

1.2 Submittals

- .1 Submit required submittals in accordance with Section 01 33 00.
- .2 *Product* data sheets:
 - .1 Submit manufacturer's *Product* data sheets for *Products* proposed for use in the work of this section.
- .3 Shop drawings:
 - .1 Show proposed system of anchorage and materials being supplied on shop drawings submitted for review.
 - .2 Show dimensional layouts, hardware items, anchorage devices, dimensions, description of materials and finishes, and all other pertinent information.
- .4 Samples:
 - .1 Submit 305 mm x 305 mm (12" x 12") samples of each *Product* specified, diagonally cut to show cross section through assembly, complete with accessories and trim.

1.3 Closeout Submittals

- .1 Submit closeout submittals in accordance with Section 01 78 00.
- .2 Operation and maintenance data:
 - .1 Submit manufacturer's operation and maintenance instructions for inclusion in the operation and maintenance manuals.

1.4 Quality Assurance

- .1 Qualifications:
 - .1 Installers / applicators / erectors:
 - .1 Erection of materials to be carried out by competent workers supervised by a foreperson with at least 10 years' experience in this specialized field and approved in writing by manufacturer for installation of their *Product*.

1.5 Delivery, Storage, and Handling

- .1 Package *Products* to prevent distortion in shipment and handling. Label and protect finish surfaces by sturdy wrappings.

Whiteboards

1.6 Warranty

- .1 Warrant work of this section in accordance with Section 01 78 36.
- .2 Provide manufacturer's standard product warranty.

PART 2 - PRODUCTS

2.1 Design/Performance Requirements

- .1 Trademarks and labels:
 - .1 No trademarks or labels will be accepted on exposed finished work.

2.2 Hard Surface Laminate Board (WB-1)

- .1 Description: Dry-erase, scratch and ghost resistant, anti-graffiti coating.
 - .1 Thickness: 2.5 mm (0.080").
 - .2 Finish: in accordance with Materials and Finishes Schedule.
 - .3 Acceptable *Products*:
 - .1 Altro 'Whiterock Whiteboard'.
 - .2 Substitutions: in accordance with Section 01 25 00.
- .2 Accessories: as required for a complete installation and as recommended by manufacturer.
- .3 Panel fixing method:
 - .1 Use 2-part Polyurethane Altro Adhesive.
- .4 Trim: Start and Edge trim, silver metal finish.
- .5 Allow for mitred corners.

2.3 Whiteboards (WB-2)

- .1 Whiteboards:
 - .1 Basis of design:
 - .1 ASI Visual Display Products 1/2" 'e3', including 12 assorted markers and microfiber cloth.
 - .2 Sizes: as indicated or scheduled.
 - .3 Configurations: as indicated or scheduled.
 - .1 Double.
 - .2 Single.
 - .4 Height: 1220 mm (48").
 - .2 Substitutions: in accordance with Section 01 25 00.
- .2 Porcelain enamel board with porcelain enamel writing surface. Boards shall be manufactured in accordance with Porcelain Enamel Institute's standards. Gloss factor: 6-8 as measured by 45° glossmeter.

Whiteboards

- .1 Face Sheet: 28 gauge Porcelain Enamel Steel.
 - .1 Colour: White colour writing surface, designed for long lasting heavy duty marker writing surface, free of permanent marker staining.
- .2 Core: in accordance with reviewed shop drawings.
- .3 Backing: moisture barrier back.
- .3 Joints shall be absolutely flush and level, plumb true with edges finished square and fitted as closely as possible. Use concealed joint fasteners.
- .4 Particle board backing to CAN3-0188.1-M78, 6 mm (1/4") thick, with sanded faces.
- .5 Concealed mechanical joining system: join abutting panels with a spline as recommended by the manufacturer.
- .6 Trim:
 - .1 Aluminum trim in accordance with Trim Components paragraph below.

2.4 Trim Components

- .1 Acceptable Manufacturers:
 - .1 ASI Visual Display Products.
 - .2 Substitutions in accordance with Section 01 25 00.
- .2 Aluminum trim:
 - .1 Finish: clear etched and satin anodized.
 - .2 Acceptable Products:
 - .1 ASI 'Series 200 Architectural' trim or approved alternate.
 - .2 Substitutions: in accordance with Section 01 25 00.
- .3 Accessories:
 - .1 Perimeter #205.
 - .2 Maprail #206.
 - .3 Chalktray #264.
 - .4 Steel spine assembly at whiteboard joints
- .4 Extruded aluminum components, AA6063 T5 or approved alternative, 25 mm x 25 mm x 3 mm (1" x 1" x 1/8"), mitred corners.
- .5 Finish: etched and clear anodized 0.051 mm (0.002") satin finish free from extruding draw marks and surface scratches.
- .6 Reveal: Provide 3.2 mm (1/8") reveal between board finish and aluminum frame.
- .7 Final assembly to have seamless/welded flush and level butt joints. No visible joints accepted and no intermediate trim.

2.5 Attachment Hardware

- .1 Use manufacturer's standard mounting hardware.

PART 3 - EXECUTION

3.1 Installation – General

- .1 Install in accordance with manufacturer's written installation requirements.
- .2 Locate seams as directed by the *Consultant*.

3.2 Installation

- .1 Installation in accordance with reviewed shop drawings and manufacturer's written requirements.

3.3 Installation - Trim Components

- .1 Install in accordance with manufacturer's written installation requirements.

3.4 Installation Tolerances

- .1 Install plumb, level, tight and secured. Comply with the following maximum tolerances:
 - .1 Within 1.5 mm (1/16") of plumb and level, and flush with adjacent panels.
 - .2 Within 25 mm (1") variation from indicated position.

3.5 Field Quality Control

- .1 Manufacturer's field review to be in accordance with Section 01 45 00.

3.6 Adjusting and Cleaning

- .1 Verify under work of this section that installed *Products* function properly, and adjust them accordingly to ensure satisfactory operation.
- .2 Do not remove protective coatings until final cleaning, or earlier if directed by *Consultant*.
- .3 Refinish damaged or defective work so that no variation in surface appearance is discernible. Refinish work at *Place of the Work* only if approved.

END OF SECTION

Corner Guards

PART 1 - GENERAL

1.1 Summary

- .1 Section includes:
 - .1 Corner guards.

1.2 Submittals

- .1 Submit required submittals in accordance with Section 01 33 00.
- .2 *Product* data sheets:
 - .1 Submit manufacturer's *Product* data sheets for *Products* proposed for use in the work of this section.
- .3 Samples:
 - .1 Submit 3 samples, 300 mm (12") long or 300 x 300 mm (12 x 12") in size as applicable, for each *Product* in specified finish.
- .4 Shop drawings:
 - .1 Include plans, elevations, hardware, and installation details.
 - .2 Show seam locations.
- .5 Templates:
 - .1 Submit templates to *Contractor* for use by installers and fabricators as required for proper location and installation of hardware.

1.3 Quality Assurance

- .1 Mock-up:
 - .1 *Provide* full mock-up of corner guard in location as designated by *Consultant*.
 - .1 Corner guards.
 - .2 Mock-up may be incorporated in the completed work upon acceptance of *Consultant*.

1.4 Delivery, Storage, and Handling

- .1 Package or crate, and brace *Products* to prevent distortion in shipment and handling. Label packages and crates, and protect finish surfaces by sturdy wrappings.
- .2 Deliver *Products* to location at the *Place of the Work* designated by *Contractor*.

1.5 Field Conditions

- .1 Install materials of this section only when surfaces and air temperatures have been maintained between 18°C and 24°C for 48 hours preceding installation, and will be so maintained during installation and for 48 hours thereafter. Maintain a minimum temperature of 13°C after above period. Relative humidity shall be 50 +/- 10%.
- .2 Ensure that adequate ventilation is provided during installation and curing of materials of this section.

Corner Guards

- .1 Do not expose wall protection to direct sunlight during or after installation.

1.6 Warranty

- .1 Warrant work of this section in accordance with Section 01 78 36.

PART 2 - PRODUCTS

2.1 General

- .1 Incorporate reinforcing, fastenings and anchorage required for building-in of *Products*.
- .2 Heights of corner guards shall be full wall heights.

2.2 Corner Guard Protection

- .1 Surface mounted, 90 corner, 50 mm x 50 mm (2" x 2"), 3 mm (1/8") thick, steel angle in accordance with CSA G40.21-13, Grade 300W, galvanized zinc coating to meet specified requirements of CAN/CSA G164-M92, manufacturer's powder coated finish, colour to match adjacent wall.
- .2 Fasteners: manufacturer's standard self-tapping stainless steel screws to provide, concealed, flush mounting.
- .3 Sealants: in accordance with Section 07 92 00.

PART 3 - EXECUTION

3.1 Installation

- .1 Install work to meet manufacturer's written requirements, true, tightly fitted, and level or flush to adjacent surfaces, as suitable for installation.
- .2 Clean substrates to remove dirt, debris and loose particles prior to installation.
- .3 Fit joints and junction between components tightly and in true planes.
- .4 Install units on solid backing as indicated, and erect with materials and components straight, tight and in alignment.
- .5 Corner guards:
 - .1 Corner guard edges shall be smooth.
 - .2 Mechanically fasten corner guards in accordance with guard manufacturer's written requirements. Fasteners shall be aligned and equally spaced.
 - .3 Visible fasteners are not permitted.
 - .4 Installed corner guard shall be tightly fitted without gaps.

END OF SECTION

Mounting Bar

PART 1 - GENERAL

1.1 Summary

- .1 Section includes:
 - .1 Mounting bar (SP-1).

1.2 Administrative Requirements

- .1 Conduct a pre-installation meeting in accordance with Section 01 31 19.

1.3 Submittals

- .1 Submit required submittals in accordance with Section 01 33 00.
- .2 *Product* data sheets:
 - .1 Submit manufacturer's *Product* data sheets for *Products* proposed for use in the work of this section.
- .3 Shop drawings:
 - .1 Clearly indicate, materials, finishes, fabrication details, dimensions, thicknesses, plans, elevations, hardware, and installation details.
- .4 Templates:
 - .1 Submit templates to *Contractor* for use by installers and fabricators as required for proper location and installation of hardware.

1.4 Closeout Submittals

- .1 Submit closeout submittals in accordance with Section 01 78 00.
- .2 Operation and maintenance data:
 - .1 Submit manufacturer's operation and maintenance instructions for inclusion in the operation and maintenance manuals.

1.5 Quality Assurance

- .1 Qualifications:
 - .1 Installers:
 - .1 Shall have 5 years' experience, minimum, in application of *Products* specified and with approval and training of *Product* manufacturer.

1.6 Delivery, Storage, and Handling

- .1 Package or crate, and brace products to prevent damage during shipment and handling. Label packages and crates, and protect finish surfaces from environmental conditions where required.
- .2 Deliver products to location at the *Place of the Work* designated by *Contractor*.

Mounting Bar

PART 2 - PRODUCTS

2.1 General

- .1 Incorporate reinforcing, fastenings and anchorage required for building in of *Products*.

2.2 Mounting Bar; SP-1

- .1 Mounting bar:
 - .1 Length: 305 mm (12").
 - .2 Finish: brushed nickel.
 - .3 Acceptable *Product*:
 - .1 Kohler 'K-23293'.
 - .2 Substitutions: in accordance with Section 01 25 00.

2.3 Fabrication

- .1 Fabricate *Products* with materials and component sizes, metal gauges, hardware, reinforcing, anchors, and fastenings of adequate strength to ensure that mounting bar will remain free of warping, buckling, opening of joints and seams, and distortion within limits of intended use.

PART 3 - EXECUTION

3.1 Preparation

- .1 Verify that rough-in dimensions and blocking or back-up has been provided to comply with product manufacturer's written requirements.

3.2 Installation

- .1 Submit manufacturer's information and templates required for installation of work of this section, and assist or supervise, or both, the setting of anchorage devices, and construction of other work incorporated with *Products* specified in this section in order that they function as intended.
- .2 Install work to meet manufacturers' recommended specifications, true, tightly fitted, and level or flush to adjacent surfaces, as suitable for installation.
- .3 Install and secure fixtures rigidly in place using expansion shields in solid masonry or concrete, toggle bolts in hollow masonry or sheet metal screws at metal studs.
- .4 Install on built-in concealed solid backing materials. Mounting bar installation shall be able to withstand 250 kg downward force.
- .5 Verify locations and mounting heights with *Consultant* before roughing-in.
- .6 Include reinforcing, anchorage and mounting devices required for the installation of each *Product*.
- .7 Fit joints and junction between components tightly and in true planes, conceal and weld joints where possible.

Mounting Bar

- .8 Fabricate *Products* with materials and component sizes, metal gauges, hardware, reinforcing, anchors, and fastenings of adequate strength to ensure that specified items will remain free of warping, buckling, opening of joints and seams, and distortion within limits of intended use.
- .9 Supply handling instructions, anchorage information, roughing-in dimensions, templates and service requirements for installation of the work of this section, and assist or supervise, or both, the setting of anchorage devices and construction of other work incorporated with *Products* specified in this section.
- .10 Back paint components where contact is made with building finishes to prevent electrolysis.

3.3 Adjusting and Cleaning

- .1 Verify under work of this section that installed *Products* function properly, and adjust them accordingly to ensure satisfactory operation.
- .2 Do not remove protective coatings until final cleaning in accordance with Section 01 74 00, or earlier if directed by *Consultant*.
- .3 Refinish damaged or defective work so that no variation in surface appearance is discernible. Refinish work at *Place of the Work* only if approved.

END OF SECTION

Roller Window Shades

PART 1 - GENERAL

1.1 Summary

- .1 Section includes:
 - .1 Roller window sun shades at interior locations, manual (WC-1).

1.2 Administrative Requirements

- .1 Conduct a pre-installation meeting in accordance with Section 01 31 19.

1.3 Submittals

- .1 Submit required submittals in accordance with Section 01 33 00.
- .2 *Product* data sheets:
 - .1 Submit manufacturer's *Product* data sheets for *Products* proposed for use in the work of this section.
 - .2 Submit flammability performance data.
 - .3 Submit manufacturers' installation instructions.
- .3 Shop drawings:
 - .1 Submit shop drawings or fully dimensioned catalogue cuts.
 - .2 Window treatment schedule: Use same designations indicated on *Contract Documents*.
 - .3 Clearly indicate general construction, configurations, jointing methods and locations, fastening methods, handing of controls, required blocking locations, banding (tandem shades), and installation details.
- .4 Samples:
 - .1 Submit samples of each material and finish colour selected and each accessory.

1.4 Closeout Submittals

- .1 Submit closeout submittals in accordance with Section 01 78 00.
- .2 Operation and maintenance data:
 - .1 Submit manufacturer's operation and maintenance instructions for inclusion in the operation and maintenance manuals.

1.5 Quality Assurance

- .1 Qualifications:
 - .1 Manufacturers:
 - .1 Company specializing in manufacturing the *Products* specified in this section, with 10 years' experience minimum.
 - .2 Installers / applicators / erectors:

Roller Window Shades

- .1 Work of this section shall be by forces in the direct employ or under control of the system manufacturer, skilled, trained, and experienced in work of similar scope and complexity.
- .2 Mock-ups:
 - .1 Erect 1 full size mock-up each roller shade type at the *Place of the Work* for review. Completed and accepted mock-up shall act as the standard to which balance of the work of this section will be judged.

1.6 Delivery, Storage, and Handling

- .1 Before delivery to the *Place of the Work*, check each shade for operation; remove finger marks and smudges.
- .2 Package *Products* to prevent distortion in shipment and handling. Label packages and crates, and protect finish surfaces by sturdy wrappings.

1.7 Warranty

- .1 Warrant work of this section in accordance with Section 01 78 36.
- .2 Extended warranty:
 - .1 Labour, materials, and workmanship for work of this section.
 - .2 Duration: 5 years.

PART 2 - PRODUCTS

2.1 Manufacturers/Products

- .1 Acceptable *Product*:
 - .1 Altex (SunProject) 'Deko Lite-Lift Casette S-70' system.
 - .2 Substitutions: in accordance with Section 01 25 00.

2.2 Hardware - Manual Controlled Shades

- .1 Chain operated, with infinite positioning. Left or right hand operation and banding as applicable to suit *Place of the Work* condition.
 - .1 Drive assembly:
 - .1 Allow finger tip control and include a built in shock absorber system to prevent chain breakage under normal operating conditions;
 - .2 Capable of being field adjusted from the exterior of the shade unit without having to disassemble the hardware.
 - .3 Drive Chain: No. 10 stainless steel bead chain formed in a continuous loop. The chain shall have passed a 40 kg (90 lb) load test.

2.3 Assembly

- .1 *Provide* fully factory assembled shade unit consisting of 2 shade brackets, one piece extruded aluminum shade tube, extruded aluminum fascia, aluminum profile hembars, extruded vinyl fabric spline, and fabric as specified.

Roller Window Shades

- .2 Fabric shall hang straight, without shifting sideways more than 3 mm (1/8") in either direction due to warp distortion or weave design.
- .3 Factory modify housings where necessary to bypass columns.
- .4 End brackets: a two piece moulded ABS construction with nylon drive sprocket. Bracket colour shall coordinate with the fascia colour.
- .5 Shade tube: Minimum 1.52 mm (0.060") thick extruded aluminum with three equally spaced continuous stiffening fins, non-sag design, maximum deflection under full load of fabric L/700.
- .6 Fascia: Minimum 1.5 mm (1/6") thick extruded aluminum.
- .7 Hembar: Extruded aluminum with matching plastic end finials.
- .8 Mounting: Removal of shade system shall not require the disassembly of the shade unit.

2.4 Shade Mounting System

- .1 Design extruded aluminum bracket to accept preassembled shade system.
 - .1 Use brackets to facilitate the alignment with shade opening.
- .2 Modular construction: Shades shall be removable as a complete modular unit without any component disassembly required.

2.5 Aluminum Finish

- .1 Exposed aluminum: Baked enamel, colour to match window mullion finish.
- .2 Unexposed aluminium: Mill finish.

2.6 Shade Fabric Types

- .1 WC-1; Sun control fabric; dimensionally stable shade fabric:
 - .1 Acceptable *Products*:
 - .1 SunProject Architectural '10101-01'.
 - .2 Substitutions: in accordance with Section 01 25 00.
 - .2 Colour: as selected by *Consultant* from manufacturer's full range.
- .2 Fabric:
 - .1 Hang flat, without buckling or distortion. Edge, where trimmed, shall hang true and straight, without shifting sideways more than 3 mm (1/8") in either direction due to warp distortion or weave design.
 - .2 Colour fast, retain its shape, and not be affected by moisture or heat.
- .3 Flammability performance:
 - .1 Certified by an independent laboratory, shade fabric shall pass CAN/ULC S109-14.

2.7 Fabrication

- .1 Finished assemblies: Square, true to size and free from distortion, twist, or other defects that could affect their strength, operation or appearance.

Roller Window Shades

- .2 Factory applied finish: Uniform, smooth and without blemishes.

PART 3 - EXECUTION

3.1 Installation

- .1 Install shade systems in plumb, squared, adequately anchored, maintaining uniformed clearances, accurate alignment levels, and parallel with the window plane. Fabric shall not travel more than 3 mm (1/8") in either direction within channels after installation.
- .2 Fabric shall be pre-measured and manufactured off-site.
- .3 Shades shall be snapped into place without screws or visible fasteners.
- .4 Incorporate reinforcing, fastening and anchorage required for installation of shades.
- .5 Securely attach installation fittings to their mounting surfaces with stainless steel or hardened aluminum screws of proper length and type, and durable anchors.
- .6 Install shade roller true and level, and with cloth to hang flat without buckling or distortion.

3.2 Adjusting and Cleaning

- .1 Verify that installed shade system functions properly, and adjust it accordingly to ensure satisfactory operation.
- .2 Refinish damaged or defective work so that no variation in surface appearance is discernible.

3.3 Closeout Activities

- .1 Demonstration:
 - .1 Before acceptance of system, arrange for demonstration of equipment with authorized representatives of *Owner*, to be performed by representative of shade manufacturer to assure proper function, operation and explanation.
 - .2 Conduct comprehensive demonstration for *Owner's* staff on operation and care of interior window treatments.

END OF SECTION

PART 1 - GENERAL

1.1 Summary

- .1 Section includes:
 - .1 Fixed furniture (FC-01, FT-01, FT-02, FT-03, FT-04, FP-01).

1.2 Administrative Requirements

- .1 Conduct a pre-installation meeting in accordance with Section 01 31 19.

1.3 Submittals

- .1 Submit required submittals in accordance with Section 01 33 00.
- .2 *Product* data sheets:
 - .1 Submit manufacturer's *Product* data sheets for *Products* proposed for use in the work of this section.
 - .2 In addition to the requirements of Section 01 33 00, *Product* data sheets shall include wiring diagram with parts list.
- .3 Shop drawings:
 - .1 Submit scaled digital shop drawings.
 - .2 Shop drawings to indicate the following:
 - .1 Fabrication details, plans, elevations, hardware, anchorage details and product data, and installation details.
 - .2 Complete seating layout plan, levels, seat numbering scheme, chair sizes, aisle widths, and locations. Assume complete responsibility for the accuracy of measurements shown on layout plan included with the *Contract Documents*.
 - .1 Final layout based on actual field conditions and measurements. Notify *Consultant* of field conditions affecting layout.
 - .3 Shop drawings shall indicate required locations of electrical items by dimension.
- .4 Samples:
 - .1 Submit duplicate samples of finishes, colours and textures of *Products* proposed for use in the work of this section.

1.4 Closeout Submittals

- .1 Submit closeout submittals in accordance with Section 01 78 00.
- .2 Operation and maintenance data:
 - .1 Submit manufacturer's operation and maintenance instructions for inclusion in the operation and maintenance manuals.
 - .2 Submit operation and maintenance data, detailing maintenance procedure for work surfaces and other items requiring specific care, noting particularly those procedures or materials which will cause damage to finished surfaces, for incorporation into maintenance manual.

Fixed Furniture

1.5 Quality Assurance

.1 Qualifications:

.1 Manufacturers:

- .1 Company specializing in manufacturing the *Products* and systems specified in this section, with 10 years' experience minimum.

.2 Installers:

- .1 Shall have 5 years' experience, minimum, in application of *Products*, systems and assemblies specified and with approval and training of *Product* manufacturers.

1.6 Delivery, Storage, and Handling

- .1 Package or crate, and brace products to prevent damage during shipment and handling. Label packages and crates, and protect finish surfaces from environmental conditions where required.
- .2 Coordinate and deliver fixed furniture at required time for installation, as directed by *Contractor*.

PART 2 - PRODUCTS

2.1 Fixed Furniture

.1 FC-01; Fixed seating with tablet arm – Lecture Hall:

- .1 Table arm shall open and stow in one movement.
- .2 Tablet arm directions (FC-01a, FC-01b): as indicated or scheduled.
- .3 Tablet shall support load up to 238 kg (525 lbs).
- .4 Manufacturer's standard power and data system for power supply to each unit.
- .5 Customized beam required to avoid floor vents.
- .6 Finishes: in accordance with the 'Fixed Furniture Selection & Finishes' Appendix.
- .7 Acceptable *Product*:
 - .1 Sedia Systems 'Fixed Pedestal Gnosi with Wrimatic Tablet'.
 - .2 Substitutions: in accordance with Section 01 25 00.

.2 FT-01; Fixed table system with modesty panel – Tiered Classrooms:

- .1 Tabletop size:
 - .1 Depth: 380 mm (15").
 - .2 Length: as indicated.
- .2 Modesty panel sizes:
 - .1 Height: 305 mm (12").
- .3 Pedestals (FC-01b):
 - .1 Quantities and location: as indicated or scheduled.

Fixed Furniture

- .4 Integrated power receptacle, complete with 2 power / 1 USB and 1 USBc port/ per user.
- .5 Finishes: in accordance with the 'Fixed Furniture Selection & Finishes' Appendix.
- .6 *Acceptable Product:*
 - .1 Sedia Systems 'M50 Series'.
 - .2 Substitutions: in accordance with Section 01 25 00.
- .3 FT-02: Freestanding tablet:
 - .1 Tablet arm directions (FT-02a, FT-02b): as indicated or scheduled.
 - .2 Tablet shall support load up to 238 kg (525 lbs).
 - .3 Power operated with power box mounted to post, complete with 1 power outlet and 1 USB and 1 USBc port.
 - .4 Finishes: in accordance with the 'Fixed Furniture Selection & Finishes' Appendix.
 - .5 *Acceptable Product:*
 - .1 Sedia Systems 'Freestanding Wrimatic Fold-away Tablet'.
 - .2 Substitutions: in accordance with Section 01 25 00.
- .4 FT-03; Fixed regular student table with modesty panel – Lecture Hall:
 - .1 Size: as indicated.
 - .2 Fixed height and fixed to the floor, squared T-leg pedestal.
 - .3 Finishes: in accordance with the 'Fixed Furniture Selection & Finishes' Appendix.
 - .4 Surface mounted power module, complete with 2 power/1 USB and 1 USBc port per unit.
 - .5 *Acceptable Product:*
 - .1 Sedia Systems 'X20 Table'.
 - .2 Substitutions: in accordance with Section 01 25 00.
- .5 FT-04; Fixed electric height adjustable student table with modesty panel – Lecture Hall.
 - .1 Size: as indicated.
 - .2 Electric powered adjustable height, fixed to the floor, squared T-leg pedestal with modesty panel and wire management.
 - .3 Surface mounted power module, complete with 2 power/1 USB and 1 USBc port per unit.
 - .4 Finishes: in accordance with the 'Fixed Furniture Selection & Finishes' Appendix.
 - .5 *Acceptable Product:*
 - .1 Sedia Systems 'X30 Table'.
 - .2 Substitutions: in accordance with Section 01 25 00.
- .6 FP-01, Podium:

Fixed Furniture

- .1 Height adjustable podium; custom: Expansion HA Podium with Right/Left AV Podium, complete with power cube and swerve monitor arm.
 - .1 Right or left AV cabinet (FP-01a, FP-01b): as indicated or scheduled.
- .2 Finishes: in accordance with the 'Fixed Furniture Selection & Finishes' Appendix.
- .3 Basis of design: Teknion.
- .4 Substitutions: in accordance with Section 01 25 00.
- .7 Power supply: to be coordinated with Divisions 26, 27, and 28.

PART 3 - EXECUTION

3.1 Examination

- .1 Examine roughed-in electrical services, installation of floors, and other conditions affecting installation of fixed furniture. Verify dimensions and locations of services and substrates before fabricating work.

3.2 Preparation

- .1 Examine work in place on which fixed furniture work is dependent. Ensure correction of defects influencing required completion and performance of fixed furniture work in accordance with the requirements of the applicable section of work prior to commencement of work.
- .2 Construction and substrates materials to receive fixed furniture shall be sound, rigid, properly sized and location, level, plumb and square.
- .3 Overhead work, including but not limited to painting, staining and finishing shall be finished prior to start of fixed furniture installation.
- .4 Commencement of work shall indicate acceptance of substrate conditions.

3.3 Electrical Wiring

- .1 Power shall be brought up to circuit breaker/disconnect switch adjacent to controller under Divisions 26, 27, and 28 - Electrical and in conformance with requirements specified therein.
- .2 Wiring from motor to switches, controls, starters, safety devices and other items requiring power shall be carried out under this section.
- .3 Use EMT conduit for fixed wiring. Use purpose-made and approved type flexible cables or cords at applicable locations; adequately support so as not to impede access or foul moving parts of equipment.

3.4 Installation

- .1 Installation in accordance with manufacturer's written requirements and reviewed shop drawings.
- .2 Securely anchor and bolt fixed furniture to the floor.

3.5 Field Quality Control

- .1 Conduct quality control in accordance with Section 01 45 00.

3.6 Adjusting and Cleaning

- .1 Verify under work of this section that installed *Products* function properly, and adjust them accordingly to ensure quiet operation, free of objectionable noise.
- .2 Refinish damaged or defective work so that no variation in surface appearance is discernible.

3.7 Protection

- .1 Be responsible for protection of work completed. Notwithstanding the warranty required, promptly correct damage at the expense of the entity responsible for the damage.

END OF SECTION

Project Manual

Issued for Tender
May 02, 2025

**YORK UNIVERSITY
CLASSROOM RENEWAL – YEAR 3 PHASE II**

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May 2025

PROCUREMENT AND CONTRACTING REQUIREMENTS GROUP

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Not Used		

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Not Used

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Not Used

SITE AND INFRASTRUCTURE SUBGROUP

Not Used

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Not Used

End of Document

1 General

1.01 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.

1.02 APPLICATION

- .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.

1.03 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 sample of each proposed type of access door if supplied under work of this Division.
- .5 Submit samples of materials and any other items as specified in Sections of Mechanical Divisions.
- .6 Submit a list of equipment identification nameplates indicating proposed wording and sizes.
- .7 Submit a list of pipe and duct identification colour coding and wording.
- .8 Submit a proposed valve tag chart and a list of proposed valve tag numbering and identification wording.
- .9 Submit drawings indicating size and location of required sleeves, recesses and formed openings in poured or precast concrete work.
- .10 As specified in Part 2 of this Section, submit a spare belt set, tagged and identified, for each belt driven piece of equipment.
- .11 Submit any other submittals specified in this Section or other Sections of Mechanical Divisions.

1.04 ADDITIONAL WORK ITEMS

- .1 Following description of work includes labour, material, payroll burden, small tools, overhead, profit, and specific tax. Amounts for Work are to include applicable programming, testing, and verification. Harmonized Sales Tax (HST) is not included in amount but is to be identified separately. Work described below is included in Bid Price:
 - .1 Refer to York Tender Document

1.05 PRE-TENDERED EQUIPMENT

- .1 Refer to Appendix for complete information regarding scope of work for pre-tendered equipment. Equipment have been pre-tendered, ordered, and paid for by Owner. Associated work to be included as part of Work of Mechanical Division of this Project, that is to include for, but not be limited to, provision of following:
 - .1 coordination with respective equipment manufacturers with regards to delivery, unloading and acceptance on site;
 - .2 inspection upon delivery and acceptance;
 - .3 unloading, transporting and moving/hoisting into installation position;
 - .4 installation, connection, testing, and certification.
- .2 Take over order and coordinate with various manufacturers/suppliers of pre-ordered equipment and associated Work. During inspection of pre-ordered equipment and associated components at site, report deficiencies to respective supplier and to Owner and be responsible for resolving such deficiencies directly with respective supplier(s).
- .3 Be available for and attend factory testing at supplier's offices of pre-ordered equipment and associated Work, as requested by Consultant.
- .4 Coordinate final installation requirements with manufacturers/suppliers of pre-ordered equipment and associated Work.
- .5 For reference purposes, copy of shop drawing may be obtained from Consultant after order has been made.
- .6 Review installation schematics and diagrams, control system schematics, and wiring diagrams supplied by manufacturers/suppliers of pre-ordered equipment and associated Work. Coordinate interconnections with related various building systems.
- .7 Refer to respective equipment Section - Part 3 for additional installation requirements.
- .8 Refer also to Appendix for further details and requirements of pre-tendered equipment. Be responsible for review of issued documents and request further information from Consultant, if required. Include and incorporate required provisions and associated costs required for a complete installation.
- .9 Install equipment in accordance with drawing notes, specifications, and manufacturer's instructions and to comply with Owner's on site standards and regulations.
- .10 Pre-tendered equipment includes following:
 - .1 Not Used
- .11 Under Electrical Divisions scope of Work, electrical equipment was also pre-tendered. Mechanical Division Contractor to coordinate interconnections and integrations with Electrical Division Contractor.
- .12 Obtain following from suppliers of per-tendered equipment and submit to Owner:
 - .1 operating and maintenance materials, testing and commissioning reports, and inspection certificates/ULC approvals/local governing inspection authority approvals, warranties and other supplied documents; organize and combine documents into manuals as specified in Division 01;
 - .2 spare parts, maintenance tools and kits, and loose accessories.
- .13 Review and coordinate with each respective vendor of pre-tendered equipment, exact pre-tendered equipment, and accessories that are being supplied and/or installed, and services being performed by

pre-tendered equipment vendor. With each respective pre-tender equipment vendor, determine installation products and services which are not included as part of pre-tender packages but which need to be supplied by respective pre-tender equipment vendor in order to complete onsite installation of equipment. Obtain costs for supply of these items and include in Bid along with respective installation costs. Identify items as an itemized price included in Bid. Attach list of detailed items and itemized prices with Bid Form submission.

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 entitled Firestopping and Smoke Seal Systems and work is to be done as part of mechanical work.

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 Acceptable products are:
 - .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 Acceptable manufacturers are:
- .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 Coordinate consistency of look and finish of access doors on project with each Division of Work. Coordinate exact requirements with General Trades Contractor. Refer to Division 10 specifications by others for additional requirements.
- .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 Acceptable manufacturers include Le Hage, SMS, Pedlar and 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;
 - .5 pressure gauges in medical gas piping systems are to conform to CSA Z7396.1 and are to be identified with the name of the service it is provided for as well as "USE NO OIL".
- .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 ($\frac{1}{2}$ ") NPT connection with 6.4 mm ($\frac{1}{4}$ ") diameter stainless steel stem;
- .9 suitable thermowell.
- .4 Acceptable manufacturers are:
 - .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 ($1\frac{1}{2}$ ") 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 ($\frac{3}{32}$ ") thick frame and expanded mesh face.
- .3 For unprotected fan inlets and outlets – unless otherwise specified, removable 20 mm ($\frac{3}{4}$ ") 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 Acceptable manufacturers are:
 - .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 Acceptable manufacturers are:
 - .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 gasketting 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 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.
 - .3 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

PIPE SERVICE	IDENTIFICATION COLOUR	LEGEND
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
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

PIPE SERVICE	IDENTIFICATION COLOUR	LEGEND
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
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

- .4 Colours for pipe identification legends and directional arrows are to be as follows:

IDENTIFICATION COLOUR	LEGEND & ARROW COLOUR
yellow	black
green	white
red	white

- .5 Medical gas piping identification materials and requirements are specified in Section 22 63 00 - Gas Systems for Laboratory and Healthcare Facilities.
- .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 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. Acceptable manufacturers are:
- .1 Hyspan 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 Provide continuous galvanized sheet metal drip pan under drain, water and water solution piping extending through rooms with electrical equipment such as electrical, elevator equipment and transformer rooms, and other spaces provided primarily for the installation of electrical equipment. Drip pans are to be complete with a drain pipe connection and drain piping is to be extended to closest drain.
 - .13 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.
 - .14 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.
 - .15 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.
 - .16 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 HIGH PRESSURE PIPING SYSTEM REQUIREMENTS

- .1 Following requirements apply to piping designated above as high pressure piping, regardless of what may be specified to contrary elsewhere in Specification:
 - .1 Class 250 screwed fittings for steel pipe;
 - .2 grooved end fittings and couplings for grooved end steel pipe are to be pressure rated for the application;
 - .3 95% tin, 5% antimony solder for copper piping joints;
 - .4 300 lb. Class companion flange unions;
 - .5 ASTM A-193 Grade B7 bolts and ASTM A-194 CL-2H nuts for flanged joints;
 - .6 other piping system accessories are to be suitable in all respects for system operating pressure;
 - .7 meet requirements of governing authorities.

3.03 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 Include (and pay for) magnetic particle testing of 10% of the welds in piping systems indicated below. Testing is to be done by a specialist qualified in accordance with CSA W178.1 and CSA W178.2 and approved by Consultant. Testing is to be done to ANSI/ASME Boiler and Pressure Vessels Code, Section V, CSA B51, and requirements of governing authorities.
- .7 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.
- .8 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.

- .9 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.
- .10 Joints in medical gas system piping are to be silver brazed in accordance with requirements of CAN/CSA Z7396.1.
- .11 Install mechanical joint fittings and couplings in accordance with manufacturer's instructions.
- .12 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.
- .13 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.
- .14 Solvent weld PVC piping in 2 parts, primer stage and cementing stage, in accordance with manufacturer's recommendations, ASTM D2855, and CSA requirements.
- .15 Install PVC piping with gasketed joints in accordance with manufacturer's current published specifications, instructions and recommendations, and CSA requirements.

3.04 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 concerned 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.

3.05 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.

3.06 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 600 mm (24") high 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.

3.07 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.

3.08 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.

3.09 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.

3.10 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 located in accordance with drawing detail;
 - .2 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;
 - .3 support underground service piping penetrating building exterior walls or foundations to prevent pipe damage if minor building settlement occurs, all as per drawing detail;
 - .4 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 roof in accordance with requirements of drawing detail.
- .12 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.
- .13 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.
- .14 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.
- .15 Do not support piping from steel deck without written consent from Consultant.

3.11 SUPPLY OF ACCESS DOORS

- .1 Supply access doors to give access to mechanical work which may need maintenance or repair 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 Submit a sample of each proposed access door for review prior to ordering.
- .7 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.

3.12 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.

3.13 INSTALLATION OF PRESSURE GAUGES AND THERMOMETERS

- .1 Provide pressure gauges in following locations:
 - .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:
 - .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:
 - .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.

3.14 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.

3.15 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 and requirements of Section 09 91 00 - Painting. 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 computer printed 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 frame and glaze one copy of chart and, unless otherwise directed, affix to a wall in each main Mechanical and/or Equipment Room;
- .5 include a copy of valve tag chart in each copy of operating and maintenance instruction manuals;
- .6 hand an identified CD of valve tag chart to Owner at same time O & M Manuals are submitted.
- .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

3.16 FINISH PAINTING OF MECHANICAL WORK

- .1 Finish paint exposed mechanical work as specified and/or scheduled in accordance with requirements of Section 09 91 00.
- .2 Touch-up paint damaged factory applied finishes on mechanical work products.
- .3 Finish painting of exposed mechanical work is specified in Section 09 91 00 - Painting and is part of the work of Division 09.

3.17 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 If project is located in the area of Lower Mainland, Lower Fraser Valley of B. C., give Consultant a minimum of 2 working days' notice of intended tests. If project is located outside Lower Mainland, Lower Fraser Valley of B. C., give Consultant 3 working days' notice of intended tests.
- .5 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.
- .6 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.
- .7 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.
- .8 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.
- .9 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.
- .10 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.
- .11 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
- .12 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.
- .13 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).
- .14 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.
- .15 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.
- .16 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.
- .17 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.
- .18 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.
- .19 Refrigerant Piping
 - .1 Test refrigerant piping for leakage and dehydrate in accordance with requirements of Chapter 18 of ASHRAE Handbook - Fundamentals.
- .20 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.
- .21 Medical Gas System Piping
 - .1 Perform leakage and flow tests for piping using oil-free compressed air or oil-free dry nitrogen in accordance with requirements of CAN/CSA Z7396.1.
- .22 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.
- .23 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 make tight leaks found during tests while piping is under pressure, and 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.

3.18 SUPPLY OF MOTOR STARTERS AND ACCESSORIES

- .1 Motor starters for mechanical equipment, except for starters integral with packaged equipment and starters factory installed in equipment power and control panels, will be provided as part of the electrical work.
- .2 Unless otherwise shown or specified, supply a starter for each item of motorized equipment. Refer to Motor Starter Schedule.
- .3 Where 3-phase starters are indicated in motor control centres, supply motor control centres with starters and bolt to a concrete housekeeping pad.
- .4 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.
- .5 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.
- .6 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.
- .7 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.

3.19 ELECTRICAL WIRING WORK FOR MECHANICAL WORK

- .1 Unless otherwise specified or indicated, following electrical wiring work for mechanical equipment will be done 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.
- .2 Mechanical wiring work not listed above or specified herein or on drawings to be done as part of electrical work is to be installed in conduit and is to be done as part of mechanical work in accordance with wiring requirements specified for electrical work.

3.20 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. 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 Where existing isolation valves do not hold, pipe freezing shall be used to connect new piping to existing piping. Pipe freeze equipment is to be equal to "NORDIC FREEZE" equipment supplied by Mag Tool Inc. (1-800-661-9983) or Rigid Tool Co. RIGID "SuperFreeze".

3.21 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 restrained stands and supports in accordance with applicable requirements.
- .3 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 OHSA 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.

3.22 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.

3.23 CONCRETE WORK FOR MECHANICAL EQUIPMENT BASES/PADS

- .1 Concrete work required for mechanical equipment bases/pads will be provided as part of concrete work of Division 03.
- .2 Exactly locate bases/pads at site and be present during concrete pour to ensure anchor bolts, inserts, plates and similar hardware are not damaged or dislodged.

- .3 Coordinate base/pad installations with concrete trade and ensure bases and pads are keyed into structure to meet seismic restraint requirements.

3.24 CONCRETE WORK FOR MECHANICAL EQUIPMENT BASES/PADS

- .1 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 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.

3.25 EXCAVATION AND BACKFILL WORK

- .1 Excavation, backfill and related work such as dewatering required for mechanical work will be performed as part of excavation and backfill work, except for final hand grading work which is to be done as part of mechanical work. Mark out location and routing of excavation required for work as well as required depth. Ensure that bedding is graded to provide proper drainage for ducts as directed by Consultant.
- .2 Inverts and locations of existing site services may have been site surveyed and approximate location may be shown on drawings. Confirm local utilities have performed locates and marking out. Ensure inverts and locations are correct, prior to commencement of work. Where discrepancies are found, immediately inform Consultant, and await a direction.
- .3 Accurately mark-out location and routing of excavation required, as well as required depth.
- .4 Ensure underground piping subject to freezing and located outside building has a minimum of 1.37 m (4-½') of cover.
- .5 Ensure underground piping subject to freezing and located inside building in unheated areas has a minimum of 450 mm (18") of cover.
- .6 Ensure pipe bedding is proper prior to laying pipes. Hand excavate under pipe hubs, couplings, flanges and similar items to ensure even bearing along the entire barrel of each length of pipe.
- .7 Ensure piping is inspected, leakage tested and approved prior to backfilling. Supervise initial backfilling operation to ensure buried work is not disturbed.
- .8 Ensure work is inspected by Consultant before covering and backfilling. Failure to do so prior to backfilling will require re-excavating of work and re-backfill at no additional cost to Owner.

3.26 EXCAVATION AND BACKFILL WORK

- .1 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.
- .2 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.
- .3 Where Work falls under jurisdiction of local governing utility, confirm requirements and comply with utility requirements.

- .4 Provide excavation, backfill and related work required for mechanical work. Perform such work in accordance with requirements of the Section 31 23 00 – Excavation and Fill, except as modified by this Article. 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.
- .5 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.
- .6 In firm, undisturbed soil, lay pipes directly on soil, unless otherwise directed.
- .7 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.
- .8 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.
- .9 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.
- .10 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.
- .11 Provide minimum 1.37 m (4.5') of cover for underground piping subject to freezing and located outside building.
- .12 Provide minimum 450 mm (18") of cover for underground piping subject to freezing and located inside building.
- .13 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.
- .14 Unless otherwise directed in Division 02 and/or 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.
- .15 Perform pumping as required to keep excavations free of water.
- .16 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.
- .17 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.
- .18 Coordinate requirements for final surface toppings (concrete, asphalt, pavers, grass sod, etc.) with General Contractor.

3.27 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 in accordance with requirements of article entitled Firestopping and Smoke Seal Materials in this Section. Do not leave openings open overnight unless approved by Owner and Consultant.

3.28 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.

3.29 FLASHING FOR MECHANICAL WORK PENETRATING ROOF

- .1 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 requirements specified in Division 07.

3.30 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.

3.31 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.

3.32 SEISMIC RESTRAINT ANCHOR POINTS FOR EQUIPMENT

- .1 Mechanical equipment requiring seismic restraint (see Section 20 05 43.16 – Seismic Controls for Mechanical Systems) 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 the internal components of equipment exceeds force level used to restrain and anchor equipment itself to the supporting structure.

3.33 INSTALLATION OF FLEXIBLE CONNECTORS

- .1 Provide flexible connectors in piping connections to seismically restrained equipment, and wherever else shown.
- .2 Provide flexible connectors in piping connections to vibration isolated equipment.

3.34 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.

3.35 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.

3.36 EQUIPMENT AND SYSTEM START-UP

- .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.

1.02 SUBMITTALS

- .1 Submit documentation to confirm reclaimed refrigerant has been properly removed and stored, recycled, or disposed of as applicable.

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.
- .6 Unless otherwise specified, remove from site and dispose of existing materials which have been removed and are not to be relocated or reused, except for following which are to be handed over to Owner at site:
 - .1 All existing plumbing fixtures and faucets / flush valves

3.02 HAZARDOUS WASTE

- .1 Be advised that items such as drainage sumps, catch basins, interceptors, and the like may contain unidentified hazardous waste and caution is to be taken when disconnecting and removing these items.
- .2 If hazardous waste not listed in Specification is found, notify Owner and Consultant immediately and await directions.

3.03 INTERRUPTION TO AND SHUT-DOWN OF MECHANICAL SERVICES AND SYSTEMS

- .1 Co-ordinate 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.
- .2 Upon award of contract, submit a list of anticipated shut-down times and their maximum duration.
- .3 Prior to each shut-down or interruption, inform Owner in writing 5 business 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.
- .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 Where existing isolation valves do not hold, pipe freezing shall be used to connect new piping to existing piping. Pipe freeze equipment is to be equal to "NORDIC FREEZE" equipment supplied by Mag Tool Inc. (1-800-661-9983) or Rigid Tool Co. RIGID "SuperFreeze".

3.04 DECOMMISSIONING OR ALTERATIONS TO REFRIGERATION EQUIPMENT

- .1 Remove and reclaim refrigerant from applicable equipment to be decommissioned and/or altered. Refrigerant reclaim and recycling work is to be in accordance with Refrigerant Management Canada guidelines, and governing codes and regulations. Do not under any circumstances vent refrigerant from existing equipment to atmosphere.
- .2 Use refrigerant recovery equipment designed specifically to reclaim and recycle refrigerant, and use only skilled refrigeration mechanics to perform reclaim and recycle work.
- .3 Provide approved, properly sized and sealable refrigerant containers for reclaimed refrigerant.
- .4 Hand containers of refrigerant to Owner at site.
- .5 Dispose of reclaimed refrigerant by engaging services of a licensed firm specializing in recycling of reclaimed refrigerant. Submit documentation to confirm refrigerant has been properly removed from site and recycled or disposed.

3.05 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 REFERENCES

- .1 Division 00 and Division 01 apply to and are a part of this Section.

1.02 APPLICATION

- .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 Divisions 00 or 01, conditions of Division 00 or Division 01 to take precedence.
- .2 Be responsible for advising product vendors of requirements 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 Divisions 20, 21, 22, 23, 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 Divisions 26, 27, 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 When scale and date of Drawings are the same, or when discrepancy exists within Specification, include most costly arrangement to take precedence.
- .13 In case of discrepancies or conflicts between Drawings and Specification, documents will govern in following order:
 - .1 Specification;
 - .2 Drawings of larger scale;
 - .3 Drawings of smaller scale;
 - .4 Drawings of later date when scale of Drawings is same.
- .14 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 existing building 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 PHASING

- .1 Include for scheduling, coordination, and construction phasing to suit project as specified in Division 01 and on 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 to 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 OF WORK

- .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 acceptable 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 acceptable 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 Indicate in Supplementary Mechanical Bid Form, names of manufacturers for proposed products to be supplied, and which were based specified or scheduled with a manufacturer's name. Names of proposed manufacturers on list must be one of names stated as acceptable for particular products, unless prior approval from Owner has been given for use of products by other manufacturers. Submit to Consultant for review as directed.
- .10 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.
- .11 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.
- .12 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.
- .13 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.
- .14 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 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 In most cases acceptable product manufacturers are listed (Appendix A) for any product specified by manufacturer's name and model number. Unless otherwise stated, Bid Price may be based on products supplied by any manufacturers named as acceptable for particular product. If acceptable manufacturers are not listed for a particular product, base Bid Price on products supplied by specified manufacturers.
- .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. Note that 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 on Appendix A, List of Acceptable Manufacturers and Suppliers, may be considered for acceptance by Owner and reviewed with Consultant if requested in writing 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 approved 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.

1.16 NON-FERROUS MATERIALS

- .1 Materials within designated imaging rooms to be of non-ferrous construction as reviewed with Consultant. Devices, system components, etc., utilized to be approved for use in designated imaging room type applications. Methods of construction to take into consideration use of non-ferrous materials. Ultimate approval of any materials, devices or components, or methods of construction to be at imaging system manufacturer's discretion. Coordinate and confirm final requirements with successful imaging system supplier.

1.17 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:
- .9 "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."
- .10 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.
- .11 Obtain shop drawings for submission from product manufacturer's authorized representatives and supplemented with additional items specified herein.
- .12 Do not order product until respective shop drawing review process has been properly reviewed with Consultant.
- .13 Where extended warranties are specified for equipment items, submit specified extended warranty with shop drawing submittal.
- .14 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.

1.18 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.

1.19 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.

1.20 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.

1.21 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 If overhead and profit percentages are not specified in Division 00 or 01, but allowable under Contract as reviewed with Consultant prior to contract signing, then allowable maximum percentages for overhead and profit are to be 7% and 5% respectively.
- .4 Unless otherwise specified in Divisions 00 or 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 journey person 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.
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- .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.

1.22 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.

1.23 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.

1.24 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.

1.25 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.
- .2 Permanent mechanical systems in building may be used for temporary heating or cooling during construction subject to following conditions:
 - .1 each entire system is complete, pressure tested, cleaned, and flushed out;
 - .2 specified water treatment system has been commissioned, and treatment is being continuously monitored;
 - .3 building has been closed in and areas to be heated/ventilated are clean and will not thereafter be subjected to dust-producing processes;
 - .4 there is no possibility of damage from any cause;
 - .5 supply ventilation systems are protected by 60% filters, which are to be inspected daily, and changed every 2 weeks, or more frequently as required;
 - .6 return air systems have approved construction filters over openings, inlets, and outlets;
 - .7 systems are operated as per manufacturer's recommendations or instructions, and are monitored on a regular and frequent basis;
 - .8 warranties are not affected in any way;
 - .9 regular preventive and other manufacturer's recommended maintenance routines are performed;
 - .10 before application for Certificate of Substantial Performance, each entire system is to be refurbished, cleaned internally and externally, restored to "as-new" condition, and filters in air systems replaced;
 - .11 energy costs are to be paid by Contractor.
- .3 Confirm with Consultant what equipment can be used during construction.
- .4 Any system or piece of equipment that is specified to be provided under requirements of Documents and is required to be used during construction stages of work prior to issuing of Certificate of Substantial Performance of the Work, are to be provided with special interim maintenance and service to cover systems/equipment during time of use during construction period of project until project has been certified as substantially performed and such systems/equipment are turned over to Owner.

- .5 During this period of construction, such systems/equipment to not become property of Owner or be Owner's responsibility for maintenance or service. Systems/equipment are to remain property of respective manufacturers/suppliers or Contractor, who are responsible for full maintenance and servicing of systems/equipment in order to maintain validity of warranties after turn over to Owner.
- .6 Prior to application for a Certificate of Substantial Performance of the Work and turn over to Owner, such systems/equipment to be cleaned, restored to "new" condition, paint finishes "touched-up", filters cleaned or replaced, etc.

1.26 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.

1.27 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.

1.28 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.

1.29 RECORD AS-BUILT DRAWINGS

- .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, at expense of \$25.00 CDN plus HST, per drawing, up to first 10 drawings, and \$5.00 CDN plus HST, per any additional drawings thereafter. Drawings may also to be used for preparation of layouts and interference drawings.
- .2 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.
- .3 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.
- .4 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.
 - .5 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.
 - .6 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.
 - .7 Unless otherwise noted in Divisions 00 or 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.
 - .8 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. Copies of hand drawn interim as-built drawings to be made available to Owner's maintenance personnel.
 - .9 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, to produce a signed and sealed AutoCAD disc (of release version reviewed with Consultant) of survey work which is to be submitted to Consultant. Transfer survey work to as-built drawings.

1.30 OPERATING AND MAINTENANCE MANUALS

- .1 For each item of equipment for which a shop drawing is required (except for simple equipment), supply minimum 3, project specific, indexed copies of equipment manufacturers' operating and maintenance (O&M) instruction data manuals. Review exact quantity of manuals with Consultant. Consolidate each copy of data in an identified hard cover three "D" ring binder. Each binder 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 Generally, binders are not to exceed 75 mm (3") thick and not to be more than 2/3 full.
- .3 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.

- .4 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.
- .5 Provide 2 digital copies of contents of operating and maintenance manuals and load onto separate USB type flash drives and submit to Consultant. Prepare digital copies using version of Adobe Acrobat Portable Document Format or equal as reviewed with Consultant and enhanced with bookmarks and internal document links.

1.31 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 of 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 of Mechanical Systems, project closeout documents, and other required submittals.
- .2 An independent Commissioning Agent is to be retained by Contractor to perform equipment and system commissioning work as specified in Division 01, and in Section 20 08 00 – Commissioning of Mechanical Systems.
- .3 An independent Commissioning Agent is retained by Owner to perform equipment and system commissioning work as specified in Division 01, and in Section 20 08 00 – Commissioning of Mechanical Systems. Interface, cooperate and coordinate with Owner's Commissioning Agent. Submit copies of submittals such as shop drawings/product data sheets, schedules, O&M manuals, and test reports to Commissioning Agent as required.
- .4 Where commissioning specifications are included as part of Division 01, requirements of Section 20 08 00 – Commissioning of Mechanical Systems are to supplement commissioning requirements of Division 01. Where variances or contradictions exist, more stringent requirement will apply unless otherwise directed by Consultant.

1.32 WARRANTY

- .1 Unless otherwise specified in Divisions 00 and 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.

1.33 PROJECT CLOSEOUT SUBMITTALS

- .1 Prior to application for Substantial Performance of the Work, submit required items and documentation specified, including following:
 - .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.

1.34 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 loaded on USB flash drive. Include in operating and maintenance manuals submission.
 - .9 Provide digital video disc (DVD) recording of operating and instructions training for following systems:
 - .1 building automation system.
 - .10 Provide a custom video in DVD format that details on site systems and equipment operations and includes following:
 - .1 professional videographer on site to capture training session; use wireless lavalier microphone to capture crystal clear audio of trainer in association with video footage; edit video to remove unnecessary footage;
 - .2 DVD to include custom site specific system/equipment screens that outline key information about system/equipment and devices used on site only;

- .3 DVD to also include custom site specific video that details programming procedures in conjunction with a voiceover from on-site technician;
- .4 DVD created with a main menu screen and authored with chapters to allow operator to access specific areas of training instantly.
- .11 Supply minimum quantity of 3 copies of DVDs for each system/equipment.

1.35 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

End of Section

1 General

1.01 APPLICATION

- .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 RELATED REQUIREMENTS

- .1 Section 07 74 00 - Firestopping.

1.03 SUBMITTALS

- .1 At least 4 weeks prior to work commencing, submit a sample of each type of firestop and smoke seal system in applied form, for approval. Identify each system with manufacturer's name and type, ULC designation, and proposed use. After samples are reviewed, work is to conform to reviewed samples.
- .2 Submit a product data sheet and a WHIMIS sheet for each firestopping and smoke seal product.
- .3 Submit for review, full company name and experience of proposed firestopping and smoke seal system applicator.
- .4 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 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.
- .2 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.
- .3 Pipe insulation forming part of a fire and smoke seal assembly is specified in Section entitled Mechanical Insulation.
- .4 Firestopping and smoke seal "F" or "FT" ratings are to be as defined in current B.C. Building Code or local Municipal Code, as applicable to requirement for sealing the construction penetrated. Refer to ULC Guide No. 40 U19.
- .5 Acceptable manufacturers are:
 - .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 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.
- .4 Submit a report by Agency after each site visit made by Agency during construction phase of this Project.
- .5 Submit a draft report, as specified in Part 3 of this Section.
- .6 Submit a final report, as specified in Part 3 of this Section.
- .7 Submit a testing and balancing warranty as specified in Part 3 of this Section.

- .8 Submit reports listing observations and results of post construction site visits as specified in Part 3 of this Section.

1.04 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 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 air handling systems is to include equipment and ductwork air temperatures, capacities and flows.
 - .4 All existing systems, revised as part of mechanical work, are to be tested, adjusted and balanced as for new systems:

3.02 TESTING, ADJUSTING, AND BALANCING

- .1 as soon as possible after award of Contract, Agency is to carefully examine a white print 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 for belt-driven equipment, Agency is to report to Commissioning Agent who in turn is to inform Contractor and Consultant of any situation where sheaves have to be replaced to suit testing and balancing, and replacements are to be done by Contractor at no cost;
- .12 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;
- .13 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;
- .14 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;
- .15 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;

- .16 for air handling systems equipped with air filters, test and balance systems with simulated 50% loaded (dirty) filters by providing a false pressure drop;
- .17 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. Submit 2 complete sets of draft reports. Only 1 complete set of draft reports will be returned.
 - .2 Upon verification and approval of draft reports, prepare final reports, type written, and organized and formatted as specified below. Submit 2 complete sets of final reports. 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. Bind report forms complete with schematic systems diagrams and other data in reinforced, vinyl, 3-ring binders. Provide binding edge labels with project identification and a title descriptive of contents. Divide contents of binder into divisions listed below, separated by divider tabs:
 - .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.
- .5 After acceptance of final report, Agency is to perform post testing and balancing site visits in accordance with following requirements:
 - .1 post testing and balancing site visits are to be made:
 - .1 once during first month of building operation;
 - .2 once during third month of building operation;
 - .3 once between fourth and tenth months in a season opposite to first and third month visit.
 - .2 during each return visit and accompanied by Owner's representative, Agency is to spot rebalance terminal units as required to suit building occupants and eliminate complaints;
 - .3 Agency is to schedule each visit with Contractor and Owner, and inform Consultant;
 - .4 after each follow-up site visit, Agency is to issue to Contractor and Consultant a report indicating any corrective work performed during visit, abnormal conditions and complaints encountered, and recommended corrective action.

End of Section

1 General

1.01 APPLICATION

- .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 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.
- .5 Submit a colour chart for coloured lagging adhesive for canvas jacketed insulation.

1.04 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. Acceptable products are:
 - .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. Acceptable products are:
 - .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. Acceptable products are:
 - .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. Acceptable products are:
 - .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. Acceptable products are:
 - .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 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. Acceptable products are:
 - .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. Acceptable products are:
 - .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.

2.05 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. Acceptable manufacturers are:
- .1 Crossby Dewar Inc.;
 - .2 Insufab Systems Inc.;
 - .3 ADL Insulflex Inc.;
 - .4 Firwin Corp.;
 - .5 GlassCell Isofab Inc.

2.06 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. Acceptable products are:
- .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. Acceptable products are:
- .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 (1½") thick, with a factory applied vapour barrier facing. Acceptable products are:
- .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. Acceptable products are:
- .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. Acceptable products are:

- .1 Armacell "AP/Armaflex SA";
.2 IK Insulation Group "K-Flex Duct Wrap", S2S.

2.07 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".

2.08 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.

2.09 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. Acceptable products are:

- .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 branch potable water piping located under counters to serve counter mounted plumbing fixtures and fittings, except barrier-free lavatories;
 - .3 exposed chrome plated potable water angle supplies from concealed piping to plumbing fixtures and fittings, except barrier-free lavatories;
 - .4 acoustically lined ductwork and/or equipment;
 - .5 factory insulated flexible branch ductwork;
 - .6 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 hot water heating piping, supply and return, less than 40 mm (1-½") dia. – 40 mm (1-½") thick;
- .8 hot water heating piping, supply and return, greater than or equal to 40 mm (1-½") dia. – 50 mm (2") 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 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.

3.04 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.

3.05 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.

3.06 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.
- .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. for following paragraph, If used, complete blank subparagraphs to describe insulation to be covered with flexible aluminum.
- .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. for following paragraph, If used, complete blank subparagraphs to describe insulation to be covered with rigid stainless steel.
- .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.
- .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 APPLICATION

- .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 REFERENCE

- .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.
- .5 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.

1.05 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.

1.06 COMMISSIONING AGENT

- .1 Retain services of a qualified Commissioning Agent.

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 Project will be constructed in phases as described in Specification. Phase commissioning 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 drainage systems includes:
- .3 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.
- .4 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.
- .5 Commissioning of BAS includes confirmation of proper operation of components, input/output points, hardware and software, and demonstration of system performing required procedures.
- .6 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 COMMISSIONING AGENT

- .1 During construction phase, Commissioning Agent is to:
 - .1 review Contractor's shop drawings for commissioning related issues, and report any such issues to Consultant;
 - .2 as soon as possible after project start-up, prepare and issue a Commissioning Plan based on Contractor's construction schedule;
 - .3 prior to tests, supply pre-functional performance test commissioning data sheets for equipment and systems to be commissioned to Contractor;
 - .4 monitor and inspect installation on a regular basis throughout construction stages, issue reports identifying any issues which may have an impact on commissioning process, and work with project team to expeditiously resolve any problems that may arise due to site conditions;
 - .5 arrange with Contractor for on-site commissioning meetings on an as-required basis, to be attended by Contractor and applicable subcontractors, Owner, and Consultant, chair meetings, and prepare and distribute meeting minutes to attendees;
 - .6 witness and validate tests, identify deficiencies, and issue progress reports;
 - .7 coordinate commissioning scheduling with Contractor;
 - .8 review final TAB report on site with Contractor, and check 100% of TAB results for fan equipment, 30% of TAB results for duct systems outward from fan equipment, and issue a report to Consultant;
 - .9 for smaller multiple items of equipment such as air terminal boxes, fan coil units, backflow preventers, and similar equipment, review completed commissioning data sheets submitted by Contractor and review data sheet information on-site with Contractor for 30% of quantity of each item of equipment;
 - .10 review pre-functional performance test commissioning data sheets submitted by Contractor, then witness and supervise functional performance testing and supervise and direct commissioning process, validate commissioning procedures, witness completion of commissioning data sheets by Contractor, and sign completed data sheets;
 - .11 perform a preliminary review of Contractor's O & M Manuals, before they are issued to Consultant, and issue any comments to Consultant;

- .12 coordinate, with Contractor and Owner, training and instructions by Contractor and his equipment and system manufacturers/suppliers to Owner's operating and maintenance personnel, and comment on quality of training and instructions to Consultant;
- .13 prepare and issue Systems Operation Manual to Owner prior to equipment and system training by Contractor.
- .2 During post construction phase, Commissioning Agent is to:
 - .1 prepare and issue final report on commissioning, identifying any deficiencies that remain outstanding;
 - .2 recommend any training and/or instructions to be given to Owner's operating and maintenance personnel in addition to training and instructions already given;
 - .3 after Substantial Performance of the Work, witness system checks and validate documentation by Contractor as follows:
 - .1 once during 1st month of building operation;
 - .2 once during 3rd month of building operation;
 - .3 once between 4th and 10th month of building operation but during a season opposite to 1st or 3rd month visits.
 - .4 ensure any deficient work resulting from system checks described above are corrected;
 - .5 3 months after Substantial Performance of the Work, attend a question and answer session(s) with Contractor to answer any questions and concerns related to commissioning work from Owner's operating personnel.

3.07 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;

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 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.
 - .2 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.
 - .3 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.
- .4 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.
- .5 "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.
- .6 "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.
- .7 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.
- .8 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 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.

2.03 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.

2.04 BALL DRIPS

.1 Equal to National Fire Equipment Ltd. Model #A58, 20 mm (¾") diameter automatic ball drip.

2.05 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.

2.06 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 Recessed sprinkler heads in finished areas are to be chrome plated unless otherwise specified. Concealed sprinkler head ceiling plates are to match ceiling colour.

.5 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.

.6 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.

- .7 Escutcheons and guards shall be listed, supplied, and approved for use with the sprinkler by the sprinkler manufacturer.
- .8 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.
- .9 Manufacturers:
 - .1 Victaulic Co.;
 - .2 Tyco Fire Suppression & Building Products;
 - .3 The Viking Corporation;
 - .4 The Reliable Automatic Sprinkler Co.

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 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;
 - .2 for wet system piping inside building and above ground – at your option, CPVC sprinkler pipe and fittings;

- .3 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;
- .4 for branch piping to heads in suspended ceilings, etc. – at your option, flexible piping installed in accordance with manufacturer's instructions;
- .5 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 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.
- .8 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 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.

3.05 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.

3.06 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.

3.07 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.

3.08 INSTALLATION OF SPRINKLER HEADS

- .1 Provide required sprinkler heads in accordance with following schedule:

Application	Sprinkler HEAD TYPE
Rooms/areas with a suspended ceiling	Victaulic V38/V39 or Tyco Series RFII "Royal Flush II" concealed pendent
Rooms/areas without a suspended ceiling	Victaulic V27 or Tyco Series TY-FRB pendent

- .2 Sprinkler head manufacturers indicated on schedule are for type indication purposes. Manufacturers are listed in Part 2 of this Section.
- .3 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.
- .4 Maintain maximum headroom in areas with no ceilings.
- .5 Provide guards for heads where they are subject to damage.
- .6 Provide high temperature heads in equipment rooms and similar areas over heat producing or generating equipment.

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 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.

2.02 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 Execution

3.01 DEMOLITION

- .1 Refer to demolition requirements specified in Section 20 05 05 – Selective Demolition for Mechanical.

3.02 DRAIN AND VENT PIPING INSTALLATION REQUIREMENTS

- .1 Provide required drainage and vent piping. Pipe, unless otherwise specified, as follows:
 - .1 for pipe inside building and aboveground in sizes less than or equal to 65 mm (2-½") dia. – type DWV copper;
 - .2 for pipe inside building and aboveground in sizes greater than or equal to 75 mm (3") dia. – Class 4000 cast iron;
 - .3 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;
- .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 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').
- .4 Provide cast brass dielectric unions at connections between copper pipe and ferrous pipe or equipment.

3.03 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 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.

3.04 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.

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 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.

2.07 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.

2.08 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.

2.09 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.

2.10 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.

2.11 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.

2.12 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.

2.13 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.

2.14 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.

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 or beaded per SMACNA standards. 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 the 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 the 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 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 the 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 the 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 1.8 m (6') fully stretched, 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 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.

3.06 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.

3.07 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.

3.08 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.

3.09 INSTALLATION OF BACKDRAFT DAMPERS

- .1 Provide backdraft dampers.
- .2 Install and secure dampers so they cannot move or rattle.

3.10 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.

3.11 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.

3.12 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.

3.13 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.

3.14 SUPPLY OF DOOR GRILLES

- .1 Supply door grilles as shown and scheduled.
- .2 Hand grilles to appropriate trade at site for installation.

3.15 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 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.
- .3 Submit a site inspection and start-up report from manufacturer's representative as specified in Part 3 of this Section.
- .4 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.

1.02 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:
 - .1 Two-Position: Line size or size using a pressure differential of 1 psi.
 - .2 Two-Way Modulating: 3 psid or twice the load pressure drop, whichever is more.
 - .3 Three-Way Modulating: Twice the load pressure drop, but not more than 5 psid.
- .2 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.
- .3 Heating valves are to be normally open unless otherwise specified.
- .4 Unless otherwise specified, control valves in hydronic piping systems are to conform to requirements specified in Section 23 21 00 – HVAC Piping and Pumps.

- .5 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.
- .6 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.

2.02 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.

2.03 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;
- .3 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.

- .4 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 Line voltage thermostats are to be 115 volt.
 - .3 Low voltage thermostats are to be 24 volt electronic type.
 - .4 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.
 - .5 Covers are to be removable, tamper-proof covers with temperature set-point and thermometer displays.
 - .6 Guards for thermostats are to be clear, ventilated acrylic covers with allen key locking hardware.
- .5 Hardware to permit building automation system control and monitoring of input/output points in accordance with drawing control diagrams and operation sequences. All such hardware is to be suitable in all respects for interface with the building automation system.

2.04 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 DEMOLITION

- .1 Perform required control system demolition work.
- .2 Refer to demolition requirements specified in Section 20 05 05 – Selective Demolition for Mechanical.

3.02 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.

3.03 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.

3.04 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. Confirm exact location of 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.

3.05 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.

3.06 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.

3.07 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.

3.08 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 Refer to Section 20 05 00 – Common Work Results for Mechanical for equipment/system manufacturer certification requirements.
- .3 Refer to Section 20 05 00 – Common Work Results for Mechanical for equipment/system start-up requirements.
- .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 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 [Section 11 11 36 – Vehicle Charging Equipment.]
- .8 [All sections related to heat tracing].
- .9 [Section 32 17 43 – Pavement Snow Melting Systems.]
- .10 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 a substitution 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 manufacturer 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. The 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 SUBMITTALS

- .1 The Contractor is to submit dimensioned drawings or sketches that indicates the dimensions of the procured equipment, demonstrates that the equipment will fit in the allocated spaces, and demonstrates that manufacturer and code required clear spaces are provided.
- .2 Include sketches for the following locations that includes at minimum, major equipment such as switchboards, panelboards, splitters, transformers, generators, transfer switches, major wall mounted or floor mounted telecommunications equipment, and fire alarm panels, passive graphics, and annunciator panels.
 - .1 [Main Electrical Room].
 - .2 [Electrical closets].
 - .3 [Telecommunications rooms].
 - .4 [Generator Room] [Area around outdoor generator enclosure].
 - .5 [CACF room].

1.12 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.

1.13 [INFECTION CONTROL PROCEDURES]

- .1 [Refer to Section 01 35 33.
- .2 Comply with the following standards:
 - .1 CAN/CSA-Z317.13, Infection Control During Construction, Renovation, and Maintenance of Health Care Facilities.
 - .2 CAN/CSA-Z317.10, Handling of Waste Materials in Healthcare Facilities.
 - .3 CAN/CSA-Z318.0, Commissioning of Healthcare Facilities.
- .3 Prepare a list of all areas of the work where the infection control procedures are to be in force and review the list and procedures with the healthcare facility's infection control officer or a designated healthcare facility representative prior to any work in the areas commencing, and as work proceeds ensure that all infection control procedures are being maintained.
- .4 Healthcare facility has policies and procedures that are to be reviewed and followed when working within areas of healthcare facility. Include for requirements specified in Division 01 and in this article.
- .5 Comply with healthcare facility's latest policies and procedures regarding infection prevention measures during work of construction/renovation/installation/maintenance.
- .6 Comply with healthcare facility's latest requirements regarding decontamination. Exact requirements and scope of this work are to be defined on drawings or in specifications where applicable and also may be defined in Division 01.

- .7 Patient Care Areas
 - .1 Comply with requirements for patient care areas (PCA) included in Work as required by Section 24 of OESC. Patient care areas are identified on drawings or in schedule appended to end of this Section. Review final PCA nomenclature with the Consultant prior to start of Work.
 - .2 Note that room and area names/numbers are based on information available at time of preparation of documents and such names/numbers may be revised in later documents or during construction of Work. In no way are patient care area classifications to be reduced due to name/number revisions. Confirm exact classifications as per local governing electrical code requirements to suit final construction and any design changes made by the Consultant.
 - .3 Provide testing and verification of circuits and devices to confirm compliance with OESC.]
- .8 [Mental Health Areas:]
 - .1 Products accessible to patients in mental health area and any other areas subject to abuse shall include the following features:
 - .1 Anti-ligature;
 - .2 Tamper-resistant exposed mounting hardware;
 - .3 Impact resistant.
 - .2 Provide anti-pick sealant around each device, confirm color prior to installation.

1.14 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.

1.15 REFERENCES

- .1 CSA Group
 - .1 CSA C22.1:21, Canadian Electrical Code, Part 1 (25th 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 (28th edition/2021), and all bulletins.
 - .5 [CSA Z317.5, Illumination Systems in Health Care Facilities.]
 - .6 [CSA Z32, Electrical Safety and Essential Systems in Health Care Facilities.]
 - .7 [CAN/CSA Z8000, Canadian Health Care Facilities.]
 - .8 [CSA Z8001, Commissioning of Health Care Facilities.]
- .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.
- .7 CAN/ULC-S1001-11, Integrated Systems Testing of Fire Protection and Life Safety Systems.

1.16 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.

1.17 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.

1.18 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.

1.19 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.

1.20 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.

1.21 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 manufacturers. Identical units of equipment shall be of same manufacturer. In any unit of equipment, identical component parts shall be of same manufacturer, but the various component parts comprising the unit need not be of one manufacturer.
- .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 in the specifications are used in lieu of products of the manufacturer noted as "basis of design", 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 the Contractor.

- .17 In addition to the manufacturers specified or named as acceptable, the Contractor may propose substitute manufacturers of equipment and/or apparatus to the Consultant for acceptance, listing in each case a corresponding credit for each substitute 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 substitute 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 substitutions, will be borne by the party making the proposal. Substitute 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.

1.22 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.

1.23 CUTTING AND PATCHING

- .1 Refer to Section 01 73 29.
- .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.

1.24 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.

1.25 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.

1.26 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 Building Permit Compliance
 - .1 Provide a minimum of 10 business days notice to the Consultant for scheduling of Consultant's occupancy inspection.
 - .2 Prior to requesting the Consultant's letter "Review of General Conformance" for submission to the municipal building department to allow occupancy, the following items must be complete and submitted to the Consultant, as applicable:
 - .1 General
 - .1 Submit all applicable inspection reports from Authorities Having Jurisdiction.
 - .2 Continuity of fire separations at service penetrations must be complete.
 - .3 [All seismic restraint requirements must be complete.]
 - .2 Electrical
 - .1 Provide Certificate of Acceptance from Electrical Inspection Department.
 - .2 Any devices not installed must have the wiring made safe and terminated in an outlet box complete with cover.
 - .3 All outlets must have cover plates installed. All electrical equipment not located in service rooms must have covers and/or doors installed complete.
 - .4 Emergency lighting system must be operational and tested by the Contractor. Where battery units and remote heads are indicated on the drawing, provide certification letter from equipment manufacturer indicating the system meets code requirements.
 - .5 [If the building is provided with emergency power with CSA C282 equipment (emergency generator or similar), the contractor is to perform light meter measurements and submit a letter indicating the system meets code requirements.]
 - .6 Simulate normal power failure within the premises in the presence of the consultant and the owner's representative. Test and verify exit lights and emergency lighting operations under emergency conditions. Submit letter of certification copy to the Consultant stating that the systems have been tested, witnessed by the Consultant or the Owner's representative, etc., and the methods of installation and performance are satisfactory to all parties.
 - .7 All exit lights must be installed and operational.
 - .3 Electronic Safety and Security
 - .1 [Fire alarm system and devices must be operational. Submit fire alarm verification report per CAN/ULC-S537, and submit audibility test. Indicate tap settings of all signalling devices.]
 - .2 [Functional testing of the fire alarm system and interconnected systems per CAN/ULC-S1001 must be completed.]

- .3 If any of the above items have not been completed at the time of Consultant's Inspection, and the letter of "assurance of professional field review and compliance" cannot be issued, any costs for subsequent Inspections will be charged to the Contractor.

1.27 CLOSEOUT SUBMITTALS

- .1 Refer to Section 01 78 00.
- .2 Project Record Documents
 - .1 Provide extra sets of white prints on which to make, as the job progresses, all approved changes and deviations from the original drawings. Complete as-built drawings accurately marked up in red ink must be submitted for review by the Consultant 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] [BIM] 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 as-built 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 [PROVISIONS FOR RADIATION SHIELDING]

- .1 [As part of scope of General Trades work, walls to be provided with lead shielding. Coordinate exact scope of work with General Trades Contractor and Consultant and be responsible for following:
 - .1 Disconnection of electrical and communications system devices to accommodate lead shielding installation work.
 - .2 Maintain integrity of lead shielding; do not penetrate lead shielding unless method of procedure is approved in writing by Owner and reviewed with the Consultant.
 - .3 Relocation/extension of back boxes and outlet boxes to accommodate work.
 - .4 Provision of pull/junction boxes located in accessible ceiling space for existing conductors which are of insufficient length to suit device relocations; do not splice telecommunications cabling (structured data/voice cabling) if run is not sufficient length; replace with home run data/voice cabling; splicing of power conductors must be made by means recommended by cable manufacturers and reviewed with the Consultant and approved by Owner; clearly identify each box to its purpose.
 - .5 Existing wall mounted raceway to be relocated out from wall to accommodate installation of lead shielding; if necessary, provide additional raceways to match existing raceway.
 - .6 Where existing devices are disconnected and that such devices are part of a telecommunication system or other such building system, engage respective system vendor's authorized technician to provide required system programming, control work, testing and verification to ensure devices are left in proper operating order.]

3.12 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.

3.13 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 from any physical defects.
- .4 Provide labour and material to conduct the integrated systems testing of interconnected life safety systems in accordance with CAN/ULC-S1001-11.

3.14 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 visual field observations and conditions derived from existing drawings, and do not assess the interiors of electrical equipment. 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 12-25-5, 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 C22.1:21, Canadian Electrical Code, Part 1 (25th Edition), Safety Standard for Electrical Installations.
 - .2 Ontario Electrical Safety Code (28th edition/2021).
 - .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.
 - .11 [CSA Z32-15 - Electrical safety and essential electrical systems in health care facilities.]
- .2 NECA (National Electrical Contractors Association) - Standard of Installation.
- .3 NETA (International Electrical Testing Association) - ATS-2021 - 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 COORDINATION

- .1 Where wire and cable destination is indicated, and routing is not shown, determine exact routing and lengths required.

1.04 CLOSEOUT SUBMITTALS

- .1 Record Documents: Indicate as-constructed feeder sizes on single line diagram.
- .2 Megger test results.

- .3 Fire rated cables: manufacturer's certification that the cables have been installed in accordance with the manufacturer's instructions.

1.05 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].
- .2 Aluminum: Not permitted.

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 40 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 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.
 - .6 Overall interlocked aluminum tape armour.
- .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 2012 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 Mineral Insulated (MI) cable.
 - .2 VITALink MC Brand Type MC-RC90, manufactured by Marmon Wire & Cable Inc. (listed by ULC under ULC category code 'FHIT7' or 'FHJR7', dated 19 May 2015). This cable is not to be installed in conduit.
 - .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 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 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 CONDUCTOR PULLING LUBRICANT

- .1 IDI Electric (Canada) Ltd., "Ideal Yellow 77" or "Wire Lube" as required.

2.09 CONNECTORS

- .1 Armoured cable connectors must be proper squeeze type connectors and plastic anti-short bushings at terminations.
- .2 Connectors for conductors connecting to devices as per local governing electrical requirements to be equal to IDI Electric (Canada) Ltd., "Ideal" No. 451, No. 452, and No. 453, "Wing-Nut", CSA certified, 600 volts, rated pressure type connectors.
- .3 For conductors sized #3/0 and greater, provide long barrel double crimp, two (2) hole compression type lug connectors, unless otherwise noted.

2.10 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

3 Execution

3.01 EXAMINATION

- .1 Verify that field measurements are as indicated.
- .2 Wire and cable routing indicated is approximate unless dimensioned.
- .3 Where wire and cable destination is indicated and routing is not shown, determine exact routing and lengths required.
- .4 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.
- .5 Verify that mechanical work likely to damage wire and cable has been completed.
- .6 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 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 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 CONDUCTORS, WIRES, AND CABLES

- .1 Provide fire rated conductors or provide a fire rated assembly around conductors used for life safety applications as described in 2012 OBC 3.2.7.10.
- .2 Indoor wiring installed in conduit, unless otherwise noted: 600 volt "RW90 XLPE".
- .3 Wiring in channel back of fluorescent and LED lighting fixtures: 600 volt type GTF or TEW.
- .4 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.
- .5 Size wires for 2 per cent maximum voltage drop to farthest outlet on a maximum 80 per cent loaded circuit.
- .6 Outdoor wiring: "RWU90 XLPE".
- .7 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.
- .8 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
- .9 Neatly train circuit wiring in cabinets, panels, pull boxes and junction boxes and hold with nylon cable ties.

3.05 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 C22.1:21, Canadian Electrical Code, Part 1 (25th Edition), Safety Standard for Electrical Installations.
 - .2 Ontario Electrical Safety Code (28th edition/2021).
 - .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 C22.1:21, Canadian Electrical Code, Part 1 (25th Edition), Safety Standard for Electrical Installations.
 - .2 Ontario Electrical Safety Code (28th edition/2021).
 - .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 [GROUNDING AND BONDING IN HEALTHCARE FACILITIES]

- .1 Provide required grounding and bonding work in accordance with the drawings and in accordance with requirements of governing authorities, including the OESC. Review grounding requirements of project areas with specific requirements of use of areas as outlined in Contract Documents. Review exact requirements with the Consultant prior to start of work.
- .2 Review medical equipment grounding with equipment vendor and provide requirements to suit.
- .3 Throughout the renovated areas, solidly ground and bond the system equipment and make all required grounding connections to all new electrical devices and apparatus. Ground conductors shall be insulated copper wire connected with approved fittings in accordance with the OESC.
- .4 All ground connections in slab shall be made using OESC approved welded copper connections - Cadweld as supplied by Erico Products or approved equal.
- .5 Service conductors exceeding 400 amperes shall be provided with minimum No. 3/0 AWG grounding conductors, unless otherwise noted.
- .6 Do not use conduit systems as ground conductors in patient care areas or in areas as per local governing electrical code requirements.
- .7 Ground and bond telecommunication components as required.
- .8 Provide conductors as sized on drawings and in accordance with OESC requirements, but which shall be of size no smaller than the requirements specified herein this article or on drawings.

3.04 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 C22.1:21, Canadian Electrical Code, Part 1 (25th Edition), Safety Standard for Electrical Installations.
- .2 Ontario Electrical Safety Code (28th edition/2021).
- .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. Electro galvanized 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 inch) 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 Manufacturers:
 - .1 Panduit TRC18FR-X20Y.
 - .2 Approved equal.

2.10 CONCRETE BASES AND HOUSEKEEPING PADS

- .1 Provide concrete bases of dimensions where indicated, but not less than 100 mm (4 inches) larger in both directions than supported unit, and 100 mm (4 inches) high, and so anchors will be a minimum of 10 bolt diameters from edge of the base. Chamfer edges.
- .2 Use 20 MPa (3000 psi) 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Division 03 – Concrete.
- .3 Install dowel rods to connect concrete bases to concrete floor. Unless otherwise indicated, install dowel rods on 450 mm (18 inch) centres around full perimeter of base.
- .4 Anchor equipment to concrete base.
- .5 Provide a housekeeping pad for floor mounted equipment, including but not limited to the following:
 - .1 Transformers.
 - .2 Switchgear and switchboards.

- .3 Distribution panelboards.
- .4 Engine Generators.
- .5 Uninterruptible Power Supplies and batteries.
- .6 Transfer Switches.

2.11 CONCRETE ANCHORS

- .1 Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
- .2 Drilled expansion anchors for anchors set in concrete block or poured concrete after the concrete has set. Size the insert and number of anchors so that the maximum load per anchor does not exceed the manufacturer's recommendation.
- .3 U-channel concrete inserts shall be 12 gauge steel 1-5/8 in. square with insert anchors 1 3/8 in. long and 4 in. on centre.
- .4 Install anchor bolts to elevations required for proper attachment to supported equipment.

2.12 PLYWOOD EQUIPMENT BOARDS

- .1 Plywood Equipment Boards: preservative treated, and kiln dried; thickness as indicated, or if not indicated, not less than 19 mm (3/4 inches) deep. Provide marine grade plywood where subject to moisture conditions.
- .2 Paint plywood board white, or to match adjacent finishes. Leave the fire-retardant label unpainted for verification by the Consultant and by Authority Having Jurisdiction (AHJ).
- .3 Unless otherwise noted, boards shall be painted with two coats of good grade weatherproof flat gray non-conductive fire-retardant paint on all sides and edges (prior to mounting) and plumbed in a true vertical position. Provide nominal 13 mm (1/2 in) rustproof spacers between back of plywood and wall. Cut, fit, and place plywood equipment boards accurately in location, alignment, and elevation to support and anchor electrical materials and equipment. Select fastener sizes that will not penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood members. Attach to substrates as required to support applied loads. Maintain at least 100 mm (4 inches) from bottom of plywood equipment boards and the finished floor surface.
- .4 Unless directed otherwise in field, plywood equipment boards shall be 2440 mm (8 feet) high by 19 mm (3/4 inches) deep by length shown on drawings (as dimensioned or as scaled) or length as required to accommodate equipment if not indicated on drawings. Unless directed otherwise in field, provide plywood equipment boards for all indoor surface mounted panelboards and systems "head-end" equipment for all applications where located in mechanical or electrical rooms/areas and only where specifically shown on drawings for all other applications.

2.13 ROOF SUPPORTS

- .1 High-density polyethylene platform and base, height adjustable with rounded corners and edges to reduce likelihood of roof penetration.
- .2 Large surface area to spread the weight of supported objects including conduits, and cable trays over a large surface footprint.
- .3 No penetration of the waterproof membrane.
- .4 Self drains water, rot proof, and sunlight resistant.

- .5 Manufacturers:
 - .1 Thomas & Betts Superstrut Adjustable Universal Support.
 - .2 Eaton Dura-Blok series.
 - .3 Approved equal.

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 C22.1:21, Canadian Electrical Code, Part 1 (25th Edition), Safety Standard for Electrical Installations.
 - .2 Ontario Electrical Safety Code (28th edition/2021).
 - .3 CAN/CSA-C22.2 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 TC121A 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 Equipment subject to vibration:
 - .1 Use liquid tight flexible metal conduit for connections to transformers, motors, and equipment, subject to vibration and movement.
 - .3 Outdoor locations, above grade: use rigid steel.
 - .4 Underground: Use rigid PVC conduit for wiring in slabs on grade and wiring below grade.
 - .5 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.
 - .6 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, 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.
 - .7 Equipment in sprinklered spaces:
 - .1 Provide CSA certified sealing rings for rigid steel galvanized conduit and CSA certified raintight connectors for steel galvanized electrical metallic tubing (EMT) where conduits enter the top or the sides of enclosures.
 - .8 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 Group:
 - .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 CSA C22.2 No. 18.1-13 (R2018) – Metallic Outlet Boxes (Tri-national standard, with UL 514A and ANCE NMX-J-023/1).
 - .4 CSA C22.2 No. 40-17 - Junction and Pull Boxes.
 - .5 CSA C22.2 No. 85-14 (R2018) – 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. 18.1, 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. 18.1.

- .3 Cast Boxes: CSA C22.2 No. 18.1, 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. 18.1, galvanized steel.
- .2 Hinged Enclosures: As specified in Section 26 27 16.
- .3 Surface Mounted Cast Metal Box: CSA C22.2 No. 18.1, 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. 18.1.
- .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 (6") separation. Provide minimum 600 mm (24") 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 [SINGLE CHANNEL METAL RACEWAY]

- .1 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 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 Basis of Design: Wiremold 500 and 700 series.

2.04 [TWO-CHANNEL METAL RACEWAY]

- .1 Surface metal raceway, single or complete with snap-in divider to form 2 compartments for power and data, with removable cover. Width to suit application while keeping code and telecommunication standard filling ratios.

- .2 Elbows, couplings, end caps, device brackets and faceplates for power, data and voice, and fittings manufactured as accessories for wireway supplied. 120 V power receptacles and mounting for voice/data.
- .3 Finish: Designer Grey.
- .4 Basis of Design: Wiremold DS4000 series.

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.
- .3 Flash all conduits and systems passing through roof or built into an outside wall, or a waterproof floor.
- .4 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 manufacture'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 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.
- .2 [Acoustic Consultant's report.]
- .3 Section 26 12 16 – Dry-Type, Medium-Voltage Transformers.
- .4 Section 26 22 13 – Low-Voltage Distribution Transformers.
- .5 Section 26 32 13.13 – Diesel-Engine-Driven Generator Sets.
- .6 Section 26 32 13.16 – Gas-Engine-Driven Generator Sets.

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 colour-coded to indicate capacity – colour 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, 10 mm (3/8") minimum thick, ribbed on both sides.
- .1 Type NSN – Sandwich neoprene pad type isolators, with 10 mm (3/8") minimum thick ribbed neoprene pads bonded to each side of a 3.5 mm (10 ga) 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 6 mm (1/4") 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 13 mm (1/2"). 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:

			Floor Span											
			Slab on Grade			Up to 6 m (20 ft)			6 m to 9 m (20 ft to 30 ft)			9 m to 12 m (30 ft to 40 ft)		
Eqpm Type	HP and Other	RPM	Base Type	Isolator Type	Min. Defl.	Base Type	Isolator Type	Min. Defl., in.	Base Type	Isolator Type	Min. Defl., in.	Base Type	Isolator Type	Min. Defl., in.
Transformers and UPS's														
All	All	All	N/A	NSN	3 mm (0.12")	N/A	NSN	3 mm (0.12")	N/A	NSN	3 mm (0.12")	NM	RD/NSN	6 mm (0.25")
Engine-Driven Generators														
All	All	All	N/A	CSR	19 mm (0.75")	N/A	CSR	38 mm (1.50")	N/A	CSR	64 mm (2.50")	N/A	CSR	89 mm (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 09 91 00 – Painting.
- .2 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 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.
- .8 Division 25 – Integrated Automation.

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 regards 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 [Healthcare Equipment]
 - .1 [CT Simulator and associated equipment to be provided and/or relocated into areas of Work. Refer to issued equipment vendor drawings including Philips and Varian Medical Systems, documents and review requirements necessary for their equipment installation. Where applicable, comply with equipment vendor limitations to material composition of devices being installed in vicinity of equipment.
 - .2 Provide required wiring devices fully wired in operation, power feeders, raceways, conduits, feeders, boxes and wiring. Refer to electrical drawings and medical equipment vendor drawing notes and schedules.
 - .3 CT Simulator includes associated equipment such as CCTV camera viewing equipment, specialty luminaires and door interlock system. Review exact requirements onsite, on drawings and with equipment vendor and provide required installations, connections, testing and verification of work.
 - .4 Note any special power requirements such as transformer impedances and power/voltage regulation, from medical equipment vendor documents.
 - .5 Note any special instructions on installed surfaces on ceiling/walls/floors that cannot be cut or penetrated by Work.
 - .6 Provide required grounding and bonding of equipment.
 - .7 Coordinate with respective medical equipment vendor, communications system vendors, security system vendors and telecommunication system vendors to ensure compliance with medical equipment vendor requirements.
 - .8 Obtain equipment vendor contact information from the Consultant and the Owner.]
- .9 Conveying Equipment (e.g. Elevators): in accordance with Section 26 05 83.14.
- .10 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.
- .11 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.

- .12 Integrated Automation (Building Automation System)
 - .1 [Refer to drawing notes for requirements.]
 - .2 From equipment as noted on drawings, extend suitable wiring in conduit from equipment contacts to designated BMS panel serving area, terminating wiring and conduit in a junction box. Leave wiring un-terminated with slack coiled length of minimum 2 m (6') long. Clearly label junction box and wiring end for termination onto BMS panel by respective Mechanical Trade.

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 [Coolers and Freezers: Cut and seal conduit openings in freezer and cooler walls, floor, and ceilings.]
- .8 Install disconnect switches, controllers, control stations, and control devices as indicated.
- .9 Modify equipment control wiring with terminal block jumpers as indicated.
- .10 Provide interconnecting conduit and wiring between devices and equipment where indicated.

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 CSA Group:
 - .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 C22.1:21, Canadian Electrical Code, Part 1 (25th Edition), Safety Standard for Electrical Installations.
 - .2 Ontario Electrical Safety Code (28th edition/2021).
 - .3 CSA C22.2 No. 14-13 – Industrial Control Equipment.
 - .4 CSA C22.2 No. 42 - General Use Receptacles.
 - .5 CSA C22.2 No. 42.1 - Cover Plates for Flush Mounted Wiring Devices.
 - .6 CSA C22.2 No. 184 - Solid-State Lighting Controls.
 - .7 CSA C22.2 No. 184.1 - Solid State Dimming Controls.
 - .8 CSA C22.2 No. 156 - Solid-State Speed Controls.
- .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 user interfaces on control devices, switches, or scene controllers, the Contractor is to submit proposed engraving/labelling/graphics as part of the shop drawing submittal, 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 C22.1:21, Canadian Electrical Code, Part 1 (25th Edition), Safety Standard for Electrical Installations.
 - .2 Ontario Electrical Safety Code (28th edition/2021).
 - .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 Work of this Section is to be submitted for review after Consultant's review of Coordination Study per Section 26 05 73.16 is completed.
- .3 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.
- .4 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
- .5 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 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 99 mm (3.875 in) 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 30 branch circuit positions.
 - .10 Ensure [apartment dwelling unit] panelboards have minimum [two] adjacent spaces in accordance with 2021 OESC 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 C22.1:21, Canadian Electrical Code, Part 1 (25th Edition), Safety Standard for Electrical Installations.
 - .2 Ontario Electrical Safety Code (28th edition/2021).
 - .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 [MENTAL HEALTH AREAS]

- .1 [Products accessible to patients in mental health areas and any other areas subject to abuse shall include the following features:
 - .1 Anti-ligature;
 - .2 Tamper-resistant exposed mounting hardware;
 - .3 Impact resistant.]
- .2 Provide anti-pick sealant around each device, confirm color prior to installation.

2.03 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.

2.04 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 USB Charger receptacles: duplex tamper resistant device.
 - .1 USB ports: one type A and one type C USB charging port, 5 amp, 5 volt.
 - .2 Example: Hubbell USB15AC5WWR.

2.05 [HOSPITAL GRADE RECEPTACLES]

- .1 [General:
 - .1 Description: CSA C22.2 No.42, Extra heavy duty hospital grade use receptacles with green dot symbol back and side wired, tamper-resistant, flush, thermoplastic polyester face/body construction, duplex U-ground, 15 ampere, 125 V, 2-pole, 3-wire grounding receptacles complete with one piece nickel-plated brass mounting strip with integral grounding clips, ground retention clips, nickel-plated brass wiring clamps with nickel-plated brass screws, front circuit identification area and reinforced thermoplastic base.
 - .2 Tamper-resistant receptacles shall permit current to flow only while a standard plug is in the proper position in the receptacle. All exposed screws shall be tamper-resistant.
 - .3 Black color for normal power and red color for emergency power.
 - .4 Configuration: Type as specified and indicated.
 - .5 GFCI Receptacle: Convenience receptacle with integral ground fault circuit interrupter to meet regulatory requirements.
 - .6 Receptacles of one manufacturer throughout project.
- .2 Receptacles shall be extra heavy duty hospital grade, unless noted otherwise.
- .3 Other types of receptacles shall be provided as shown on Drawings.]

2.06 COVER PLATES

- .1 Cover plates for wiring devices to: CSA C22.2 No. 42.1.
- .2 Cover plates from one manufacturer throughout project.
- .3 [Secure cover plates to the device frames with tamper-resistant screws to match the cover plate.]
- .4 Sheet steel utility box cover for wiring devices installed in surface-mounted utility boxes.
- .5 Stainless steel, vertically brushed, cover plates, thickness 2.5 mm for wiring devices mounted in flush-mounted outlet box.
- .6 Cast cover plates for wiring devices mounted in surface-mounted FS or FD type conduit boxes.
- .7 Weatherproof double lift spring-loaded cast aluminum cover plates, complete with gaskets for duplex receptacles as indicated.
- .8 Weatherproof spring-loaded cast aluminum cover plates complete with gaskets for single receptacles or switches.
- .9 Decorative Cover Plate: Polycarbonate.

- .1 Pass & Seymour TP26W series.
- .10 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.
- .11 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 2021 OESC rule 26-708.
- .1 [Weatherproof Cover Plate: Ultra-rugged polycarbonate and synthetic neoprene rubber:
 - .1 Hubbell ML500GCN series (single-gang):
 - .1 low profile design which expands from 25 mm (1 inch) to 75 mm (3 inches) for weatherproof protection while an outlet is in use while maintaining the “Extra Duty” ratings.
 - .2 Clear window allows for quick/easy visual inspection.
 - .3 All required gasket and mounting hardware.
 - .4 Pre-configured for GFCI type receptacles.
 - .5 Complete with gaskets to accommodate duplex receptacles or Data outlets.
 - .6 NEMA 3R compliant.
 - .7 Colour: [Gray].
 - .2 Hubbell ML2450GCN series (2-gang):
 - .1 low profile design which expands from 25 mm (1 inch) to 75 mm (3 inches) for weatherproof protection while an outlet is in use while maintaining the “Extra Duty” ratings.
 - .2 Clear window allows for quick/easy visual inspection.
 - .3 All required gasket and mounting hardware.
 - .4 Pre-configured for GFCI type receptacles.
 - .5 Complete with gaskets to accommodate quadplex receptacles or Data outlets.
 - .6 NEMA 3R compliant.
 - .7 Colour: [Gray].]

2.07 PENDANT RECEPTACLES

- .1 Pendant cord mounted single receptacles complete with strain relief device.
- .2 Strain relief system: Hubbell Kellems Grips, Molex, or equal.

2.08 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.

2.09 SPECIAL WIRING DEVICES

- .1 Pilot lights as indicated, with neon type 0.04 W, 125 V lamp and red plastic jewel flush type.

2.10 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.

2.11 HAZARDOUS (CLASSIFIED) LOCATION RECEPTACLES

- .1 In accordance with CSA C22.2 No. 159-18, Plugs, connectors, receptacles, and similar wiring devices for use in hazardous locations.
- .2 Manufacturers:
 - .1 Crouse-Hinds.
 - .2 Appleton Electric.
 - .3 Killark; Division of Hubbell Inc.

2.12 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 [Receptacles to be [black] [ivory] for devices connected to normal power circuits, red for devices connected to essential power circuits including isolated power centres. Isolated ground receptacles connected to circuits fed from uninterruptible power supply units to be orange colour. Generally, install receptacles in Patient Care Areas vertically with ground pins up.
 - .5 Safety shutter type receptacles to be located where shown and required by code and CSA Z32.
 - .6 In patient care areas, 15A/20A straight blade receptacles to be hospital grade.
 - .7 Comply with requirements of CSA Standard Z32, with regards to identifying circuit number and supplying panelboard, permanently identified at outlets. Identify this information in areas on front

of each receptacle. In addition, provide typed label on wall below each device faceplate, identifying circuit number and panelboard from where each device is fed. Confirm nomenclature with the Consultant prior to printing of labels and nameplates. Turn over label maker to Consultant/Owner prior to application for Certificate of Substantial Performance of the Work.

- .8 Within special imaging/scanning unit type rooms, devices including mounting screws and hardware must be of non-ferrous construction as per unit manufacturer's instructions.]
- .9 [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 2021 OESC rule 26-658.]
- .10 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 "while in use" "extra duty" 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 2021 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.
 - .5 [Within special imaging/scanning unit type rooms, devices including mounting screws and hardware to be of non-ferrous construction as per unit manufacturer's instructions.
 - .6 Confirm exact material, finish, and colour of faceplates for devices in any particular area with the Consultant prior to ordering. Submit sample board as per requirements of Part 1.
 - .7 Provide faceplates with printed self-adhesive label on inside face identifying circuit number and panel feeding device. Turn over label maker to the Consultant prior to application for Certificate of Substantial Performance of the Work.]
- .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 SUMMARY

- .1 Poke-through devices provide the interface between power, communication and audio/ visual (A/V) cabling in an above grade concrete floor and the workstation or activation location where power, communication and/or A/V device outlets are required. These poke-thru devices provide recessed device outlets that will not obstruct the floor area.

1.02 RELATED REQUIREMENTS

- .1 Section 03 80 00 – Concrete Cutting and Boring.

1.03 REFERENCES

- .1 The poke-thru device shall have been examined and tested by Underwriters Laboratories Inc. to Standard UL514A and/or UL514C and Canadian Standard C22.2, No. 18.1, and bear the U.S. and Canadian UL Listing Mark. The poke-thru device shall also have been tested by Underwriters Laboratories Inc. and classified for fire resistance and bear the U.S. and Canadian UL Classification Mark. Devices shall be classified for use in 1-hour, 1 1/2-hour, or 2-hour rated, unprotected reinforced concrete floors and 1-hour, 1 1/2-hour, or 2-hour rated floors employing unprotected steel floor units and concrete toppings, or concrete floors with suspended ceilings (fire resistive designs with suspended ceilings should have provisions for accessibility in the ceiling below the poke-thru fittings).
- .2 These devices meet all UL scrub water requirements, but are not suitable for wet or damp locations, or other areas subject to saturation with water or other liquids such as commercial kitchens. This poke-thru device shall also have been evaluated by UL to meet the applicable Canadian safety standards for scrub water exclusion when used on tile, terrazzo, wood, and carpet covered floors.
- .3 Devices to be suitable for use in air handling spaces and meet required flame spread and developed smoke ratings for plenum per Building Code requirements.

2 Products

2.01 MANUFACTURERS

- .1 Wiremold/Legrand.
- .2 Hubbell.
- .3 Wellmark.
- .4 Canadian Electrical Raceways.

2.02 6 INCH NOMINAL POKE-THROUGH ASSEMBLY

- .1 Basis of Design: Wiremold 6AT Evolution series Poke-Thru Assembly.
 - .1 Insert:
 - .1 The insert body shall recess the devices and have a polyester based backing enamel finished interior. There shall be the necessary channels to provide complete separation of power and communication services. There shall be three compartments that allow for up to three duplex receptacles that can be wired as a standard receptacle or isolated ground and/or twelve communication ports.
 - .2 Unless indicated otherwise on plans, provide minimum one duplex receptacle.

- .3 The body will consist of an intumescent fire stop material to maintain the fire rating of the floor slab. The intumescent material will be held securely in place in the insert body and shall not have to be adjusted to maintain fire rating of the unit and the floor slab. The insert shall have retaining feature that will hold the poke-thru device in the floor slab without additional fasteners. The poke-thru insert shall also consist of a 3/4" trade size conduit stub that is connected to the insert body and a 24.5 cu. in. (402 mL) stamped steel junction box for wire splices and connections. The stamped steel junction box shall also contain the necessary means to electrically ground the poke-thru device to the system ground.
- .2 Activation Cover:
 - .1 The activation covers shall be Wiremold "Evolution" Heavy Duty series, screwed type lid, manufactured of stainless steel construction with solid brass, cover. Exact finish colour selection to be by architect as part of submittal review.
 - .2 Two gaskets (one for carpet and one for tile) are to be provided to go under the trim flange to maintain scrub water tightness. The activation covers shall be available in carpet and tile versions.
 - .3 The carpet covers shall be surface mounted and the tile covers shall be flush with the finished floor covering. The cover shall have spring loaded slides to allow cables to egress out of the unit and maintain as small an egress opening as possible.
- .3 Communication Modules Mounting Accessories:
 - .1 The activation shall have locations to mount communication connectors. Connectors shall be mounted using a mounting bracket. Mounting brackets shall be provided to mount a minimum of six Category 6 data outlets. The unit shall also accommodate a mechanism to permit protection of communication cabling. This mechanism shall be stamped steel construction and accept both flexible and rigid conduit. This mechanism shall accept 21 mm (3/4"), 35 mm (1-1/4") or 53 mm (2") trade size conduits.

3 Execution

3.01 INSTALLATION

- .1 Measure intended location of hole cores and chalk mark on site.
- .2 Perform scanning and coring procedures in accordance with Section 03 80 00. Review with Structural Engineer, and review with Architect if exact core location needs to be shifted.
- .3 Use is defined by the UL Fire Resistance Directory as a minimum spacing of 2 feet (610 mm) on centre and not more than one device per each 65 sq. ft. (6 square metres) of floor area in each span."
- .4 Provide a cored hole of diameter in accordance with manufacturer's instructions.
- .5 Installation shall be completed by pushing unit down into the cored hole. Prior to and during installation, refer to system layout and/or approval drawings. Installer shall comply with detailed manufacturer's instruction sheet included with each device. The unit shall contain a retainer for securing the device in the slab, as well as the necessary intumescent material to seal the cored hole under fire conditions.

End of Section

1 General

1.01 REFERENCES

- .1 CSA C22.2 No. 248 series.

1.02 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.

1.03 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 00.

1.04 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.
- .5 Provide the following accessories where indicated or where required to complete installation:
 - .1 Fuseholders: Compatible with indicated fuses.
 - .2 [Fuse Reducers: For adapting indicated fuses to permit installation in switch designed for uses with larger ampere ratings.]

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 914 mm by 914 mm by 305 mm (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 Materials for Molded-Case Circuit Breakers (MCCB).
- .2 Accessories

1.02 RELATED REQUIREMENTS

- .1 Section 26 24 13 – Switchboards.
- .2 Section 26 24 16 – Panelboards.

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 CSA C22.2 No. 5-16, Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures.
- .4 NEMA AB1 - Molded Case Circuit Breakers, Molded Case Switches, and Circuit - Breaker Enclosures.
- .5 NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment (published by the International Electrical Testing Association).

1.04 SUBMITTALS

- .1 Submit product data in accordance with Section 01 33 00.
- .2 Include time-current characteristic curves for breakers with ampacity of 400 A and above, or with interrupting capacity of 22,000 A symmetrical (rms) and over at system voltage.
- .3 Include termination temperature rating in degrees C.
- .4 Certificate of Origin
 - .1 Prior to any installation of circuit breakers in either a new or existing installation, Contractor must submit three (3) copies of a certificate of origin from the manufacturer, duly signed by the factory and the local manufacturer's representative, certifying that all circuit breakers come from this manufacturer, they are new and they meet standards and regulations. These certificates must be submitted to the Consultant for review.
 - .2 A delay in the production of the certificate of origin won't justify any extension of the contract and additional compensation.
 - .3 Any work of manufacturing, assembly or installation should begin only after acceptance of the certificate of origin by the Consultant. Unless complying with this requirement, Consultant reserves the right to mandate the manufacturer listed on circuit breakers to authenticate all new circuit breakers under the contract, and that, to Contractor's expense.
 - .4 In general, the certificate of origin must contain:
 - .1 The name and address of the manufacturer, and the person responsible for authentication. The responsible person must sign and date the certificate;

- .2 The name and address of the licensed dealer, and the person of the distributor responsible for the Contractor's account.
- .3 The name and address of the Contractor, and the person responsible for the project.
- .4 The name and address of the local manufacturer's representative. The local representative must sign and date the certificate.
- .5 The name and address of the building where circuit breakers will be installed:
 - .1 Project title.
 - .2 End user's reference number.
 - .3 The list of circuit breakers.

2 Products

2.01 GENERAL

- .1 Molded-case circuit breakers, Circuit breakers, and Ground-fault circuit-interrupters, Fused circuit breakers, and Accessory high-fault protectors: to CSA C22.2 No. 5.
- .2 Bolt-on Molded case circuit breaker: quick- make, quick-break type, for manual and automatic operation with temperature compensation for 40 degrees C ambient.
- .3 Plug-in Molded case circuit breakers: quick-make, quick-break type, for manual and automatic operation with temperature compensation for 40 degrees C ambient.
- .4 Common-trip breakers: with single handle for multi-pole applications.
- .5 Magnetic instantaneous trip elements in circuit breakers to operate only when value of current reaches setting.
 - .1 Trip settings on breakers with adjustable trips to range from 3-8 times current rating.
- .6 Circuit breakers with interchangeable trips.

2.02 INTERRUPTING CAPACITY

- .1 Protective devices shall be fully rated, for required available fault current. Series rated shall not be used on this installation.
- .2 Refer to Section 26 24 13, and Section 26 24 16.

2.03 MOLDED CASE CIRCUIT BREAKERS – GENERAL

- .1 Molded case circuit breaker to operate automatically by means of thermal and magnetic tripping devices to provide inverse time current tripping and instantaneous tripping for short circuit protection.
- .2 NEMA AB 1, circuit breakers with integral thermal and instantaneous magnetic trip in each pole.
- .3 Provide circuit breakers UL listed as Type HACR for air conditioning equipment branch circuits.
- .4 1-, 2-, or 3-pole bolt on, single-handle common trip voltage as indicated on drawings.
- .5 Overcentre toggle-type mechanism, quick-make, quick-break action. Trip indication is by handle position.
- .6 Calibrate for operation in 40 degree C ambient temperature.

2.04 MOLDED CASE CIRCUIT BREAKERS – UP TO 150 AMPERE

- .1 Permanent trip unit containing individual thermal and magnetic trip elements in each pole, unless noted otherwise on drawings.

2.05 MOLDED CASE CIRCUIT BREAKERS – 151 TO [224] [399] AMPERE

- .1 Variable magnetic trip elements. Provide push-to-trip button on cover of breaker for mechanical tripping.

2.06 MOLDED CASE CIRCUIT BREAKERS – [225] [400] AMPERE AND ABOVE

- .1 Electronic trip type with adjustments for long-time, instantaneous, and short-time functions.

- .2 Provide ground fault function for breakers greater than [400] [1000] Amps.

- .3 1000 Amp and Above:

- .1 Modbus Communications

- .1 Breaker status.

- .1 Open.

- .2 Closed.

- .3 Tripped.

- .2 Cause of trip.

- .3 Time of trip.

- .4 Current at time of trip.

- .5 RMS currents per phase and ground.

- .6 Peak demand.

- .7 Present demand.

- .8 Energy consumption.

- .4 1200 Amp and Above:

- .1 Provide handle mechanisms that are lockable in the open (off) position.

2.07 ADDITIONAL FEATURES

- .1 Provide as indicated on drawings:

- .1 Shunt trip.

- .2 Auxiliary switch.

- .3 Motor-operated mechanism.

- .4 Under-voltage release.

- .5 On-off locking device.

- .6 Handle mechanism.

2.08 ENCLOSED BREAKERS

- .1 Molded case, front operated, automatic circuit breakers sized as specified on drawings each secured in a NEMA 1, flush wall mounting enclosure with steel front panel.
- .2 Voltage rating suitable for circuit phase to phase voltage as indicated on drawings.
- .3 Units to include solid state adjustable trip units and contactors. Contactors to be of rating and type to suit application.

2.09 [CIRCUIT BREAKERS FOR EXISTING DISTRIBUTION EQUIPMENT]

- .1 Products to be of types from existing equipment manufacturers.
- .2 Additional breakers for existing panelboards are to match existing device standards and be completely compatible to equipment in which they are installed.
- .3 During Bidding period, check and verify exact requirements of existing equipment to ensure that additional devices are accommodated.
- .4 Make necessary modifications to equipment to accommodate device and feeder installation.
- .5 Provide suitable engraved lamacoid identification nameplate on additional components.
- .6 Revise typed circuit directory cards on branch circuit panelboards.
- .7 Mount additional devices to standards of existing equipment manufacturer.
- .8 Refer to notes on drawings.
- .9 Provide additional retrofit work to existing equipment as noted on drawings.

3 Execution

3.01 INSTALLATION

- .1 Install circuit breakers as per related sections.

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 CSA Group:
 - .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-C22.2 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 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 CSA Group:
 - .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 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 IEEE 1789-2015 – IEEE Recommended Practices for Modulating Current in High-Brightness LEDs for Mitigating Health Risks to Viewers.
- .6 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 [Manufacturer reports: Provide a point-by-point photometric analysis of the [pool], in accordance with the procedures laid out in IES recommended practices to demonstrate compliance with OBC illumination requirements as described in 2012 OBC 3.11.10.1.(3)(a)(i).]
- .3 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.
- .10 Flicker control:
 - .1 All electric lights (except decorative lights, emergency lights and other special-purpose lighting) used in regularly occupied spaces meet at least one of the following requirements for flicker:
 - .1 A minimum frequency of 90 Hz at all 10% intervals from 10% to 100% light output.
 - .2 LED products with a “low risk” level of flicker (light modulation) of less than 5%, especially below 90 Hz operation as defined by IEEE standard 1789-2015 LED.

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 For luminaires with field selectable lumen output and/or CCT, ensure the correct setting matches the intended set points.
- .3 All ladders, scaffolds, lifts, etc. required for aiming and adjusting luminaires shall be furnished by the Contractor.
- .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.

3.04 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 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 C22.1:21, Canadian Electrical Code, Part 1 (25th Edition), Safety Standard for Electrical Installations.
 - .2 Ontario Electrical Safety Code (28th edition/2021).
 - .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.

1.05 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.

1.06 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.

1.07 DELIVERY, STORAGE, AND HANDLING

- .1 In accordance with Section 01 61 00.

1.08 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 00.

1.09 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 Lithonia (Acuity Brands Lighting).
 - .5 Lumacell.
 - .6 Stanpro.
 - .7 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 where indicated on the plans 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 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 finish.
 - .2 The trim plate shall have a 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 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.

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 emergency power supply circuits.
- .4 Ensure that emergency lighting circuit breaker is locked in ON position.
- .5 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 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.

1.02 RELATED REQUIREMENTS

- .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. Ensure that the systems specified hereafter are complete and operative.

1.04 REFERENCE 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 BICSI G1-17 – Outside Plant Manual.
- .3 Canadian Standards Association (CSA)
 - .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 CSA T529 – Commercial Building Telecommunications Cabling Standard (ANSI/EIA/TIA-568-B).
 - .4 CSA T530 – Commercial Building Standard For Telecommunications Pathways And Spaces (TIA/EIA 569-A).
 - .5 CSA T528 – Administration Standard For The Telecommunications Infrastructure Of Commercial Buildings (ANSI/EIA/TIA-606).
 - .6 CSA T527 – Commercial Building Grounding And Bonding Requirements For Telecommunications (ANSI/EIA/TIA-607).
 - .7 CSA C22.2 No. 214 – Communications Cables.

- .8 CSA C22.2 No. 232-M – Fibre Optic Cables.
- .9 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 SUBMITTALS

- .1 Before delivery to site of any item of equipment, submit shop drawings c/w all data, pre-checked and stamped accordingly, for review to the Consultant. Indicate project name on each brochure or sheet. Submit shop drawings within 1 week after award of contract.

1.06 RECORD DOCUMENTATION

- .1 To Section 01 78 00.
- .2 Red lines, mark-ups by this contractor.

1.07 OPERATION AND MAINTENANCE MANUALS

- .1 Refer to Division 01.

1.08 INSPECTIONS

- .1 The Consultant will carry out inspections and prepare deficiency list for action by the Contractor, during and on completion of project.

1.09 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.

1.10 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.

1.11 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 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.

1.12 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 Engineer. Protect work so that finishes will not be damaged or marred during construction. Maintain the necessary protection until completion of the work.

1.13 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.

1.14 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.

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 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.

3.03 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.

3.04 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.

3.05 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.

3.06 LABELS AND SIGNS

- .1 Labelling shall be as per TIA/EIA-606.

3.07 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.

3.08 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 SECTION INCLUDES

- .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 09 69 00 – Access Flooring.
- .2 Section 26 05 26 – Grounding and Bonding for Electrical Systems.
- .3 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 ASTM B1-2001 - Standard Specification for Hard-Drawn Copper Wire.
 - .2 ASTM 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 IEEE 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 C22.1:21, Canadian Electrical Code, Part 1 (25th Edition), Safety Standard for Electrical Installations.
 - .2 Ontario Electrical Safety Code (28th edition/2021).
- .5 Telecommunications Industry Association, (TIA)
 - .1 TIA-J-STO-607-A - Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications.
- .6 Underwriters Laboratories, Inc. (UL):
 - .1 UL 44-2005 - Thermoset-Insulated Wires and Cables.
 - .2 UL 83-2003 - Thermoplastic-Insulated Wires and Cables.
 - .3 UL 467-2004 - Grounding and Bonding Equipment.
 - .4 UL 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 MANUFACTURERS

- .1 Grounding and bonding system:
 - .1 Panduit.
 - .2 Approved equal.

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 & Betts.

2.03 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.

2.04 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.

2.05 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.

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 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.

3.03 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 Strut channel and Raised Floor Stringers: Fasten bonding jumpers using zinc-plated, self-drill screws and external tooth lockwashers.

3.04 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.

3.05 INSTALLATION

- .1 Connection of communications ground to electrical safety ground at power service entrance.
- .2 Provide dedicated telecommunications grounding bus at the following locations:
 - .1 Telecom entrance facility rooms.
 - .2 Server rooms.
 - .3 IT closets.
- .3 Provide bonding to all telecom cabinets and communication/security equipment.
- .4 Cable trays and conduit bonded to building ground.
- .5 Incoming carrier armor sheath bonded to building ground.

End of Section

1 General

1.01 SUMMARY

- .1 Provide a complete system of empty conduit, pull boxes, outlets, and sleeves for enclosure of 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 BISCI Telecommunications Distribution Methods Manual, 14th Edition.

1.04 CLOSEOUT SUBMITTALS

- .1 Record documentation:
 - .1 Records of underground utility locates.
 - .2 Record as-constructed location of all underground conduits and telecommunications pathways on as-built drawings regardless of conduit size.

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 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 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 3.2 mm (1/8") 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 SUMMARY

- .1 Provide a complete system of empty conduits, terminal cabinets, plywood backboards, pull boxes and outlets for enclosure of wiring.

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.

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 m 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. 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 MANUFACTURERS

- .1 ERICO, Inc.
- .2 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

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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 84 00 – Firestopping.

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 Consultant 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: 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 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 CLOSEOUT SUBMITTALS

- .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 Consultant.
- .6 The test result documentation is to be submitted to the Consultant for review no later than 10 working days following the completion of the installation.
- .7 All deficiencies must be corrected before the Consultant will provide a certificate to release the Holdback on the project.

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 122 m (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 -2.35 dB.
- .5 Maximum single-mode passive link loss (including patch cords) is not to exceed -1.0 dB.

3.02 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

- .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

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 Belden.
 - .2 Commscope.
 - .3 Panduit.
 - .4 TE.
 - .5 Wirewerks.
 - .6 Approved equal.
- .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 5e 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.

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 5e, 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 5e 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 (Belden AX100465 or equal)
- .2 PS5 HD-BIX Patch panel, 2U, 48 Port (Belden AX100473 or equal)
- .2 Network rack must have the following features:
 - .1 Free standing.
 - .2 Standard 19" module compatible.
 - .3 Lockable door.
 - .4 Maximum dimensions of 22"w x 36"d x 85" h.
 - .5 Acceptable products:
 - .1 RF Mote Cat. #RFM-1944-RHD c/w hinged lockable door.
 - .2 Anixter Cat. #175419 c/w hinged lockable door.
- .3 Distribution panels must be category 5E rated BIX punchdown style with capacities as follows;
 - .1 24 port Belden AX100465
 - .2 48 port Belden AX100473
 - .3 96 port Belden AX100485
- .4 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 5e 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.

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 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 To Section 27 05 53.
- .2 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.
- .3 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.

- .4 All labels must be mechanically printed using a laser printer. Hand written labels are not permitted.
- .5 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
- .6 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 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 43 00.26.
- .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 43 00.26.
- .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 C22.1:21, Canadian Electrical Code, Part 1 (25th Edition), Safety Standard for Electrical Installations.
 - .7 Ontario Electrical Safety Code (28th edition/2021).
 - .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 [as indicated on drawings] [Edwards EST] [Notifier] [Simplex] [Mircom] series [single-stage] [two-stage] fire alarm system.
 - .1 The location of the Fire Alarm Control Panel is as indicated on the drawings.
 - .2 There is [one] passive graphic annunciator to be updated, location as indicated on the drawings.

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 Section 01 91 26.13 – Integrated Systems Testing of Fire Protection and Life Safety Systems.

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