

PROJECT MANUAL

Issued for Bid

Chemong Public School Science Lab & Prep Room Renovation

**Kawartha Pine Ridge District School Board
1029 Gore Street
Bridgenorth, Ontario**

CMV Group Architects
247 Spadina Avenue, 4th Floor
Toronto, Ontario
M5T 3A8

Tel: 416-506-1600
Fax: 416-506-0956

Project No.: 21A105

May 3, 2021

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 O - Denotes documents prepared by Owner.
 - .3 M - Denotes documents prepared by Mechanical Engineer.
 - .4 E - Denotes documents prepared by Electrical Engineer.
 - .5 S - Denotes documents prepared by Structural Engineer.
 - .6 H - Denotes documents prepared by Architectural Hardware Consultant
- .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:
Kawartha Pine Ridge District School Board
1994 Fisher Drive
Peterborough, Ontario
K9J 7A1

Project Director:
Tel: 705-742-9773
Cell: 705-930-6883
Contact: Cheryl Schnurr

- .2 Architect (the *Consultant*):
CMV Group Architects
247 Spadina Avenue, 4th Floor
Toronto, Ontario
M5T 3A8

Tel: 416-506-1600
Fax: 416-506-0956
Contact: Otto Miller

- .3 Mechanical Engineer:
The Mitchell Partnership Inc.
285 Yorkland Blvd.
Toronto, Ontario
M2J 1S5

Tel: 416-499-8000

Document Responsibility and Project Directory

.4 Electrical Engineer:

Hammerschlag & Joffe Inc.

43 Lesmil Road
Toronto, Ontario
M3B 2T8

.5 Structural Engineer:

Exp Services Inc.

220 Commerce Valley Drive West, Suite 110
Markham, Ontario
L3T 0A8

Tel: 905-695-3217

Contact: Darrell Sakauye

.6 Architectural Hardware Consultant:

Assa Abloy Opening Solutions

Tel: 647-237-7126

Contact: Ranbir Sihra

END OF SECTION

Table of Contents

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

<u>Document Identification</u>	<u>DR</u>	<u>Pgs</u>	<u>Issued</u>
INTRODUCTORY INFORMATION			
00 01 05 Document Responsibility and Project Directory.....	A	2	May 3, 2021
00 01 10 Table of Contents	A	2	May 3, 2021
DIVISION 01 - GENERAL REQUIREMENTS			
01 10 00 General Instructions.....	A	5	May 3, 2021
01 25 00 Product Substitution Procedures.....	A	2	May 3, 2021
01 26 00 Requests for Interpretation.....	A	2	May 3, 2021
RFI Form	A	1	May 3, 2021
01 31 13 Coordination	A	2	May 3, 2021
01 31 19 Project Meetings	A	6	May 3, 2021
01 32 16 Construction Progress Documentation.....	A	2	May 3, 2021
01 32 33 Photographic Documentation.....	A	1	May 3, 2021
01 33 00 Submittals.....	A	9	May 3, 2021
01 35 13 Special Procedures for Work in Occupied Buildings.....	A	6	May 3, 2021
01 45 00 Quality Control.....	A	7	May 3, 2021
01 50 00 Temporary Facilities and Controls.....	A	5	May 3, 2021
01 60 00 Product Requirements	A	7	May 3, 2021
01 73 29 Cutting and Patching.....	A	2	May 3, 2021
01 74 13 Progressive Cleaning.....	A	1	May 3, 2021
01 77 00 Contract Closeout Procedures and Submittals.....	A	10	May 3, 2021
01 78 36 Extended Warranties	A	1	May 3, 2021
DIVISION 02 - EXISTING CONDITIONS			
02 41 16 Demolition.....	A	4	May 3, 2021
DIVISION 03 - CONCRETE			
03 30 00 Cast-in-Place Concrete.....	S	32	April 28, 2021
DIVISION 06 - WOOD, PLASTIC, AND COMPOSITES			
06 10 53 Rough Carpentry	A	3	May 3, 2021
06 40 00 Architectural Woodwork	A	9	May 3, 2021
DIVISION 07 - THERMAL AND MOISTURE PROTECTION			
07 01 50 Roofing Repairs	A	5	May 3, 2021
07 26 16 Below-Grade Vapour Barrier.....	A	3	May 3, 2021
07 62 00 Metal Flashing	A	4	May 3, 2021
07 84 00 Joint Firestopping and Smoke Seals.....	A	6	May 3, 2021
07 92 00 Joint Sealants	A	7	May 3, 2021
DIVISION 08 - OPENINGS			
08 11 13 Steel Frames	A	9	May 3, 2021
08 14 00 Flush Wood Doors	A	5	May 3, 2021
08 71 00 Door Hardware	H	20	May 3, 2021

Table of Contents

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

<u>Document Identification</u>	<u>DR</u>	<u>Pgs</u>	<u>Issued</u>
08 80 00 Glass and Glazing	A	10	May 3, 2021
DIVISION 09 - FINISHES			
09 22 00 Metal Supports for Gypsum Board	A	8	May 3, 2021
09 29 00 Gypsum Board	A	13	May 3, 2021
09 51 23 Acoustical Tile Ceiling Systems	A	6	May 3, 2021
09 65 13 Resilient Base	A	5	May 3, 2021
09 65 20 Vinyl Tile Flooring	A	7	May 3, 2021
09 66 24 Terrazzo Repair and Patching	A	7	May 3, 2021
09 91 00 Painting	A	10	May 3, 2021
DIVISION 10 - SPECIALTIES			
10 11 00 Visual Display Surfaces	A	4	May 3, 2021
10 14 00 Signage	A	2	May 3, 2021
10 25 00 Classroom Control Panels	A	3	May 3, 2021
DIVISION 11 - EQUIPMENT			
11 53 13 Laboratory Equipment	A	2	May 3, 2021
DIVISION 12 - FURNISHINGS			
12 24 13 Roller Window Shades	A	5	May 3, 2021
DIVISION 20 - MECHANICAL			
Refer to Mechanical Specifications for Indices	M	123	May 3, 2021
DIVISION 26 - ELECTRICAL			
Refer to Electrical Specifications for Indices	E	160	May 3, 2021

END OF SECTION

General Instructions

PART 1 - GENERAL

1.1 Language of the *Contract*

- .1 The use of the words "include" or "including", or variations thereof, within the *Contract Documents* is not limiting.

1.2 The *Contract Documents*

- .1 The *Contract Documents* have been arranged into various divisions, sections, drawings, and schedules for the purpose of presenting the *Work* in a logical and organized form and to enable ease of reference and interpretation, and are not intended to be an arrangement of precise and independent *Subcontractors*, or jurisdiction of responsibility for the various parts of the *Work*. The *Contractor* shall be solely responsible for coordinating the execution of the *Work* of this *Contract* in accordance with the requirements of the *Contract Documents*.
- .2 As a result, the *Consultant* shall not be required to decide on questions arising with regard to agreements or contracts between the *Contractor* and *Subcontractors* or *Suppliers*, nor to the extent of the parts of the *Work* assigned thereto.
- .3 Further, no extra will be allowed as a result of the failure to coordinate and allocate the *Work* such that the *Work* is *Provided* in accordance with the *Contract Documents*.
- .4 The *Contract Documents* may specify, indicate, or schedule requirements that exceed the requirements of the building code, other applicable codes, requirements of authorities having jurisdiction, and standards cited in the *Contract Documents*. In such cases, the requirements specified, indicated, or scheduled in the *Contract Documents* shall govern.
- .5 This section coordinates, relates, and governs the work of other sections of the specifications.

1.3 Laws, Notices, Permits and Fees

- .1 The building code - Ontario Regulation 332/12, including amendments, shall govern the *Work*.
- .2 Comply with codes, by-laws, and regulations of authorities having jurisdiction over the *Place of the Work*. Codes and regulations form an integral part of the *Contract Documents*.
- .3 *Owner* shall apply and pay for the building permit. The *Contractor* shall pick up building permit from the municipal department having jurisdiction at the *Place of the Work*. Obtain and pay for all other permits, licenses, deposits and certificates of inspection as part of the *Work*.
- .4 Arrange for inspection, testing and acceptance of the *Work* required by the authorities having jurisdiction. Be responsible for necessary preparations, provisions and pay costs.
- .5 Obtain permits required to execute work on municipal rights of way. Obtain damage deposits for sidewalks, roads and services, unless otherwise indicated.
- .6 It is the responsibility of the *Contractor* to schedule notifications and inspections required by authorities having jurisdiction such that notifications can be properly received and that inspections can be properly undertaken without causing a delay in the *Work*. The *Contractor*, at no additional cost to the *Owner*, shall be solely responsible for any delay in the *Work* caused by failure to properly schedule required notifications and inspections.

General Instructions

- .7 The *Contractor* shall provide to the chief building official or the registered code agency, where a registered code agency is appointed under the Ontario Building Code Act in respect of the construction to which the notice relates, the required notices set out in Division C – Part 1 Sentence 1.3.5.1(2) and Sentence 1.3.5.2 of the Ontario Building Code, O. Reg. 332/12 as amended. The *Contractor* shall be present at each site inspection by an inspector or registered code agency as applicable under Division C – Part 1 Sentence 1.3.5.2 of the building code.
- .1 It is the responsibility of the *Contractor* to schedule notifications to the chief building official or the registered code agency such that the inspection pertaining to the notifications can be made within the time frame as required under Division C – Part 1 Sentence 1.3.5.3 of the Ontario Building Code, O. Reg. 332/12 as amended, without causing a delay in the *Work*. The *Contractor*, at no additional cost to the *Owner*, shall be solely responsible for any delay in the *Work* caused by failure to properly schedule required notifications and inspections.

1.4 Examination of the *Place of the Work*, Documents, Surfaces and Conditions

- .1 Examine the *Place of the Work* and investigate matters relating to the nature of the *Work*, means of access and egress, obstacles, rights and interests of other parties which may be interfered with during the execution of the *Work*, conditions and limitations including obstructions, existing structures or facilities, local conditions, actual levels, character and nature of the *Work*, documents related to existing building or buildings, as applicable and when available, and other consideration which may affect performance of the *Work*.
- .2 Examine the extent of work to be performed and matters which are referred to in the *Contract Documents* prior to start of the *Work*.
- .3 Examine work to which work is to be applied, anchored or connected, and relevant as-built conditions.
- .4 Each work operation following on a previous work operation of a differing *Subcontractor*, as in the case of finishing and surfacing work, shall include a thorough examination of the condition of the previous work. Conditions found unacceptable, either for the commencement of the new work or its satisfactory completion, shall be reported in writing to the *Consultant*.
- .5 Do not commence work until unsatisfactory conditions are corrected. Commencement of work implies acceptance of surfaces, tolerances, and conditions and existing conditions will not be accepted as a contributing factor to subsequent failure or acceptability of the *Work*.

1.5 Quantity of Items

- .1 Where a component, device, item or part of materials or equipment is referred to in the singular number, such reference shall require the provision of as many components, devices, items or parts of material or equipment necessary to complete the *Work*.

1.6 Discrepancies and Clarifications

- .1 Advise *Consultant* of discrepancies discovered in requirements of the *Contract Documents* and request clarification in written form.
- .2 Advise *Consultant* when clarifications are required pertaining to meaning or intent of requirements of *Contract Documents* and request clarification from *Consultant* in written form.

General Instructions

- .3 Do not proceed with related work until written clarification is provided by *Consultant*.
- .4 Failure to notify *Consultant* shall result in *Contractor* incurring responsibility for resulting deficiencies and expense at no additional cost to the *Owner*.
- .5 Written instructions issued by *Consultant* for the purpose of clarification, implicitly supersede applicable and relevant aspects of the *Contract Documents* irrespective of whether or not these documents are explicitly or specifically cited in clarification requests or clarification instructions.

1.7 Setting out the *Work*

- .1 Assume full responsibility for and execute complete layout of the *Work* to required locations, lines and elevations.
- .2 Arrange meeting with *Consultant* to discuss critical setting out assumptions for the *Work* and establish limiting conditions for setting out the *Work*. *Consultant Contractor* shall chair and prepare minutes of the meeting, and prepare and submit sketches recording understanding of key setting out principles.
- .3 Provide devices needed to lay out and construct the *Work*.

1.8 Documents at the *Place of the Work*

- .1 Maintain at the *Place of the Work*, one copy of each of following:
 - .1 *Contract Documents* including drawings, specifications, addenda, and other modifications to the *Contract*.
 - .2 'Reviewed' or 'Reviewed as Noted shop drawings.
 - .3 Construction and submittal schedules.
 - .4 *Supplemental Instructions*, proposed *Change Orders*, *Change Orders*, and *Change Directives*.
 - .5 Field Test Reports.
 - .6 *Consultant's* field review reports and deficiency reports.
 - .7 Reports by authorities having jurisdiction.
 - .8 Building and other applicable permits, and related permit documents.
 - .9 Daily log including:
 - .1 Number of workers actively working at the *Place of the Work* by each subcontract.
 - .2 *Subcontractors* working at the *Place of the Work*.
 - .3 Parts of the *Work* being worked on.
 - .4 Working hours worked at the *Place of the Work*.
 - .5 Activities with intermittent progress.
 - .6 Time lost and explanation for such time lost.
 - .7 Difficulties (work scheduled to start but did not with the reason why, delays, labour inefficiencies, labour shortage).
 - .8 *Products* and materials delivered.

General Instructions

- .9 Equipment mobilized and/or demobilized.
- .10 Demolition conditions.
- .11 Start and finish date of each part of the *Work*.
- .10 As-built drawings recording as-built conditions, instructions, changes for structure, equipment, wiring, plumbing, and the like, as called for in Section 01 77 00 and Divisions 21, 22, and 23 and Divisions 26, 27, and 28, prior to being concealed.
- .2 Make above material available to *Consultant* upon request.

1.9 Trademark and Labels

- .1 Trademarks and labels, including applied labels, shall not be visible in finished work in finished areas, unless otherwise accepted or indicated by *Consultant*.
- .2 The exceptions to this requirement are trademarks and labels which are essential to identify materials, systems, assemblies, and equipment for maintenance and replacement purposes, and for life safety, fire resistance and temperature rise ratings.

1.10 Waste Audits/Plans for Waste Reduction

- .1 Comply with requirements of authorities having jurisdiction .
- .2 Deliver to nearest appropriate depot materials accepted for recycling by region or municipality having jurisdiction over the *Place of the Work*, including but not limited to cardboard, paper, plastic, aluminum, steel, and glass. Deliver to nearest appropriate depot scrap and excess gypsum wallboard for recycling of this material. Costs for this work are included in the *Contract Price*.

1.11 Interferences

- .1 Coordinate placement of equipment to ensure that components will be properly accommodated within spaces provided prior to commencement of the *Work*.
- .2 Take complete responsibility for remedial work that results from failure to coordinate aspects of work prior to its fabrication/installation.
- .3 Ensure that accesses and clearance required by jurisdictional authorities and/or for easy maintenance of equipment are provided in layout of equipment and services; notify *Consultant* if indicated clearances are in conflict.

1.12 Not In Contract Items and Items Supplied by Owner

- .1 NIC (Not In *Contract*) shall be used to designate various items of equipment that require coordination for installation although are not *Provided* as part of the *Work*.
- .2 SBO (Supplied by *Owner*) shall be used to designate various items of equipment that will be supplied by the *Owner* for installation by the *Contractor* as part of the *Work*.
 - .1 Install items indicated as supplied by *Owner* (SBO) during the *Work*. Coordinate shipping and delivery with the *Owner*. Store items supplied by *Owner* at the *Place of the Work* and protect from damage. Install completely, and leave in full operating condition, in accordance with manufacturer's directions.

1.13 Publicity Releases and Photographs

- .1 No press or publicity releases will be permitted without prior written approval of the *Owner*.

General Instructions

- .2 No photographs of the *Place of the Work* or of any portion of the *Work* will be permitted without written approval of the *Owner*, except as provided by the *Contract Documents*.

1.14 Electronic Files

- .1 In the event that the *Contractor*, a *Subcontractor*, or a *Supplier* requests AutoCAD files from the *Consultant*, the *Consultant* will be allowed to use their discretion whether or not they will provide them. The *Consultant* may charge a fee for providing the electronic files and/or require a copyright waiver to be signed, also at the *Consultant's* discretion.

1.15 Incentives, Rebates, and Refunds

- .1 The *Contractor* shall, at the request of the *Owner*, assist, join in, or at *Owner's* expense, make application on behalf of the *Owner* for any exemption, recovery, rebate, or refund.
- .2 Provide the *Owner* with copies, or where required originals of records, invoices, purchase orders, or other documentation as may be necessary to support such application.

PART 2 - PRODUCTS

Not applicable.

PART 3 - EXECUTION

Not applicable.

END OF SECTION

Product Substitution Procedures

PART 1 - GENERAL

1.1 Approved Alternates and Approved Equals

- .1 Named *Products* 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 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 of such RFIs, and the *Consultant* and the *Contractor* will jointly prepare an estimate of the time necessary for processing same as well as an 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	_____ Contractor
_____ Date	_____ Date
Cc: <input type="checkbox"/> Owner <input type="checkbox"/> Consultant <input type="checkbox"/> Contractor	<input type="checkbox"/> Field <input type="checkbox"/> Other:

PART 1 - GENERAL

1.1 General

- .1 *Provide the Work in accordance with the Contract Documents and be responsible for delays or costs resulting from failure to properly inspect or coordinate the Work, and for replacement or corrective work required.*

1.2 Identification of Systems

- .1 *Provide identification of electrical and mechanical system installations and other automated systems or equipment in compliance with Contract Documents.*

1.3 Commissioning and Systems Demonstrations

- .1 Provide testing, adjusting, balancing and certification and commissioning of mechanical and electrical installations and other automated systems or equipment in accordance with Section 01 77 00.
- .2 Instruct *Owner's* designated representatives in operation and maintenance of mechanical and electrical installations and other automated systems or equipment, in accordance with Section 01 77 00.

1.4 Superintendence

- .1 Provide superintendent and necessary supporting staff personnel who shall be in attendance at the *Place of the Work* while *Work* is being performed, with proven experience in erecting, supervising, testing and adjusting projects of comparable nature and complexity.
- .2 The *Contractor* shall appoint a superintendent at the *Place of the Work* who shall have overall authority at the *Place of the Work* and shall speak for the *Contractor* and represent the *Contractor's* interest and responsibilities at meetings at the *Place of the Work* and in dealings with the *Consultant* and the *Owner*.

1.5 Dimensions

- .1 Verify dimensions at the *Place of the Work* before commencing shop drawings. Before fabrication commences report discrepancies to *Consultant* in writing. Incorporate accepted variances on shop drawings and as-built records.

1.6 Coordination

- .1 Coordinate and ensure workers, *Subcontractors*, and *Suppliers* cooperate to ensure that the *Work* will be carried out expeditiously and in proper sequence.
- .2 Make adjustments to allow adjustable work fit to fixed work.

1.7 Building Dimension, Templates, Built-ins, and Coordination

- .1 Take necessary dimensions for the proper execution of the *Work*. Assume complete responsibility for the accuracy and completeness of such dimensions, and for coordination.

Coordination

- .2 *Provide* forms, templates, anchors, sleeves, inserts and accessories required to be fixed to or inserted in the *Work* and set in place or instruct separate *Subcontractors* as to their location.
- .3 Supply items to be built in, as and when required together with templates, measurements, shop drawings and other related information and assistance.
- .4 Pay the cost of extra work and make up time lost as a result of failure to provide necessary information and items to be built in.
- .5 Verify that the *Work*, as it proceeds, is executed in accordance with dimensions and positions indicated which maintain levels and clearances to adjacent work, as set out by requirements of the *Contract Documents*, and ensure that work installed in error is rectified before construction resumes.
- .6 Check and verify dimensions referring to interfacing of services. Verify such dimensions with interconnected portions of the *Work*.
- .7 Do not scale directly from drawings. Obtain clarification from *Consultant* if there is ambiguity or lack of information.
- .8 Details and measurements of any work which is to fit or to conform with work installed shall be taken at the *Place of the Work*.
- .9 Advise *Consultant* of discrepancies and omissions in the *Contract Documents* that affect aesthetics, or that interfere with services, equipment or surfaces. Do not proceed with work affected by such items without clarification from *Consultant*.
- .10 Prepare and submit setting drawings, templates and other information necessary for the location and installation of material, holes, sleeves, inserts, anchors, accessories, fastenings, connections and access panels.
- .11 *Subcontractors* shall direct related *Subcontractors* on site of specific locations required for sleeves and openings. The *Contractor* shall be responsible for coordinating such activity to ensure no interruption in the progress of the *Work*.

PART 2 - PRODUCTS

Not applicable.

PART 3 - EXECUTION

Not applicable.

END OF SECTION

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.
 - .4 Establishing a schedule for progress meetings.

Project 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 *Owners* 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 As-built documents.
- .17 Operation and maintenance manuals.
- .18 Take-over procedures, acceptance, warranties.
- .19 Publication to be used for publishing certificate of substantial performance.
- .20 Progress claims, administrative procedures, holdbacks.
- .21 Insurances, transcripts of policies.
- .22 *Contractor's* safety procedures.
- .23 Workplace Safety and Insurance Board Certificate.

1.3 Pre-Installation Meetings

- .1 During the course of the *Work* prior to *Substantial Performance of the Work*, schedule pre-installation meetings as required by the *Contract Documents* and coordinated with the *Consultant*.
- .2 As far as possible, pre-installation meetings shall be scheduled to take place on the same day as regularly scheduled progress meetings.
- .3 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.
- .4 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 as directed by the *Consultant*.
- .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.
 - .7 Problems that impede compliance with construction schedule.

Project Meetings

- .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 30 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.
 - .13 Status of commissioning and training.
 - .14 Review *Contractor's* deficiency list and status.

Project Meetings

- .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.

PART 2 - PRODUCTS

Not applicable.

Project Meetings

PART 3 - EXECUTION

Not applicable.

END OF SECTION

Construction Progress Documentation

PART 1 - GENERAL

1.1 General

- .1 Schedules required:
 - .1 Construction schedule.
 - .2 *Product* delivery schedule.
 - .3 Inspection and testing schedule.
- .2 Format:
 - .1 Prepare schedules in the form of a Microsoft Project horizontal bar chart method. Include a separate bar for each trade or operation.
 - .2 Include horizontal time scale identifying the first *Working Day* of each week.
 - .3 Format for listings: The chronological order of the start of each item or part of the *Work*.
 - .4 Identification of listings: By systems description.
- .3 Construction schedule:
 - .1 Include the complete sequence of construction activities, including provision for climate and weather.
 - .2 Include the dates for the commencement and completion of each major element of the *Work* parallel to the sections of the specifications.
 - .3 Show projected percentage of completion for each item as of the first *Working Day* of each week.
 - .4 Submit draft schedule for review, and incorporate responses to comments identified by *Consultant* and/or *Owner*.
 - .5 Show dates for the commencement and completion of inspection and testing.
 - .6 Show dates for the commencement and completion of mock-ups and dates required for review of mock-ups by *Consultant*.
 - .7 At each date of submission of schedule, indicate progress of each activity.
 - .1 Show changes occurring since previous submission of the construction schedule:
 - .1 Major changes in scope.
 - .2 *Change Orders* and *Change Directives*.
 - .3 Activities modified since previous submission.
 - .4 Revised projections of progress and completion.
 - .5 Other identifiable changes.
 - .2 Include a narrative report to define:
 - .1 Problem areas, anticipated delays, and the impact on the schedule.
 - .2 Corrective action recommended and its impact on the schedule.

Construction Progress Documentation

- .3 Include cash flow projection with minimum look ahead as directed by the *Consultant*.
- .4 *Product* delivery schedule:
 - .1 Include dates for delivery of *Products*, equipment, finish items, factory-finished manufactured items. Show last dates for order, shipment, and delivery in order to meet construction schedule.
- .5 Inspection and testing schedule:
 - .1 Prepare schedule for inspection and testing by advance discussion with the selected independent inspection and testing company to determine the time required for the independent inspection and testing company to perform its tests and to issue each of its findings, and allow for required time in the construction schedule.
 - .2 Refer to Section 01 45 00 for additional requirements for inspection and testing scheduling.

PART 2 - PRODUCTS

Not applicable.

PART 3 - EXECUTION

Not applicable.

END OF SECTION

PART 1 - GENERAL

1.1 General

- .1 Provide photographic documentation in digital format and in accordance with procedures and submission requirements specified in this section.

1.2 Digital Photographs

- .1 Equipment: Provide photographs using minimum 10 megapixel digital camera.
- .2 Submit the required photographs to the *Consultant* and to the *Owner*.
- .3 Output: Supply date stamped maximum resolution colour photos to *Consultant* in JPEG format, on CD-ROM for USB Flash Drive format.
- .4 Number of photos required:
 - .1 Prior to construction: Provide necessary number of photographs, as required to document existing conditions and verify damage to adjacent streets and property that may have existed prior to construction or demolition work: Minimum 50 photos.
 - .2 Each Progress draw: Provide 24 construction photographs each month to accompany each application for progress draw to document the stage of the *Work* from points selected by the *Consultant* showing as much as possible of the *Work* installed during the previous month.
 - .3 Provide minimum of 8 photographs on each meeting report and for each progress meeting.
 - .4 Completion: When the *Work* is completed, arrange to take final photographs of the *Work* from a minimum of 8 points of view.

PART 2 - PRODUCTS

Not applicable.

PART 3 - EXECUTION

Not applicable.

END OF SECTION

Submittals

PART 1 - GENERAL

1.1 General Requirements

- .1 Submit submittals as requested by the *Contract Documents*, as specified herein, and in accordance with the conditions of the *Contract*.
- .2 In addition to submittals specifically requested by the *Contract Documents*, submit other submittals as may be reasonably requested by the *Consultant*, or as are required to coordinate the *Work* and to provide the *Owner* with choices available, within the scope of *Contract Documents*.
- .3 Procedures and requirements for *Contract* closeout submittals shall be in accordance with the following sections:
 - .1 Section 01 77 00 - Contract Closeout Procedures and Submittals.
 - .2 Section 01 78 36 – Extended Warranties.
- .4 *Contractor's* review of submittals:
 - .1 Review submittals for conformity to *Contract Documents* before submitting to *Consultant*. Submittals shall bear stamp of *Contractor* and signature of a responsible official in *Contractor's* organization indicating in writing that such submittals have been checked and coordinated by *Contractor*. *Contractor's* review shall be performed by qualified personnel who have detailed understanding of those elements being reviewed and of the conditions at the *Place of the Work* proposed for installation.
 - .2 Check and sign each submittal and make notations considered necessary before submitting to *Consultant* for review. Where submittal is substantially and obviously in conflict with requirements of *Contract Documents*, reject submittal without submitting to *Consultant* and request resubmission. Note limited number of reviews of each submittal covered under *Consultant's* services as specified below.
 - .3 *Contractor* shall assume sole responsibility for any conflicts occurring in the *Work* that result from lack of comparison and coordination of submittals required for the *Work*.
 - .4 Submittals that have not been reviewed, checked, and coordinated by *Contractor* prior to submission to *Consultant*, or that do not bear the stamp and signature of *Contractor* as described above, will be stamped "REVISE AND RESUBMIT" and returned.
 - .5 Notify *Consultant* in writing of changes made on submittals from *Contract Documents*. *Consultant's* review of submittals shall not relieve *Contractor* of responsibility for changes made from *Contract Documents* not covered by written notification to *Consultant*.
- .5 *Consultant's* review of submittals:

Submittals

- .1 Review of submittals by *Consultant* is for the sole purpose of ascertaining conformance with the general design concepts and the general intent of the *Contract Documents*. This review shall not mean that *Consultant* approves the detail design inherent in the submittals, responsibility for which shall remain with the *Contractor*. Such review shall not relieve the *Contractor* of responsibility for errors or omissions in the submittals, or responsibility for meeting requirements of *Contract Documents*.
- .2 *Contractor* shall be responsible for dimensions to be confirmed and correlated at the *Place of the Work* for information that pertains solely to fabrication processes or to techniques of construction and installation, and for coordination of the *Work*.
- .3 As part of their scope of work, *Consultant* shall review shop drawings no more than twice. Should three or more reviews be required due to reasons of *Contractor* omissions causing resubmission requests, then *Contractor* shall reimburse the *Consultant* for time expended in these extra reviews. Time shall be invoiced to the *Owner* (to be deducted from monies due to the *Contractor* and paid to *Consultant* by *Owner*) at rates recommended by *Consultant's* professional association and disbursements shall be invoiced at *Consultant's* cost. The *Contractor* shall cover directly costs and administration associated with courier services and the like for these extra shop drawing reviews.
- .4 *Consultant's* review and markings on submittals do not authorize changes in the *Work* or the *Contract Time*, and will be accommodated at no additional cost to the *Owner*. If, in the opinion of the *Contractor*, the *Consultant's* markings on submittals constitute a change in the *Work* or will effect a change in the *Contract Time*, then the *Contractor* shall so notify the *Consultant* in writing and request an interpretation following the procedures for requests for interpretation in accordance with Section 01 26 00. If the *Consultant* finds that the *Consultant's* markings on submittals do constitute a change in the *Work* or will effect a change in the *Contract Time*, then a *Change Order* will be prepared therefore. The time taken to process such a request for interpretation shall not, in and of itself, constitute a change in the *Work* nor increase the *Contract Time*.
- .5 Submittals which are not required by the *Contract Documents* or not requested by the *Consultant* will not be reviewed by the *Consultant* and will be marked 'NOT REVIEWED' by the *Consultant* and returned to the *Contractor*.
- .6 Make submittals with reasonable promptness and in an orderly sequence so as to cause no delay in the *Work*. Be responsible for delays, make up time lost and pay added costs, at no additional cost to the *Owner*, incurred because of not making submittals in due time to permit proper review by *Consultant*.
 - .1 Once submitted, a submittal shall not be re-submitted until original submission has been reviewed by *Consultant* and returned to *Contractor*.
- .7 Submittals that contain substitutions will be rejected. Substitutions are permitted only on substitution submittals as specified in Section 01 25 00.
- .8 Do not proceed with work affected by a submittal, including ordering of *Products*, until relevant submittal has been reviewed by *Consultant*.
- .9 Prepare submittals using SI (metric) units.
- .10 *Contractor's* responsibility for deviations in submittal from requirements of *Contract Documents* is not relieved by *Consultant's* review of submittal, unless *Consultant* gives written acceptance of specific deviations.

Submittals

.11 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 \$1,000,000 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 certificates 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*.
- .12 Keep copies of reviewed submittals at the *Place of the Work* in an organized condition. Only submittals that have been reviewed by the *Consultant* and are marked with *Consultant's* review stamp, as applicable, are permitted at the *Place of the Work*.
- .13 The *Work* shall conform to reviewed submittals subject to the requirements of this section. Remove and replace materials or assemblies not matching reviewed submittals at no increase in the *Contract Time* and at no additional cost to the *Owner*.

Submittals

1.2 Schedule of Submittals

- .1 Before commencement of the *Work*, submit to the *Consultant* a detailed schedule of submittals required by the *Contract Documents*.
- .2 Indicate dates for submitting, review time, resubmission time, float time, and last date for meeting construction schedule.
- .3 *Consultant* will review submittal schedule and advise *Contractor* if volume and timing of submittals will permit timely review and response. *Consultant* may require modifications to submittals schedule in order to allow adequate time for review of submittals. Adjust submittals schedule and construction schedule as required to comply with *Consultant's* needs.
- .4 Make provisions in schedule for at least 10 *Working Days* for *Consultant's* review of submittals. When submittals have to be reviewed by one or more of *Consultant's* subconsultants, add 5 more *Working Days* for a total 15 *Working Day* review period.
- .5 If the *Consultant* requires resubmission of submittals, allow for an additional 10 *Working Days* review for each resubmission.
- .6 If, at any time, the *Contractor* submits a large enough number of submittals such that the *Consultant* cannot process these submittals within 10 *Working Days*, the *Consultant*, in consultation with the *Contractor* within 3 *Working Days* of receipt of such submittal, will provide the *Contractor* with an estimate of the time necessary for processing same. The *Contractor* shall accommodate such necessary time at no increase in the *Contract Time* and at no additional cost to the *Owner*.
- .7 The *Contractor* shall periodically resubmit the submittal schedule to correspond to changes in the construction schedule. Such resubmissions shall maintain the minimum 10 *Working Day* period for the *Consultant's* review.
- .8 Schedule submissions of submittals well in advance of scheduled dates for installation, to provide lead time for reviews and possible resubmissions and for placing orders and securing delivery so as to avoid delays in the *Work*.

1.3 Submission Procedures

- .1 Coordinate each submittal with requirements of the *Work* and *Contract Documents*. Individual submittals shall include related information.
- .2 Distribute copies of submittals to parties whose work is affected by submittals except *Consultant* and *Owner* before final submission for review by *Consultant*.
- .3 Accompany submittals with transmittal letter containing:
 - .1 Date.
 - .2 *Project* title and number.
 - .3 *Contractor's* name and address.
 - .4 *Contractor's* review stamp.
 - .5 Identification and quantity of each submittal.
 - .6 Other pertinent data.
- .4 Each submittal shall be identified numerically by relevant specification section number with a numeric indicator for multiple submittals by that section followed by revisions number, for example 04 05 19-01-R0.

Submittals

- .5 Submit original PDF documents only: scanned documents shall not be accepted.
- .6 Make any changes in submittal that *Consultant* may require, consistent with *Contract Documents*, and resubmit as directed by *Consultant*.
- .7 Notify *Consultant*, in writing, when resubmitting, of any revisions other than those requested by *Consultant*.
- .8 After *Consultant's* review, distribute copies to affected parties.

1.4 Product Data Sheets

- .1 Submit *Product* data sheets as follows:
 - .1 1 copy digitally in pdf format to *Consultant* using the *Consultant's* document management system.
- .2 Submit *Product* data sheets as called-for by the *Contract Documents* or as the *Consultant* may reasonably request where shop drawings will not be prepared due to a standardized manufacture of a *Product*. Manufacturers' catalogue cuts will be acceptable in such cases, providing that they are 213 mm x 275 mm (8-1/2" x 11") originals, and that they indicate choices including sizes, colours, model numbers, options and other pertinent data, including installation instructions. Submissions showing only general information are not acceptable.
- .3 Where requirements of *Contract Documents* are more stringent than design proposed on *Product* data sheets, the requirements of the *Contract Documents* take priority.
- .4 Upon completion of review by *Consultant*, 1 marked set of *Product* data sheets will be returned to *Contractor* in digital format for reproduction and distribution.
- .5 Retain 1 complete set of prints of reviewed *Product* data sheets for issuance to *Owner* immediately prior to *Substantial Performance of the Work*, in an acceptable, bound manner and in accordance with Section 01 77 00.

1.5 Shop Drawings

- .1 Submit shop drawings as follows:
 - .1 1 copy digitally in pdf format to *Consultant* using the *Consultant's* document management system.
- .2 Lettering on shop drawings shall be not less than 3mm (1/8") high.
- .3 Where requirements of *Contract Documents* are more stringent than design proposed on shop drawings, the requirements of the *Contract Documents* take priority.
- .4 *Consultant* markings and resulting action required:
 - .1 Shop drawings requiring no changes will be marked 'REVIEWED', and shall be submitted for as-built drawings purposes.
 - .2 Shop drawings requiring several changes will be marked 'REVIEWED as NOTED' and shall be revised and submitted for as-built drawings purposes.
 - .3 Shop drawings requiring substantial changes will be marked 'REVISE AND RE-SUBMIT' and shall be revised and resubmitted until *Consultant* stamps drawings with 'REVIEWED' or 'REVIEWED as NOTED'.

Submittals

- .5 Shop drawing size shall be multiple of 213 mm and 275 mm (8-1/2" and 11") excluding 38 mm (1-1/2") binding margin and not larger than 838 mm x 1117 mm (33" x 44"). Leave minimum 150 mm x 100 mm (6" x 4") clear space for *Consultant's* comments.
- .6 Upon completion of review by *Consultant*, 1 marked set of shop drawings will be returned to *Contractor* in digital format for reproduction and distribution.
- .7 Retain 1 complete set of prints of reviewed shop drawings for issuance to *Owner* immediately prior to *Substantial Performance of the Work*, in an acceptable, bound manner and in accordance with Section 01 77 00.
- .8 Submit copies of reviewed shop drawings to authorities having jurisdiction as required.
- .9 Shop drawings shall include:
 - .1 Fabrication and erection dimensions.
 - .2 Plans, sections, elevations, arrangements and sufficient full size details which indicate complete construction, components, methods of assembly as well as interconnections with other parts of the *Work*.
 - .3 Design calculations for items that require design calculations.
 - .4 Clear definition of the division of responsibility for the work described thereon. No *Products*, items or equipment, or description of work, shall be indicated to be supplied, or work to be done, "By Others" or "By Purchaser". Shop drawings marked with either of these phrases will be rejected without having been reviewed by the *Consultant*.
 - .5 Location and type of exposed anchors, attachments and locations and types of fasteners, including concealed reinforcements to accept mounted fasteners.
 - .6 Adhesives, joinery methods and bonding agents.
 - .7 Kinds and grades of materials, their characteristics relative to their purpose, detailed description of finishes and other fabrication information.
 - .8 Configurations, types and sizes required; identify each unit type on drawing and on *Product*.
 - .9 Descriptive names of equipment and mechanical and electrical characteristics when applicable.
 - .10 Data verifying that superimposed loads will not affect function, appearance and safety or work shown on shop drawings, as well as other interconnected work.
 - .11 Assumed design loadings, dimensions of elements and material specifications for load-bearing members.
 - .12 Proposed chases, sleeves, cuts and holes in structural members.
 - .13 Wall thicknesses of metals.
 - .14 Location and types of welds. For structural welds use AWS symbols and clearly show net weld lengths and sizes.
 - .15 Materials, gauges, and sizes being supplied including connections, attachments, reinforcement, anchorage and locations of exposed fastenings.
 - .16 Installation instructions and details for *Products* to be installed by separate *Subcontractors*, including function of each part.

Submittals

- .17 A list of *Products* covered by, or included on, the shop drawing. List of *Products* shall be complete and show manufacturer's name, *Product* name, generic description, standard certification where specified, manufacturer's complete installation data and precautions against wrong installation, operation and maintenance.
- .18 Refer to individual sections of the specifications for more particular requirements for shop drawings.
- .19 Compatibility statement: Include with each shop drawing a statement that each *Product* and material indicated on the shop drawing is compatible with each *Product* and material with which it comes into contact.

1.6 Certificates and Certification Submittals

- .1 Certificates and certifications submittals: Provide a statement that includes signature of entity responsible for preparing certification.

1.7 Engineered Judgements

- .1 When an engineered judgement is required by authorities having jurisdiction, such engineered judgement shall be prepared as an engineered submittal in accordance with Section 01 33 00.

1.8 Project Firestopping Manual and Coordination

- .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*.
- .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:

Submittals

- .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.
 - .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.
- .3 Closeout submittals:
 - .1 Submit closeout submittals in accordance with Section 01 77 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.

Submittals

1.9 Samples

- .1 Submit a minimum of 3 samples unless a greater amount is specified.
- .2 Deliver samples to the following location with expenses, including carrying costs, prepaid, unless otherwise instructed:
 - .1 *Consultant's office.*
- .3 Identify samples or assemblies by *Project* number and name, name of *Consultant*, *Contractor* and *Subcontractor*, and date of submission. Identify location, specified material reference and any other pertinent information. Show construction by layered method if necessary, clearly displaying textures and patterns.
- .4 Resubmit samples until written acceptance is obtained from *Consultant*.

PART 2 - PRODUCTS

Not applicable.

PART 3 - EXECUTION

Not applicable.

END OF SECTION

Special Procedures for Work in Occupied Buildings

PART 1 - GENERAL

1.1 General Procedures

- .1 For the purposes of this section:
 - .1 The words “worker” or “workers” shall mean the *Contractor*, *Contractor’s* staff or employees, *Subcontractors*, *Subcontractor’s* staff or employees, *Suppliers*, *Supplier’s* staff or employees, or anyone engaged for the *Work*, directly or indirectly, by the *Contractor*, unless otherwise indicated.
 - .2 The words “make good” or “making good” shall mean that, when a finish or material has been altered, the material or finish shall be repaired or replaced, and refinished to match existing quality and appearance to acceptance of *Consultant*, and that repaired or replaced and refinished *Work* shall not be discernible from existing materials or finishes when judged by the *Consultant* from a viewing distance of 1830 mm (6’), and that such work is included in the *Contract Price*.
- .2 Operational limitations:
 - .1 The existing building will remain in full use and occupancy throughout the *Work*, except for such parts of the building that have been vacated for the *Work*.
 - .2 *Contractor’s* use of the *Place of the Work* is limited to permit regular use of existing *Owner’s* facilities to continue with the least amount of interference and disruptions possible.
 - .3 In consultation with, and to acceptance of, the *Consultant* in the presence of the *Owner*, designate an entrance and a circulation route that workers shall use and that shall not be used by *Owner’s* staff, building occupants, or the public.
- .3 Dust tight enclosure and partition doors and entrance doors to the *Place of the Work* shall remain closed.
- .4 Areas of the existing building adjacent to the *Place of the Work* or areas affected by the *Work*, including circulation and access routes, shall be maintained in a clean state equivalent to the level of cleanliness maintained in the existing building, and as follows:
 - .1 Clean and vacuum the *Place of the Work* and areas surrounding the *Place of the Work* daily or more frequently as required.
 - .2 Wet mop floor areas in vicinity of access doors to the *Place of the Work* daily, or more frequently as required.
 - .3 Vacuum carpeted areas daily or more frequently as required.
 - .4 Wet clean carpets in accordance with manufacturer’s recommendations once work in such areas is complete.
 - .5 Final cleaning shall be in accordance with Section 01 77 00.
- .5 Waste protection and removal:
 - .1 Waste management and disposal shall be in accordance with Section 01 50 00 as supplemented herein.
 - .2 Transport waste in containers with tightly fitting lids or cover waste with a wet sheet.

Special Procedures for Work in Occupied Buildings

- .3 Remove waste as it is created. Debris shall be contained and covered if it can not be removed immediately.
- .4 Do not transport waste through occupied areas of existing building.
- .5 Remove waste at the end of each *Working Day* through construction access routes.
- .6 Document condition of the existing building in areas immediately adjacent to the *Place of the Work* by means of construction photographs in accordance with Section 01 32 33.

1.2 Security

- .1 The *Contractor* shall be solely responsible for securing the *Place of the Work* and the *Work*, and for securing areas used for the storage of *Products* or construction machinery and equipment. The *Owner* shall have no responsibility in this regard.
 - .1 *Provide* and maintain security lighting.
 - .2 *Provide* and maintain temporary locks. Premises to be locked after working hours.
- .2 *Provide* security for the *Place of the Work* by methods compatible with the security system for the existing building.
 - .1 *Contractor* shall coordinate the *Work* with the *Consultant* in the presence of the *Owner* in order to ensure no disruption to the existing building's security system.
 - .2 Where existing building's security system is breached due to *Contractor's* negligence, be responsible for any damage or theft of property, regardless if area where damage or theft occurred is under *Contractor's* control or not.

1.3 Use of Existing Facilities

- .1 Restrict access, parking, material deliveries, execution of work, operations and procedures to designated locations and times and do not deviate from designated procedures without prior acceptance by the *Consultant* in the presence of the *Owner*.
- .2 Periodically review proposed construction operations with the *Consultant* in the presence of the *Owner* and cooperate as required to ensure that *Owner's* interests and requirements are not unduly compromised with regard to the normal operation and function of occupied areas on the existing building.
- .3 Traffic through occupied areas of the existing building shall be kept to a minimum. Travel within occupied areas of the existing building shall be via the most direct route.
- .4 Noise, dust and debris, and odours shall be minimized to ensure building occupants in adjacent areas are disturbed as little as possible. Corrective action to cease or limit disagreeable annoyances to building occupants shall be implemented immediately upon notification by the *Consultant* or the *Owner*.
- .5 Use of existing laundry and garbage chutes shall not be permitted.
- .6 Use of existing containers and garbage bins shall not be permitted.
- .7 Use of existing elevators shall not be permitted.
- .8 Existing fire protection equipment:
 - .1 Existing fire protection equipment shall only be used in an emergency situation.

Special Procedures for Work in Occupied Buildings

- .2 Do not remove existing fire protection equipment.
- .3 If any existing fire protection equipment is used or interfered with in any way, the *Owner's* fire equipment inspector shall be retained to inspect, test, recharge, and otherwise repair such equipment at no additional cost to the *Owner*.
- .9 Sanitary facilities:
 - .1 Use of existing sanitary facilities shall not be permitted. Provide temporary sanitary facilities in accordance with Section 01 50 00.
- .10 Temporary site office:
 - .1 Provide temporary site office as described in Section 01 50 00.

1.4 Parking

- .1 There is no reserved parking. Parking is on a first-come-first-served basis. It may be necessary for workers to park off-site.
- .2 Throughout the *Work*, ensure that there is no interference with the operation of the existing premises, and that the existing parking areas and road system remain free and clear of obstructions.
- .3 Illegally parked vehicles will be ticketed and/or towed at vehicle owner's expense, and at no additional cost to the *Owner*.

1.5 Existing Services Interruptions

- .1 Connection or disconnection of services that will interfere with the operation of the *Owner's* facilities shall not be done without the prior written acceptance of the *Consultant* in the presence of the *Owner* and during the times designated by the *Owner*. Premium charges associated with such work shall be included in the *Contract Price*.
- .2 Provide at least 10 *Working Days*' prior written notice to the *Consultant* and the *Owner* of requirement or intention to interrupt services, and obtain written permission of the *Consultant* in the presence of the *Owner* prior to commencing such interruption.
- .3 In no instance shall interruptions affect the entire existing building.
- .4 As far as possible, coordinate interruptions with the *Owner's* regular maintenance of building services and systems.
- .5 Areas adversely affected by changes in air flows outside the construction areas as a result of a required shut-down of portions of the existing HVAC system within the construction areas are to be re-balanced to comfortable levels as advised by the *Consultant*.
- .6 Should existing services be interrupted in breach of the above, *Make Good* immediately and provide protection against further such disruptions. Costs resulting from such interruptions and for making good shall be the responsibility of the *Contractor* at no additional cost to the *Owner*.

1.6 Protection of the Existing Building

- .1 Protection requirements shall be in accordance with Section 01 50 00, as supplemented herein.
- .2 Keep *Place of the Work* safe and secure, denying access to unauthorized personnel.

Special Procedures for Work in Occupied Buildings

- .3 Protect existing work from damage. *Make Good* any damage caused. The onus is on the *Contractor* to substantiate that damage existed prior to commencement of the *Work*.
- .4 Do not overload the existing structure due to the *Work*.
- .5 Take special measures to protect existing work from damage when moving heavy loads or equipment. Protect areas used as passageways or through which materials are moved. Use resilient tired conveyances only when moving materials and equipment inside building. *Provide* coverings as required to protect existing work from damage.
- .6 Separate exterior access, work and storage areas from *Owner* occupied existing areas, with fencing and hoarding. Rearrange fencing/hoarding as *Work* progresses to suit extent and configuration of the *Work*.
- .7 *Provide* guards, barricades and other temporary protection to prevent injury to persons.
- .8 Protect existing building components and contents from damage by weather, when executing *Work* affecting integrity of the building envelope. *Provide* temporary insulated and air tight weatherproof closures to protect openings made in existing building envelope. *Make Good* existing building components and contents damaged by weather resulting from inadequate temporary protection measures.
- .9 Protection of existing occupied areas:
 - .1 Existing exterior walls with windows of plain glazing, when exposed to the *Work*, shall be protected with 16 mm (5/8") gypsum board for interior surfaces and 9.5 mm (3/8") exterior grade plywood for exterior surfaces, mounted on suitable framing.
 - .2 Maintain such protection throughout the *Work*.
 - .3 Other openings in the existing exterior walls, such as doors and louvres, shall be similarly protected or replaced with doors of solid core wood or hollow steel construction.

1.7 Emergency and Fire Protection

- .1 *Provide* and maintain ready access to fire protection equipment, in accordance with Section 01 50 00.
- .2 *Provide* temporary fire resistant closures at existing areas openings exposed to construction areas for the *Work* to maintain fire and life safety of existing building.
- .3 *Contractor* shall coordinate the work with the *Owner* in order to ensure no disruption to the existing fire detection and annunciation systems. Failure to provide such coordination shall result in the *Contractor* incurring the responsibilities and expenses associated with disruption to the existing fire detection and annunciation systems at no additional cost to the *Owner*.
 - .1 Provide fire watch when existing fire detection and annunciation systems are not operational or on bypass.
 - .2 Whenever a changeover time occurs, which is an outage time of at least a portion of the fire alarm system, the municipal fire department shall be notified of the temporary shutdown and alternative measures shall be devised.
- .4 *Contractor* shall coordinate the work with the *Consultant* in the presence of the *Owner* in order to prevent unapproved disruptions to the existing sprinkler system, standpipe system, or other fire protection systems.

Special Procedures for Work in Occupied Buildings

- .1 Where temporary shut-down is necessitated, such shut down shall be in accordance with the requirements of authorities having jurisdiction and the building code.
- .5 Obtain 'Hot Work Permit' from *Owner* prior to hot work operation, which may cause the building's fire alarm system to be activated or create an unwarranted fire risk condition. The prevention of fires and false fire alarms caused by hot work operations is the primary goal of this procedure. Gas hoses, backflow preventers, fire resistive tarpaulins, curtains and other cutting and welding equipment must be in good repair before the permit is issued.
 - .1 'Hot Work' is defined as work using open flames or sources of heat that could ignite materials in the work area.
- .6 Fire separations:
 - .1 Maintain the integrity of fire separations, fire protection systems, and fire rated assemblies.
 - .2 *Make Good* fire separations, fire protection, and fire rated assemblies compromised as a result of the *Work*.
- .7 Temporary fire separations:
 - .1 *Provide* temporary fire separations between existing occupied floor areas and new areas under construction.
 - .2 Construct temporary fire separations out of steel studs and gypsum board to provide a construction equivalent to a minimum of 1 hour fire resistance rating, unless otherwise indicated.
 - .1 Gypsum board: in accordance with Section 09 29 00.
 - .2 Steel studs: in accordance with Section 09 22 00.
 - .3 Where access is required, the doorway shall be protected by a door of solid core wood or hollow steel construction.
 - .4 Finish hardware equivalent to a minimum of 1 hour fire resistance rating, unless otherwise indicated.
- .8 Maintaining existing building exit facilities:
 - .1 Maintain exit facilities serving the existing building.
 - .2 Where an exit is blocked-off or deleted as a result of the *Work*, an alternative exit shall be *Provided* that is acceptable to the *Consultant*, the *Owner*, and authorities having jurisdiction.
 - .3 Where it is necessary for access to be gained to an exit through the *Place of the Work*, the access shall be clearly defined and protected so that it is separated from construction areas by a smoke tight fire separation equivalent to a minimum of 1 hour fire resistance rating, unless otherwise indicated.
- .9 Fire department access:
 - .1 Do not obstruct access route designated for fire department equipment.

Special Procedures for Work in Occupied Buildings

- .2 If it is necessary that existing access routes be obstructed or deleted, alternative access routes acceptable to the fire department and in accordance with the requirements of the *Contract Documents* and authorities having jurisdiction shall be *Provided* prior to commencement of work that will obstruct or delete existing access.
- .10 Combustible materials:
 - .1 Stockpiling of combustible materials adjacent to or inside the existing building shall not be acceptable.
- .11 Temporary protection of openings in fire separations:
 - .1 Openings in existing floor assemblies and vertical fire rated assemblies required by the *Work*, shall be temporarily protected with materials as required to maintain continuity of the required fire resistance rating for existing fire rated assembly.

PART 2 - PRODUCTS

Not applicable.

PART 3 - EXECUTION

Not applicable.

END OF SECTION

Quality Control

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 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.
 - .11 On line fabrication quality control practices.

Quality Control

- .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 *Consultant* will, on behalf of *Owner*, appoint independent inspection and testing companies, representing, reporting and responsible to the *Owner* through the *Consultant*.
 - .1 Cost of independent inspection and testing company services will be authorized as a disbursement from Cash Allowance as specified in Section 01 21 00. Independent inspection and testing company shall submit monthly invoice original to *Contractor* for review, relating invoices to tests and inspection reports. Provide original receipts for disbursements. Invoices for independent inspection and testing services shall be forwarded by *Contractor* to *Consultant* for inclusion in progress payment application.
- .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*.

Quality Control

- .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:
 - .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.

Quality Control

- .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*.
 - .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:

Quality Control

- .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*.
- .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. Mock-ups may not become part of finished work, except with explicit, 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.

Quality Control

- .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

Temporary Facilities and Controls

PART 1 - GENERAL

1.1 General Instructions

- .1 Temporary facilities and controls specified in this section shall be supplemented as applicable in accordance with Section 01 35 13.
- .2 Arrange, obtain and pay cost for permits required for temporary facilities and controls.
- .3 *Provide* and maintain temporary facilities and controls for the *Work* and remove them from the *Work* upon issuance of certificate of *Substantial Performance of the Work*.
- .4 Arrange and pay for required temporary services, unless otherwise indicated by *Consultant*.
- .5 Protect and maintain without interruption, existing water, heating, drainage, telephone and other services within the *Place of the Work* to existing buildings not within the scope of the *Work* of this *Contract*. Obtain written permission of the *Owner* for services required to be temporarily shut off, at least 2 full *Working Days* in advance.
- .6 Do not use permanent conveying, mechanical, or electrical systems, except standpipe for firefighting, during the course of the *Work* unless specific written permission is provided by the *Consultant*. Use of permanent facilities or services for temporary construction service shall not prejudice warranties.
- .7 *Provide* connection and disconnection of temporary services and facilities required in the *Work*, including connection to existing services made available by the *Owner*.

1.2 Existing Services and Facilities

- .1 Do not use any existing services and facilities during construction unless specific written permission is provided by *Owner*.
- .2 Electrical Services
 - .1 Use existing electrical service into building. *Owner* will pay electrical bills.
 - .2 *Provide* and maintain any components and equipment necessary to transform supply power to necessary temporary power voltage.
- .3 Water Supply
 - .1 Use existing water supply. *Owner* will pay water bills.
 - .2 Extend supply pipe or pipes from nearest available sources and maintain in good condition until permanent system is installed and ready for use.

1.3 Temporary Sanitary Facilities

- .1 *Provide* and maintain temporary sanitary facilities for use by workers.

1.4 Temporary Site Offices

- .1 *Provide* heated, lighted, air conditioned and ventilated site office, of sufficient size to accommodate site meetings for 12 people, and furnished with drawing layout table, filing cabinets, telephone, and computer as described below.

Temporary Facilities and Controls

1.5 Temporary Telephone, and Computer

- .1 *Provide* and maintain a telephone in temporary site office for exclusive use of *Consultant*, *Contractor*, and *Subcontractors*. Pay phone is not acceptable.
- .2 Superintendent shall be equipped with mobile telephone device.
- .3 Long distance charges shall be paid by party making call.
- .4 *Provide* and maintain a computer for the purposes of email and internet access. Computer to have dedicated, high-speed access, and be *provided* complete with a printer capable of printing 11" x 17" format.

1.6 Temporary Heating and Ventilation

- .1 *Provide* and pay for temporary heating, cooling and ventilating required for the *Work*, including attendance, maintenance and fuel.
- .2 *Provide* temporary heat and ventilation as required to:
 - .1 Facilitate continuous uninterrupted progress of the *Work*.
 - .2 Protect the *Work* and *Products* against damage and defacement caused by weather, harmful levels of temperature, humidity, and moisture.
 - .3 Provide ambient temperatures and humidity levels for proper storage, installation and curing of materials, in accordance with specified standards and manufacturer's requirements.
 - .4 Provide adequate ventilation to meet health regulations for safe working environment.
- .3 Prior to enclosing building, maintain work areas at not less than 7°C. After enclosing, keep premises heated to at least 13°C using temporary heating devices that do not cause moisture and humidity build-up within the facility. Increase temperatures in isolated areas to 20°C as required by various sections of the specifications or by *Product* manufacturers.
- .4 Solid fuel salamanders will not be permitted.
- .5 *Provide* temporary heat or adequate protection by means of straw or other coverings to floor slabs, footings, or any part of building not specifically designed to withstand frost penetration.
- .6 Furnish other temporary heating as required by various sections of the specifications or by *Product* manufacturers.
- .7 Replace with new, any work damaged due to failure to provide adequate heat at no cost to *Owner*.

1.7 Temporary Enclosures and Protection

- .1 *Provide* temporary enclosures and protection of adequate construction to prevent dispersion of dust and dirt into other areas of existing building and to prevent dispersion of dust and dirt beyond the *Place of the Work*.
- .2 Temporary enclosure and protection shall be of finished appearance and painted to colour approved by *Owner*.
- .3 Provide dust seal and sound resistant enclosures to protect existing building and operations as indicated. Include temporary doors, fastenings and keys.

Temporary Facilities and Controls

- .4 Supplement these requirements in accordance with Section 01 35 13.

1.8 Plant, Machinery and Scaffolding

- .1 *Provide* formwork, scaffolding, equipment, tools, machinery, including lifts, and incidental appurtenances necessary for the proper execution of the *Work*.
- .2 Erect plant, machinery and scaffolding to permit access to building and the *Work*.
- .3 Use scaffolds in such manner as to interfere as little as possible with other trades' operations.
- .4 Support scaffolds from finished surfaces only after taking precautions to prevent damage. No supports, clips, brackets, or similar devices shall be welded, bolted, or otherwise affixed to any finished member or surface without prior permission.

1.9 Site Storage

- .1 Handle and store materials so as to prevent damage or defacement to the *Work* and surrounding property.
- .2 Construct weather-tight storage sheds for storage of materials that may be damaged or defaced by weather. *Provide* floors raised 150 mm (6") clear of ground for storage of *Products*.
- .3 *Owner* is not responsible for securing *Products* or materials at the *Place of the Work*.

1.10 Protection of the Public

- .1 *Provide* fencing, barricades, hoarding, notices and warning boards and maintain lights and signals for protection of workers engaged on the *Work*, for protection of adjoining property and for protection of the public.
- .2 Such protective measures shall be finish painted to *Owner's* approved colour, when visible to the public.
- .3 Where any special hazard exists from which it is not possible to protect the public safety by other means, watchpersons shall be employed to preserve public safety until the area of special hazard no longer poses a risk to public safety.

1.11 Protection of the Work

- .1 Protect the *Work* from damage, discolouring, and defacement. Maintain protection until the *Work* is complete.
- .2 Protect completed work from soiling, abrasion, punctures, damage, and defacement, and maintain protection until the surrounding or overhead work is complete.
- .3 Keep surfaces free of oils, grease or other materials that may damage or deface them or affect bond of applied *Products*.
- .4 Remove and replace materials damaged or defaced as a result of failure to provide adequate protection.
- .5 Have damaged or defaced work corrected by workers meeting qualification requirements of the *Contract Documents*.

1.12 Waste Management

- .1 Do not bury rubbish and waste materials at the *Place of the Work*.

Temporary Facilities and Controls

- .2 Do not dispose of waste into waterways or storm or sanitary sewers.
- .3 Do not burn waste materials at the *Place of the Work*.
- .4 Comply with waste disposal requirements of authorities having jurisdiction.
- .5 Remove waste material from the *Place of the Work* daily. If waste is collected in bins, bins to be removed from site once full.
- .6 Arrange and pay for removal of debris and waste from the *Place of the Work*.
- .7 Make arrangements with and obtain permits from authorities having jurisdiction for disposal of waste and debris. Pay fees.
- .8 Supplement these requirements in accordance with Section 01 35 13.

1.13 Control of Dust, Debris and Noise

- .1 Cover or wet down dry materials and rubbish to prevent blowing dust and debris.
- .2 Control dust and dirt produced during the *Work* to prevent dispersion beyond the immediate work areas.
- .3 Prevent materials from contaminating air beyond application area, by providing temporary enclosures and ventilation/filtration.
- .4 Limit noise levels in accordance with requirements of authorities having jurisdiction and the *Owner*.
- .5 Prevent abrasive-blasting, pressure-washing spray, and other extraneous materials from contaminating air beyond application area.
- .6 Supplement these requirements in accordance with Section 01 35 13.

1.14 Traffic Control and Road Maintenance

- .1 Do not block roads or impede traffic. Keep construction traffic to designated roads only. Provide flagperson to direct traffic as required.
- .2 *Provide* a hard surface area at the *Place of the Work* for cleaning down trucks prior to entry onto municipal roads or private roads outside of the *Place of the Work*.
- .3 Keep public and private roads free of dust, mud and debris resulting from truck, machinery and vehicular traffic related specifically to this *Project*, for the duration of *Work*.
- .4 Clean roads regularly, public or private. Wash down and scrape flush roads at least daily when earth moving operations take place. Maintain public property in accordance with requirements of authorities having jurisdiction.

1.15 Design and Safety Requirements for Temporary Facilities

- .1 Be responsible for design, erection, operation, maintenance and removal of temporary structural and other temporary facilities. Engage and pay for registered professional engineering personnel skilled in the appropriate disciplines to perform these functions where required by law or by the *Contract Documents*; and in cases where such temporary facilities and their method of construction are of such a nature that professional engineering skill is required to produce safe and satisfactory results.

Temporary Facilities and Controls

- .2 Engage and pay for professional engineer(s) registered in *Place of the Work* to design and supervise construction and maintenance of hoardings, covered ways, protective canopies and project sign(s). Designs provided by *Consultant* or *Owner* for such work cover general appearance only.

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.
- .2 *Products* and *Product* installation shall be in compliance with building code, regulations and requirements of authorities having jurisdiction.

Product Requirements

- .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.
 - .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.

Product Requirements

- .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.
- .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.

Product Requirements

- .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(2018) 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.

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.

Product Requirements

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:
 - .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:

Product Requirements

- .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.
- .8 Protection of mechanical and electrical *Products* or materials:
 - .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.

Product Requirements

- .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.

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.
- .3 Execution:

Cutting and Patching

- .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

Progressive Cleaning

PART 1 - GENERAL

1.1 Environmental Controls

- .1 Conduct cleaning and disposal operations to comply with local ordinances and anti-pollution laws.
- .2 Store volatile wastes in covered metal containers, and remove from *Place of the Work* daily.
- .3 Prevent accumulation of wastes which create hazardous conditions.
- .4 Provide adequate ventilation during use of volatile or noxious substances.

PART 2 - PRODUCTS

2.1 Materials

- .1 Use only cleaning materials recommended by manufacturer of surface to be cleaned and as recommended by cleaning material manufacturer.

PART 3 - EXECUTION

3.1 Cleaning During Construction

- .1 Clean-up the *Place of the Work* daily. Maintain clean and clear egress routes.
- .2 Maintain *Place of the Work*, grounds and public properties free from accumulations of waste materials and rubbish.
- .3 *Provide* containers at the *Place of the Work* for collection of waste materials and rubbish. Remove waste materials and rubbish from the *Place of the Work* when containers become full.
- .4 Vacuum and clean interior building areas when ready to receive finish painting, and continue vacuum cleaning on an as-needed basis until *Substantial Performance of the Work*.
- .5 Schedule cleaning operations so that dust and other contaminants resulting from cleaning process will not fall on wet, newly painted surfaces.
- .6 Promptly as the *Work* proceeds, on a daily basis and upon completion, clean up and remove rubbish, surplus materials and equipment.
- .7 Remove as the work of this section progresses, corrosive and foreign materials which may set or become difficult to remove at time of final cleaning or which may damage members.
- .8 Wash exposed surfaces with a cleaning solution approved by *Product* manufacturers.
- .9 Debris and waste not permitted within cavities of *Work*.

END OF SECTION

PART 1 - GENERAL

1.1 General Instructions

- .1 The procedures for completing *Contract* and acceptance by the *Owner* shall be in accordance with the methods described in OAA/OGCA Document 100 (July 1, 2018, and reissued January 8, 2019) and any additional requirements described below.
- .2 Stages will be reviewed at the *Contract* start-up meeting to ensure that parties understand their responsibilities. Refer to Section 01 31 19 for procedures and requirements for *Contract* start-up meeting.
- .3 Within 4 weeks of commencement of the *Work*, submit to the *Consultant* a list of closeout submittals required by the *Contract Documents*.

1.2 Cleaning Prior to *Substantial Performance of the Work*

- .1 Immediately prior to *Consultant's* review to determine if *Substantial Performance of the Work* has been achieved, remove surplus *Products* and construction machinery and equipment not required for the performance of the remaining *Work* and clean as described under paragraph 1.3 - Final Cleaning to the greatest extent practicable given work remaining to be completed. Cleaning shall be to a sufficient extent to permit the *Consultant's* review to be performed properly and reasonably.

1.3 Final Cleaning

- .1 Environmental controls:
 - .1 Conduct cleaning and disposal operations to comply with local ordinances and anti-pollution laws.
 - .2 Store volatile wastes in covered metal containers, and remove from *Place of the Work* daily.
 - .3 Prevent accumulation of wastes which create hazardous conditions.
 - .4 Provide adequate ventilation during use of volatile or noxious substances.
- .2 Materials:
 - .1 Use only cleaning materials recommended by manufacturer of surface to be cleaned and as recommended by cleaning material manufacturer.
- .3 Final cleaning:
 - .1 Remove waste *Products* and debris other than that caused by the *Owner*, and leave the *Work* clean and suitable for occupancy by *Owner*.
 - .2 When the *Contract* is completed, remove surplus *Products*, tools, construction machinery and equipment.
 - .3 Clean glass, mirrors, hardware, wall tile, stainless steel, chrome, porcelain enamel, prefinished surfaces, and fixtures.
 - .4 Remove stains, spots, marks and dirt from decorative parts of the *Work*, electrical and mechanical fixtures, furniture fittings, walls, and floors.
 - .5 Vacuum clean and remove dust from building interiors, behind grilles, louvres, and screens. Vacuum clean interior of electrical equipment.

Contract Closeout Procedures and Submittals

- .6 Clean floor finishes to written requirements of manufacturer.
- .7 Remove non-permanent labels.
- .8 Remove dirt and residue from surfaces.
- .9 Inspect finishes, fittings and equipment and ensure specified workmanship and operation.
- .10 At completion of the *Work*, remove protective coatings, clean surfaces and remove excess compounds and sealant materials. Make good defective, scratched or damaged work.
- .11 Clean equipment and fixtures to a sanitary condition, clean or replace filters of mechanical equipment.
- .12 Remove seal wrap on mechanical and electrical *Products* and materials and clean as required.
- .13 Clean and/or replace lamps, light fixtures, lenses and grilles.
- .14 Remove protective covering and labels from lamps, hardware, and speciality items.
- .15 Under the direction of the *Consultant*, aim adjustable luminaires.
- .16 Clean architectural metal surfaces to remove surface discolouration and rust staining.

1.4 Closeout Submittals

- .1 Collect reviewed submittals, and assemble required closeout submittals executed by *Subcontractors*, *Suppliers*, and manufacturers. Prior to submitting closeout submittals to the *Consultant*, undertake the following:
 - .1 Review maintenance manual contents (operating, maintenance instructions, as-built drawings, materials) for completeness.
 - .2 Review supply and completeness of spare parts required by *Contract 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.

Contract Closeout Procedures and Submittals

- .2 No later than 10 *Working Days* prior to submitting request for *Consultant's* review to determine if *Substantial Performance of the Work* has been achieved, submit to the *Consultant* the closeout submittals specified in this section, including, but not limited to, reviewed shop drawings, *Product* data sheets, samples, operating instructions, as-built records, fully executed warranties and guarantees, reports recording demonstration and instruction provided to *Owner* for operation and maintenance of building systems, software required for operation and maintenance of building systems, maintenance materials, and keys.
- .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.
- .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*.
- .6 As-built documents:
 - .1 *Owner* will provide 1 set of *Contract Documents* to the *Contractor* for as-built documentation purposes.
 - .2 Accurately document as-built conditions and deviations from *Contract Documents* as the *Work* progresses.
 - .3 Mark changes in red ink.
 - .4 Document, without being limited to, the following:
 - .1 Changes by *Change Orders*, *Change Directives*, and *Supplemental Instructions*.
 - .5 As-built documentation:
 - .1 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*.
- .7 Operation and maintenance manuals:
 - .1 Submit operation and maintenance manuals, consisting of the following general components:
 - .1 Operation and maintenance documents.
 - .2 Shop drawing documents.
 - .3 Warranty documents.
 - .4 *Project* data documents.
 - .2 Submit operation and maintenance manuals as follows:
 - .1 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*.

Contract Closeout Procedures and Submittals

- .3 Operation and maintenance documents shall contain operating and maintenance data and information specified below for supplied *Products*, in English, and shall be made up as follows:
 - .1 Charts, diagrams and reports identified in Divisions 21, 22, and 23 and Divisions 26, 27, and 28 of the specifications.
 - .2 Description, operation and maintenance instructions for equipment and parts list. Indicate nameplate information such as make, size, capacity, serial number.
 - .3 Neatly type lists and notes. Use clear drawings, diagrams of manufacturers' literature.
- .4 Shop drawing documents:
 - .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 00 appended to the pertinent engineered shop drawing in the shop drawing manual.
- .5 Warranty documents:
 - .1 Submit copies of bonds, guarantees, warranties and extended warranties together in one report binder, complete with an indexed summary list of warranties and expiration dates. Warranties to be in accordance with Section 01 78 36.
- .6 *Project* data documents: shall include the following information supplemented by additional required data specified elsewhere in the *Contract Documents*:
 - .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 as described below in this section.
 - .6 Key construction photos.
 - .7 Permits and forms:
 - .1 Workplace Safety & Insurance Board certificate of clearance.
 - .2 Certificates of approval of the *Work* by local building department (if available).
 - .3 Electrical authority certificate of inspection.
- .8 Maintenance materials:

Contract Closeout Procedures and Submittals

- .1 Provide overage, extra stock, and maintenance materials. For required materials, see individual sections of specifications. Deliver to a location and at a time specified by the *Owner*, and as follows:
 - .1 Use unbroken cartons, or if not supplied in cartons, material shall be strongly packaged.
 - .2 Clearly mark cartons or packaging as to contents, project name, and *Supplier*.
 - .3 If applicable give colour and finish, room number or area where material is used.
 - .4 Include necessary information for re-ordering of materials as part of packaging of materials.
- .2 Replace incorrect or damaged maintenance materials delivered to *Owner*, including damage through shipment.
- .3 Provide a typed inventory list of maintenance materials prior to *Substantial Performance of the Work* application. List all items, complete with quantities, and storage locations.
- .4 Establish 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*.

1.5 System Demonstration and Project Commissioning

- .1 Refer also to requirements of Divisions 21, 22, and 23 and Divisions 26, 27, and 28 with respect to commissioning for.
- .2 Perform system demonstration and commissioning work no later than 10 *Working Days* prior to submitting request for *Consultant's* review to determine if *Substantial Performance of the Work* has been achieved.
- .3 Submit required certificates of approval or acceptance from authorities having jurisdiction.
- .4 Meet with other consultants; to coordinate demonstration, instruction, commissioning and completion.
- .5 Review condition of equipment such as lighting, elevators and heating system, which has been used in the course of the *Work* to ensure turning over at completion in "as new condition" with warranties dated and certified from time specified.
- .6 When partial occupancy of uncompleted project is required by *Owner*, coordinate *Owner's* uses, requirements, access, and the like, with *Contractor's* requirements to complete the *Work*.
- .7 Demonstration and instruction:
 - .1 Demonstrate operation of each system to *Owner* and *Consultant*.
 - .2 Instruct *Owner's* personnel in operation, adjustment and maintenance of equipment and systems, using operation and maintenance data provided as the basis for instructions. Arrange and coordinate instruction of *Owner's* staff in care, maintenance and operation of building systems and finishes
 - .3 *Contractor*, manufacturer's representatives, and responsible personnel from *Subcontractors* whose work is being demonstrated shall be present at these demonstrations.

Contract Closeout Procedures and Submittals

- .4 Instruct *Owner's* representative on use of software required for operation and maintenance of building systems and provide a toll-free telephone number or website address for further assistance to the *Owner*.
- .5 Prepare and insert additional data in the operation and maintenance data manuals when the need for additional data becomes apparent during demonstration or instruction.
- .6 Demonstration and instruction report: Submit a written report of such demonstration, instruction, and commissioning to the *Consultant* as part of the contract closeout submittals described earlier in this section. Report shall include time and date of each demonstration, instruction, and commissioning activity, complete with a list of persons present.
- .8 Correct deficiencies and defects identified during demonstration, instruction, or commissioning.
- .9 Attend 'end-of-work' testing and break-in or start-up demonstration.

1.6 Substantial Performance of the Work

- .1 Deficiency review:
 - .1 Neither *Owner* nor *Consultant* will be responsible for preparation or issuance of extensive lists of deficiencies. *Contractor* assumes prime responsibility for ensuring that items shown and described in the *Contract Documents* are complete. Any reviews to approve the certificate of *Substantial Performance of the Work* will be immediately cancelled if it becomes obvious to the *Consultant* that extensive deficiencies are outstanding.
 - .2 The *Contractor* shall conduct an inspection of the *Work* to identify deficiencies and defects, which shall be repaired. When the *Contractor* considers that the *Work* is substantially performed, the *Contractor* shall prepare and submit to the *Consultant* a comprehensive list of items to be completed or corrected (the deficiency list) and apply for a review of the *Work* by the *Consultant* to determine if *Substantial Performance of the Work* has been achieved.
 - .3 The *Contractor's* request described above shall include a statement by *Contractor* that the *Work* to be reviewed by *Consultant* for deficiencies is, to the best of the *Contractor's* knowledge, in compliance with *Contract Documents*, reviewed shop drawings, and samples, and that deficiencies and defects previously noted by *Consultant* have been repaired.
 - .4 No later than 10 *Working Days* after the receipt of the *Contractor's* request described above, but contingent upon the prior receipt, by the *Consultant*, of the closeout submittals in the manner and form specified in this section, the *Consultant* and the *Contractor* will review the *Work* to identify any defects or deficiencies. If necessary, the *Contractor* shall tabulate a list of deficiencies to be corrected prior to *Substantial Performance of the Work* being certified by the *Consultant*. During review, the *Consultant* and the *Contractor* will decide which deficiencies or defects must be rectified before *Substantial Performance of the Work* can be certified, and which defects are to be treated as warranty items.
 - .5 Provide a schedule of planned deficiency review having regard to the foregoing.
- .2 Certification of *Substantial Performance of the Work*:

Contract Closeout Procedures and Submittals

- .1 When the *Consultant* considers that the deficiencies and defects have been completed and that it appears that the requirements of the *Contract Documents* have been substantially performed, the *Consultant* shall issue a certificate of *Substantial Performance of the Work* to the *Contractor*, stating the date of *Substantial Performance of the Work*.
- .2 The certificate of *Substantial Performance of the Work* shall be prepared and issued in accordance with the Construction Act.
 - .1 Inform *Owner, Consultant, Subcontractors*, and *Suppliers* which publication is to be used for publishing certificate of substantial performance in accordance with Section 01 31 19.
- .3 Final Inspection for completion of the *Contract*.
 - .1 Deficiencies and defects shall be made good before the *Contractor* submits a written request for final review of the *Work* and before the *Contract* is considered complete.
 - .2 When *Contractor* is satisfied that the *Work* is complete, and after the *Contractor* has reviewed the *Work* to verify its completion in accordance with the requirements of the *Contract Documents*, the *Contractor* shall submit a written request for a final review by the *Consultant*, who in turn will notify the *Owner*.
 - .3 If there are any deficiencies identified as a result of this review, they shall be listed by the *Consultant* and submitted to the *Contractor*. This list shall be recognized as the final deficiency list for purposes of acceptance of the *Work* under the *Contract*.
 - .4 Such deficiencies shall be corrected by a date mutually agreed upon between *Consultant* and the *Contractor*, unless a specific date is required by *Contract*, and a further review by the *Consultant* shall be called for by the *Contractor* following his own review to take place within 7 days from date of request.
 - .5 *Contractor* shall thereafter submit invoice for final payment.
 - .6 Money shall be withheld for deficiency work and will be released only when all deficiencies have been completed. No partial payment to be recognized until all work is completed.

1.7 Warranty Period

- .1 Provide on-going review and attendance to building call-back, maintenance and repair problems during the warranty periods.

PART 2 - PRODUCTS





























Not applicable.

PART 3 – EXECUTION



































3.1 Closeout Submittals USB Flash Drive File Structure

- .1 General Layout:

Contract Closeout Procedures and Submittals





- ▼  Project Name
- ▼  1. GD Manual
 -  1. Cover Table of Contents
- ▼  2. Drawings
 - ▼  1. Drawing List
 -  100 Series
 - ▼  200 Series
 -  As Built, Record
 - ▼  300 Series
 -  As Built, Record
 - ▼  400 Series
 -  As Built, Record
 - ▼  500 Series
 -  As Built, Record
 -  Etc
 - ▼  2. Shop Drawings Product Data Warranty
 - ▼  Division xx
 -  Section xx xx xx
 - ▼  Division xy
 -  Section xx xx xx
 - ▼  Division xz
 -  Section xx xx xx
 -  Etc
 - ▼  3. Inspection Reports
 -  Materials Testing
 -  Site Reports
 -  4. Independent Specialty Engineers Sign-Off
 -  5. Final Survey Drawing

Contract Closeout Procedures and Submittals







- ▼  2. O & M Manual
 -  1. Cover Table of Contents
 - ▼  2. Drawings
 -  1. Drawing List
 - ▼  100 Series
 -  As Built
 -  Record
 - ▼  200 Series
 -  As Built
 -  Record
 - ▼  300 Series
 -  As Built
 -  Record
 -  Etc
- ▼  3. Shop Drawings Product Data Warranty
 - ▼  1. Contents
 -  Division xx
 -  Division xy
 -  Division xz
 -  Etc
 - ▼  2. TAB Inspection Reports
 - ▼  Inspection Reports
 -  Materials Testing
 -  Site Reports
 -  3. Air Balancing
 -  4. Automated Control Systems Operation
 -  Etc
 -  4. Spare Parts Listing
 -  5. Maintenance Materials Listing
 -  6. Special Tools Listing
- ▼  3. Warranty Manual
 -  1. Cover Table of Contents
 -  2. Contractors
 -  3. Warrantees and Guarantees

Contract Closeout Procedures and Submittals

.2 Typical shop drawing, *Product* data and warranty folder in GD Manual:

-  Section xx xx xx
-  1 Section xx xx xx Tab Page - Copy
-  2 Shop Drawing x - Copy
-  3 Warranty

.3 Typical shop drawing, *Product* data and warranty folder in O & M Manual:

-  Section 25 xx xx
-  1 Section x Tab Page
-  2 Shop Drawing x
-  3 Operating Instructions x
-  4 Maintenance Instructions x
-  5 Warranty x

.4 File structure shall be edited to suit project requirements.

END OF SECTION

Extended Warranties

PART 1 - GENERAL

1.1 Extended Warranties

- .1 Extended warranties shall be in accordance with GC 12.3, as amended, and as follows:
 - .1 Where specifically identified in the *Contract Documents*, extended warranties shall be furnished by individual manufacturer for particular product/system/assembly.
 - .2 Extended warranties shall include for proper performance of the portion of the *Work* as defined by the scope of the applicable specification section to the extent that the design and *Contract Documents* permit such performance.
 - .3 The *Owner* shall promptly give the warrantor notice in writing of observed defects and deficiencies which occur during the warranty period.
 - .4 Extended warranties shall commence at date of *Substantial Performance of the Work*.
 - .5 Extended warranties specified shall be in addition to, and run concurrent with, other warranties required by the *Contract Documents*. Manufacturer's disclaimers and limitations on product warranty do not relieve *Contractor* of obligations under requirements of the *Contract Documents*.
 - .6 Submit extended warranty on form acceptable to the *Owner* specifically endorsed by the warrantor to the *Owner* and shall include the following information:
 - .1 Name and address of *Project*.
 - .2 Warranty commencement date (date of *Substantial Performance of the Work*).
 - .3 Warranty period.
 - .4 Specific warranty terms as required in applicable portion of *Contract Documents*.
 - .5 Name and title of authorized signing officer and seal of warrantor.

PART 2 - PRODUCTS

Not applicable.

PART 3 - EXECUTION

Not applicable.

END OF SECTION

Demolition

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*
 - .2 Salvage of designated items to be reused in the *Work*.
 - .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.

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, including footings, foundations, slabs, toppings, secondary floor finishes, and structures 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 Comply with Section 01 32 33.
 - .3 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 drawings.
 - .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 Installers / applicators / erectors: the work of this section shall be executed by a *Subcontractor* having a minimum of 5 years specialized demolition experience and 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 in accordance with Section 01 32 33.

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.
 - .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.

Demolition

- .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 Concrete: Demolish in sections. Cut concrete full depth at junctures with construction to remain and at regular intervals, using power-driven saw, then remove concrete between saw cuts.
- .2 Masonry: Demolish in small sections. Cut masonry at junctures with construction to remain, using power-driven saw, then remove masonry between saw cuts.
- .3 Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished, then break up and remove.

3.5 Salvage

- .1 Remove and store items indicated or directed for salvage. Remove, handle and transport such items to storage area within the *Place of the Work*, or to an area away from the *Place of the Work* if acceptable to the *Consultant* and the *Owner*. Perform such work to prevent damage to the items during removal and in storage.
- .2 The *Owner* will review *Place of the Work* prior to commencement of demolition and instruct the *Contractor* 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
- .3 or adjacent structures or services appears to be endangered, cease operations and notify demolition engineer, *Contractor* and *Consultant*.
- .4 *Provide* temporary weather enclosures in accordance with Section 01 35 13 01 50 00.
- .5 Prevent debris from obstructing active services and drainage systems.

Demolition

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

END OF SECTION

1 General

1.1 **SUMMARY**

1.1.1 General Conditions and Division 1, General Requirements, shall govern *Work* of this Section.

1.1.2 Quantities and dimensions enclosed by brackets apply for *Project* for which the Drawings are in imperial units.

1.1.3 *Contractor* shall obtain a copy of CSA Standards A23.1, and A23.2, and maintain on site.

1.1.4 This is a performance specification in accordance with Alternative (1) of CSA Standard A23.1 Table 5 "Alternative methods for specifying concrete". Nothing in this Section shall be construed or interpreted as rendering the specification to be Alternative (2) Prescriptive.

1.2 **DESCRIPTION**

1.2.1 **Sections Which Specify Concrete Work Performed in Compliance with This Section**

03 11 19: Insulating Concrete Forming
03 41 13: Precast Concrete Hollow Core Planks
31 62 16: Steel Piles
31 63 26: Drilled Caissons
32 16 00: Curbs, Gutters, Sidewalks, and Driveways

1.2.2 **Related Work Specified in Other Sections**

03 10 00: Concrete Forming and Accessories
03 20 00: Concrete Reinforcing
03 35 43: Polished Concrete Finishing
03 41 13: Precast Concrete Hollow Core Planks
04 21 00: Clay Unit Masonry
04 22 00: Concrete Unit Masonry
05 12 00: Structural Steel Framing
05 31 13: Steel Floor Decking
05 50 00: Metal Fabrications
07 11 13: Bituminous Dampproofing
07 14 13: Hot Fluid-Applied Rubberized Asphalt Waterproofing
07 14 16: Cold Fluid-Applied Waterproofing
07 16 16: Crystalline Waterproofing
07 16 19: Metal Oxide Waterproofing
07 92 00: Joint Sealants
31 23 00: Excavation and Fill

Division 23 and

Division 26: Equipment bases, exterior catch basins and manholes and similar *Work* specified for inclusion under mechanical and electrical *Work*.

1.2.3 **Co-operation with Consultant**

.1 Before commencing *Work*, review with *Consultant*, *Work* performed under this Section.

- .2 Schedule *Work* to allow sufficient time and access for *Consultant* to carry out periodic field review.

1.2.4 Definition

- .1 Architectural Concrete
Architectural concrete shall mean concrete surfaces designated as "architectural concrete" in *Contract Documents*. Consider surfaces specified or indicated a sandblasted or bush-hammered as "architectural concrete".

1.3 QUALITY ASSURANCE

1.3.1 Reference Standards

The following Reference Standards shall govern *Work* of this Section, except where they are in conflict with requirements imposed by this Specification in which case the latter shall govern. Standards referenced by following Standards apply but are not necessarily repeated in following list.

- .1 ACI 117-10 - Standard Specifications for Tolerances for Concrete Construction and Materials and Commentary American Concrete Institute
- .2 ASTM C29/C29M-17a - Standard Test Method for Bulk Density ("Unit Weight") and Voids in Aggregate
- .3 ASTM C127-15 - Standard Test Method for Relative Density (Specific Gravity), and Absorption of Coarse Aggregate
- .4 ASTM C171-16 - Standard Specification for Sheet Materials for Curing Concrete
- .5 ASTM C295-18a - Standard Guide for Petrographic Examination of Aggregates for Concrete
- .6 ASTM C309-19 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
- .7 ASTM C494/C494M-17 - Standard Specification for Chemical Admixtures for Concrete
- .8 ASTM C873/C873M-15 - Standard Test Method for Compressive Strength of Concrete Cylinders Cast in Place in Cylindrical Molds
- .9 ASTM C900-15 - Standard Test Method for Pullout Strength of Hardened Concrete
- .10 CGSB 19.13-M87 - Sealing Compound, One Component, Elastomeric, Chemical Curing
- .11 CGSB 19.24-M90 - Multicomponent, Chemical-Curing Sealing Compound
- .12 CGSB 37.2-M88 - Emulsified Asphalt, Mineral-Colloid Type, Unfilled, for Dampproofing and Waterproofing and for Roof Coatings
- .13 CGSB 37.3-M89 - Application of Emulsified Asphalts for Dampproofing or Waterproofing
- .14 CGSB 37.5-M89 - Cutback Asphalt Plastic Cement
- .15 CGSB 37-GP-6Ma - Asphalt, Cutback, Unfilled, for Dampproofing
- .16 CGSB 37-GP-12Ma - Application of Unfilled Cutback Asphalt for Dampproofing
- .17 CGSB 51.34-M86 - Vapour Barrier, Polyethylene Sheet for Use in Building Construction
- .18 CSA A23.1-14 - Concrete materials and methods of concrete construction
- .19 CSA A23.2-14 - Test methods and standard practices for concrete
- .20 CSA A3000-18 - Cementitious materials compendium
- .21 CSA S413-14 - Parking structures
- .22 Ontario Provincial Standard Specification OPSS 1010, Material Specification for Aggregates – Base, Subbase, Select Subgrade, and Backfill Material (latest edition)
- .23 Ontario Provincial Standard Specification OPSS 1212, Material Specification for Hot-Poured Rubberized Asphalt Joint Sealing Compound (latest edition)

1.3.2 Certification of Concrete Plant

- .1 Concrete plants shall be certified by the Ready Mixed Concrete Association of Ontario.
- .2 Submit a copy of "Certificate of Ready Mixed Concrete Production Facilities" for each plant that will supply this *Project*.

1.3.3 Tolerances

- .1 In accordance with ACI 117; definitions for tolerance terminology and tolerances for formed concrete surfaces are recapitulated in Section 03 10 00, Concrete Forming and Accessories.
- .2 Difference between elevation of high point and low point in specified area not to exceed:
In any bay up to 100 m²: 12.5 mm [1/2"]
In any bay up to 400 m²: 25.0 mm [1"]
- .3 **F-Number System**
Finish floor slabs to meet following tolerance classification in accordance with CSA Standard A23.1, Clause 7.6.1.4 "F-number method" and Table 21 "Slab and floor finish classifications".
 - Class A: $F_F = 20$, $F_L = 15$
 - Class B: $F_F = 25$, $F_L = 20$
 - Class C: $F_F = 35$, $F_L = 25$
 - Class D: $F_F = 45$, $F_L = 35$
 - Highly polished floor surfaces (such as RetroPlate): $F_F = 40$, $F_L = 30$
- .4 Measure F_L levelness tolerance at 72±12 hours after completion of floor finishing, on formed slabs before removal of shores and on slabs-on-grade.
- .5 **Straightedge Method**
 - .1 Finish floor slabs to meet following tolerances when measured at 72±12 hours after completion of floor finishing, before shores are removed from formed slabs, by placing a freestanding unlevelled 3 m [10'] long straightedge with 20 mm [3/4"] sleeper pads affixed to each end, at random locations on floor.
 - .2 Take at least one measurement per 10 m² [108 ft²] area of floor slab, taking a reading with straightedge parallel and then perpendicular to long dimension of floor.
 - .3 Make measurements to closest 1 mm [1/32"] and record location and value of each reading. Gap between and floor surface not to exceed:
 - Class A: 8 mm [5/16"]
 - Class B: 5 mm [3/16"]

1.3.4 Sample of Floor Finishing

- .1 Finish and cure an area of floor slab where directed by *Consultant* to provide sample of finish and curing procedures for approval.
- .2 *Provide* new sample area until finish is approved.
- .3 If liquid membrane curing compound is to be used on *Project*, determine and apply correct quantity required to meet rate of coverage recommended by manufacturer for measured test area.
- .4 Approved sample will be the standard by which subsequent finishing will be judged and will be incorporated into *Work*.

1.3.5 Job Mock-Up of Formed Surface

- .1 *Provide* and place specified concrete for *Project* and to meet requirements of mock-up specified in Section 03 10 00, Concrete Forming and Accessories.
- .2 *Provide* additional mock-up area for architectural finishing samples.
Finish portions of area in varying degrees of sandblasting to provide acceptable finish for approval of *Consultant*.
Finish portions of area in varying degrees of bush-hammering to provide acceptable finish for approval of *Consultant*.
- .3 Approved mock-up will be the standard by which subsequent *Project Work* will be judged acceptable.

1.3.6 Source Quality Control

- .1 Both source quality control, and field quality control specified in article, may be performed by an Inspection and Testing Company appointed by *Consultant*.
- .2 Review provided by Inspection and Testing Company does not relieve *Contractor* of his sole responsibility for quality control over *Work*. Performance or non-performance of Inspection and Testing Company shall not limit, reduce, or relieve *Contractor* of his responsibilities in complying with the requirements of the Specification.
- .3 Inspection and Testing Company shall be certified under CSA Standard A283, Qualification Code for Concrete Testing Laboratories, for Category 1 Certification.
- .4 Payment for specified *Work* performed by Inspection and Testing Company will be made from cash allowance specified in Section 01 21 00.
- .5 Include in *Contract Price* a cash allowance to cover specified *Work* performed by Inspection and Testing Company.
- .6 Payment for additional tests for additional tests (including testing of structure and its performance, and load testing) required by changes of materials or concrete mix design requested by *Contractor*, and failure of completed *Work* to meet specified requirements shall be made at *Contractor's* expense.
- .7 Perform *Work* of source quality control in accordance with CSA Standard A23.2 and to include:
 - .1 Verification that ready-mix *Supplier* is qualified to supply concrete in accordance with Specification.
 - .2 Review of proposed concrete mix designs.
 - .3 Sampling, inspection, and testing of materials as may be required.

1.3.7 Corrosion Inhibitor Quality Control

- .1 Representative of manufacturer of corrosion inhibitor shall visit concrete batch plant once a day for the first 3 days that concrete is batched with corrosion inhibitor, and thereafter at least once a week, to confirm that equipment is in good working order and correct dosage of corrosion inhibitor is consistently being added to the concrete. Submit letter promptly after each visit stating findings and recommendations.

1.4 PROJECT RECORDS

1.4.1 Concrete Pour Records

Record time, date, delivery ticket serial number, and location in building of each concrete pour, and identify related test cylinders. Keep these records on site until *Project* is completed.

1.4.2 Delivery Records

File duplicate copies of concrete delivery slips. Print the following information on each ticket at the plant using an automated printing device in accordance with Ontario Provincial Standard Specification OPSS.PROV 1350:

- .1 Name and location of plant.
- .2 Date and serial number of the ticket.
- .3 Name of *Contractor*.
- .4 Project name.
- .5 Specified Class of Exposure of the concrete, specified strength and ordered slump or slump flow.
- .6 Volume of concrete in load.
- .7 Truck number.
- .8 Mix design number.
- .9 Time of first mixing of aggregate, cementing materials and water. Where an electronic ticketing system is not used, time shall be stamped by time clock, within 5 minutes of batching.
- .10 Information on the amount of any material added after batching.
- .11 Time truck arrived on site and time when truck was finished discharging.
- .12 Rejection of a load or part thereof, if applicable.

1.4.3 Record Drawings

- .1 Record on a set of Drawings:
 - .1 Time and date of each pour.
 - .2 High and low ambient air temperatures during each pour.
 - .3 Date of removal of forms in each area.
 - .4 Founding elevations of all footings.
 - .5 Variations of foundation *Work* from that indicated on Drawings.
- .2 Make record drawings available for *Consultant's* inspection at all times.

1.5 SUBMITTALS**1.5.1 Certificate**

- .1 Submit a copy of "Certificate of Ready Mixed Concrete Production Facilities" for each plant that will supply this *Project*.

1.5.2 Samples

- .1 Submit for inspection, material samples of specified mix designs.

1.5.3 Concrete Mix Designs

- .1 Submit concrete mix designs to *Consultant* and Inspection & Testing Company within two weeks of tender award, including verification that each concrete mix will meet the specified performance requirements.
- .2 The verification shall consist of test results from trial batches in accordance with CSA Standard A23.1 Clause 8.5.4 "Trial mixes".
- .3 Test results from another project completed within the last 12 months are also acceptable.
- .4 Include in the submitted verification:
 - .1 For C-XL, C-1 and A-1 exposure classes: concrete strength, hardened air void structure and chloride permeability index (coulombs).

- .2 For F-1 exposure class: hardened air void structure.
- .3 For elements specified as requiring low shrinkage concrete: shrinkage testing as per ASTM C157.
- .5 Do not place concrete until the specified performance testing verification has been submitted to and reviewed by the *Consultant*.
- .6 Include in submitted mix designs the quantities of constituent components of the mixes. Alternatively, where quantities are not disclosed, each mix design shall be signed by a professional engineer licensed to practice in Ontario and knowledgeable and experienced in concrete mix design. Where quantities of constituent components are to be disclosed, the *Consultant* and the Inspection & Testing Company will sign a confidentiality agreement not to disclose the information without authorization.
- .7 When optimum bulk density of aggregates is specified, submit supporting evidence of compliance with requirements.
- .8 Review of mix design does not relieve *Contractor* from responsibility for compliance with *Contract Documents*.
- .9 Submit evidence, and material samples if requested, acceptable to Inspection and Testing Company to verify that proposed concrete mix design will produce specified quality of concrete.
- .10 Batch Records:
 - .1 Submit batch records if requested by *Consultant* when concrete test results indicate that concrete may not be in conformance with specifications.
 - .2 Submit once a week, batch records for concrete with specified corrosion inhibitor, unless other means are provided to prove that the specified dosage of corrosion inhibitor was included in the mix.
- .11 **Inspection Reports**

Inspection and Testing Company shall:

 - .1 Provide concrete test reports electronically using Ready Mixed Concrete Association of Ontario "Concrete Materials Tests" (CMATS). Notify *Consultant* that this is how results will be reported, and provide assistance and instructions on how to access the test results.
 - .2 Submit inspection reports in pdf format and distribute as follows, unless otherwise specified in Division 1:
 - : to *Consultant*;
 - : to Structural Engineer;
 - : to *Contractor*;
 - : to Concrete Supplier.
 - .3 On concrete cylinder test reports, include:
 - : Specific location of concrete represented by sample.
 - : Design strength.
 - : Unit weight of sample.
 - : Class of Exposure.
 - : Aggregate size.
 - : Date, hour and temperature at time sample taken.
 - : Percentage air content.
 - : Test strength of cylinder.
 - : Type of failure if test fails to meet specification.

1.5.4 Joint Location Drawings

- .1 Submit drawings showing proposed location of control joints in slab-on-grade, where not shown on Drawings.

1.5.5 Corrosion Inhibitor

- .1 Submit letter from representative of manufacturer promptly after each visit to concrete batch plant.

1.6 JOB CONDITIONS**1.6.1 Environmental Conditions**

- .1 In addition to Cold Weather and Hot Weather Requirements of CSA Standard A23.1, the following shall apply to *Work* of this Section.

1.6.2 Plastic Shrinkage Drying

- .1 Be aware that conditions causing plastic shrinkage cracking can occur at any time of year.
- .2 Obtain forecasts each day from Environment Canada, including long-range forecasts, of temperature, relative humidity and wind speed.
- .3 *Provide* the protection and other measures specified in CSA Standard A23.1 Clause **7.5** "Environmental Protection", whenever forecast conditions are such that plastic shrinkage cracking may occur.
- .4 *Provide* protection, wind breaks, and other measures before concrete placement commences.
- .5 *Provide* equipment to spray fine fog mist in air over concrete. Do not spray onto concrete surface.

1.6.3 Protection and Heat

- .1 *Provide* protection or heat, or both, so that temperature of concrete at surfaces is maintained at not less than
 - .1 21 deg. C for 3 days after placing;
 - .2 10 deg. C for the 2 days;
 - .3 above freezing for the next 2 days.
- .2 Do not permit alternate freezing and thawing for fourteen days after placing.
- .3 Do not heat above 30 deg. C.
- .4 Provide heat and insulated blankets to minimize thermal gradient and to maintain slabs at similar temperature to beams.
- .5 Distribute heaters uniformly and provide stand alone fans to distribute heat uniformly.
- .6 Vent exhaust gases from combustion type heaters to atmosphere outside protection enclosures.

1.6.4 Insulating Blankets

- .1 Use thermal blankets with an R value of not less than 3.5 ft.² hr. ° F/BTU (imperial units), or multiple layers to achieve this R value.
- .2 Place insulating blanket to closely follow finishing of concrete. Place as soon as finishing of sufficient portion of pour is completed that it can be covered by blankets. Do not wait till end of day to start placing insulating blankets.
- .3 Do not remove protection until concrete has cooled sufficiently that the temperature differential between the concrete surface and ambient air does not exceed 12 deg. C.

1.6.5 **Curing**

- .1 *Provide protection to maintain concrete continuously moist during curing period.*

1.6.6 **Hot Weather Concreting**

- .1 For hot weather concreting, including but not limited to when daytime temperatures are forecast to exceed 30 deg. C, or severe drying conditions, implement all of the measures of CSA Standard A23.1 Clause 7.5.1 "Environmental Protection General". Note that this includes concrete placement at night.

1.6.7 **In-Situ Strength**

- .1 Determine in-situ strength by one of the following two methods. Field cured cylinders placed on top of floor are not acceptable means of assessing the in-situ strength of the concrete.
- .2 Inspection and Testing Company shall be experienced in carrying out these test procedures.

.1 **Method 1 – Pullout Tests**

- .1 Perform these tests in accordance with ASTM C900.
- .2 Use proprietary inserts (LOK tests).
- .3 Calibrate inserts with standard cylinders for each mix design prior to construction.
- .4 Install proprietary inserts (LOK tests) at 30 locations within each pour area, fastened to formwork, distributed over the floor, including near edges of floor and openings where floor is likely to be coldest.
- .5 When time to test, apply load by hydraulic jack that has been calibrated within the previous six months.
- .6 Apply load to 5 inserts and determine strength. If strength is below specification for stripping form, wait another day before pulling another 5. When strength appears satisfactory, pull the remaining inserts.
- .7 Make good any spalls around inserts.

.2 **Method 2 – Cast-in-Place Cylinders**

- .1 Install cast-in-place cylinders with outer sleeve and inner sleeve in accordance with ASTM C873 using purpose made cylinder molds.
- .2 Install cylinders at locations distributed over the floor, including near edges of floor and openings where floor is likely to be coldest. Obtain *Consultant's* approval of number and locations before proceeding.
- .3 Patch holes neatly using specified metallic grout in dry locations and non-metallic grout in wet locations and parking structures.

1.6.8 **Rain**

- .1 Do not place concrete when it is raining. Should rain commence during placing, cover freshly placed concrete.

1.6.9 **Bonded Toppings**

- .1 Do not place bonded toppings on rough slabs that are less than 15 deg. C surface temperature.

1.6.10 Grout

- .1 Do not grout at ambient air temperatures or concrete surface temperatures less than 5 deg. C, or when temperature is forecast to fall to less than 5 deg. C within 24 hours of grouting.

1.6.11 Sealants

- .1 Do not apply sealants at ambient air temperatures or concrete surface temperatures less than 10 deg. C.

1.7 PROTECTION

- 1.7.1 Protect floor slabs and concrete surfaces exposed to view or on which finishes are to be applied, from grease, oil, and other soil which will affect appearance of concrete, or impair bond of toppings or finish materials.

2 Products**2.1 UNIT PRICES**

- 2.1.1 Unit prices requested as part of Tender shall include concrete, and its placing, curing and finishing.

2.2 MATERIALS**2.2.1 Generally**

In accordance with Reference Standards.

2.2.2 Cementing Materials

- .1 Portland Cement: to CSA Standard A3000 type GU or GUL unless otherwise indicated.
- .2 Cementitious Hydraulic Slag and Fly Ash: to CSA Standard A3000.

2.2.3 Fine Aggregate

For slabs-on-grade: fineness modulus of fine aggregate between 2.6 and 3.1.

2.2.4 Coarse Aggregates - General

20 mm to 5 mm [3/4" to 3/16"] unless otherwise specified.

2.2.5 Coarse Aggregate for Slabs Over Open Web Steel Joists (OWSJ), Waffle Slabs and Bonded Toppings ≤ 50 mm [2"] Thick

12 mm to 5 mm [1/2" to 3/16"].

2.2.6 Coarse Aggregate for Columns ≤ 300 mm [12"] in Least Dimension

10 mm [3/8"] to 5 mm [3/16"] (or 14 mm to 5 mm if 10 mm is not available).

2.2.7 Coarse Aggregate for Slabs-on-Grade

- .1 Abrasion loss not to exceed 35 percent.
- .2 Petrographic number of aggregate not to exceed 125 when tested in accordance with ASTM C295.

.3 Additional Requirement for Slabs-on-Grade ≥ 125 mm [5"] Thick

40 mm to 5 mm [$1\frac{1}{2}$ " to $3/16$ "]; combine at least two of the single sizes specified in Table 11 "Grading requirements for coarse aggregate" Group II of CSA Standard A23.1, one of which is to be 40 mm [$1\frac{1}{2}$ "], to obtain maximum bulk density (unit weight) and optimum grading, in accordance with an approved procedure.

2.2.8 Traprock Aggregate

Hard, fine-grained igneous rock with "lath-like" crystals interlocked; having a loss in 5 cycles of no more than 5 percent by weight when tested for soundness by magnesium sulphate in accordance with CSA Test Method A23.2-9A, a maximum absorption of 1 percent when tested in accordance with ASTM C127, and maximum petrographic number of 100.

2.2.9 Admixtures

- .1 Conform to Reference Standards for chemical and air-entraining admixtures.
- .2 Calcium Chloride: Do not use calcium chloride or admixtures containing chloride.
- .3 Chemical Admixture: Incorporate water-reducing admixture conforming to ASTM C494 type A, in all concrete.
- .4 Conform to ASTM C494 for other admixtures such as retarders, non-chloride accelerators and high range water reducers.
- .5 Air Entraining Admixture: Incorporate air-entraining admixture in addition to chemical admixture in concrete of relevant Class of Exposure, in accordance with CSA Standard A23.1, Table 4 "Requirements for air content categories".
- .6 **Corrosion Inhibitor**
Calcium Nitrite, meeting the requirements of CSA Standard S413, Annex C.
: DCI, by W.R. Grace & Co. of Canada Ltd, Ajax, ON.
: Eucon CIA, by Euclid Canada Inc., Toronto, ON.
: MasterLife CI 30 by BASF
: Sika CNI, by Sika Canada Inc., Cambridge, ON

2.2.10 Integral Crystalline (Chemical) Waterproofing Admixture

- .1 A non-corrosive integral crystalline waterproofing admixture for incorporation into the concrete, at the dosage recommended in the manufacturer's printed instructions, that generates a non-soluble crystalline formation throughout the pores and capillaries of the concrete.
: Eucon Vandex AM-10 by Euclid Canada Inc., Toronto, ON.
: Kryton Internal Membrane by Kryton Canada Corporation, Vancouver, B.C.
: MasterLife 300D, by BASF
: Penetron Admixture, by Penetron Specialty Products

2.2.11 Steel Fibres

- : Dramix ZC 60 x 1.00, by Dramicon Inc.
- : Eurosteel 60-100, by Nu-Tech Fiber-Con Inc., Toronto, ON.
- : Novocon 1050 by Propex, London, ON.
- : MasterFiber FF 1, by Maccaferri for BASF

2.2.12 Granular Underbed for Slabs-on-Grade

- .1 20 mm [3/4"] clear limestone, proof rolled for compaction, compacted thickness 150 mm [6"] under slabs 125 mm [5"] or less, 200 mm [8"] under thicker slabs (other than raft slab), unless greater thickness is indicated in geotechnical report.
- .2 20 mm [3/4"] crusher run limestone to OPSS 1010 for type A aggregate, but with 100 percent passing 22.4 mm [7/8"] sieve; proof rolled for compaction, compacted thickness

2.2.13 Vapour Barrier for Slabs-on-Grade

- .1 Polyethylene membrane, 0.15 mm [6 mil] thick to CGSB 51.34.
- .2 For floors covered with resilient floor finishes: polyethylene membrane, 0.25 mm [10 mil] thick to CGSB 51.34.
- .3 Do not use any polyethylene sheet under highly polished floors (such as Retroplate).

2.2.14 Curing-Sealing Compound

Membrane curing compounds, acrylic emulsion, to ASTM C309, type 1; select compound which will not discolour in sunlight for use in such areas.

- .1 **Solvent Based:**
 - : Diamond Clear, by Euclid Canada Inc., Toronto, ON.
 - : Mapecure Uv, by Mapei Inc., Brampton, ON.
 - : MasterKure CC 250 SB by BASF
 - : Sealtight CS-309, by W.R. Meadows of Canada Limited, Milton, ON.
- .2 **Water-Based:**
 - : Diamond Clear VOX, by Euclid Canada Inc., Toronto, ON.
 - : Florseal WB 18, by Sika Canada Inc., Mississauga, ON.
 - : MasterKure CC 200 WB by BASF
 - : Vocomp-20, by W.R. Meadows of Canada Limited (do not use on coloured concrete).

2.2.15 Floor Hardener

- .1 **Metallic Hardener**

Ferrous aggregate premixed with Portland cement and plasticizers.

 - : Euco-Plate HD, by Euclid Canada Inc., Toronto, ON.
 - : Masterplate F_F, by BASF
- .2 **Non-Metallic Hardener**

Natural and synthetic materials with Mohs hardness 7 minimum, premixed with Portland cement.

 - : Surfex, by Euclid Canada Inc., Toronto, ON.
 - : Diamag 7, by Sika Canada Inc., Mississauga, ON.
 - : Mastercron F_F, by BASF

2.2.16 Sealant

- .1 **Hot-Poured Asphalt**

For use with bituminous type joint filler: rubberized asphalt compound, to OPSS 1212.

 - : Hi-Spec Hot-Applied Polymeric Pavement Joint Sealant, by W.R. Meadows of Canada Ltd., Milton, ON.
 - : Sealz No. 6165 Hot Poured Joint Sealant, by Hydrotech Membrane Corporation.
- .2 **Cold Poured Liquid Neoprene**

For use with non-bituminous joint filler.

 - : Gardox, by W.R. Meadows of Canada Limited, Milton, ON.
 - : MasterSeal CR 100 by BASF

.3 Elastomeric Sealant

For use with non-bituminous type joint filler.

- .1 Multi-component polyurethane, in colour selected by *Consultant*, to CGSB Specification CGSB 19.24.

: For horizontal joints:

- : Eucolastic 2SL, by Euclid Canada Inc., Toronto, ON.
- : Planiseal Rapid Joint 15, by Mapei Inc., Brampton, ON.
- : Sikaflex 2C SL, by Sika Canada Inc., Mississauga, ON.
- : Masterseal SL2, by BASF
- : THC 900, by Tremco Ltd.

: For vertical joints:

- : Eucolastic 2NS, by Euclid Canada Inc., Toronto, ON.
- : Sikaflex 2C NS EZ Mix, by Sika Canada Inc., Mississauga, ON.
- : Masterseal NP2, by BASF
- : Dymeric, by Tremco Ltd.

- .2 Or one-part urethane, in colour selected by *Consultant*, to CGSB 19.13.

- : Eucolastic SL, by Euclid Canada Inc., Toronto, ON.
- : Mapeflex P1, by Mapei Inc., Brampton, ON.
- : Sikaflex 1A, by Sika Canada Inc., Mississauga, ON.
- : Masterseal SL1, by BASF

.4 Sealant in Conjunction with Dampproofing

- : Plastic cutback asphalt to CGSB 37.5.

2.2.17 Control Joint Filler**.1 Interior Floors**

For control joints in interior floors, approved semi-rigid joint filler, to protect against slab edge breakdown:

- : QWIKjoint UVR, by Euclid Canada Inc., Toronto, ON.
- : Loadflex, by Sika Canada Inc., Mississauga, ON.
- : Planibond JF, by Mapei Inc., Brampton, ON.

.2 Exterior Floors

For control joints in exterior floors left exposed.

- : Elastomeric sealant as specified in above sub-paragraph 2.2.16.3.

2.2.18 Dampproofing

- .1 For use in temperatures above 5 deg. C.
 - : Mineral colloid asphalt emulsion, to CGSB 37.2.
- .2 For use in temperatures 5 deg. C and below
 - : Asphalt cutback, unfilled, to meet CGSB 37-GP-6Ma.

2.2.19 Non-Slip Inserts

Fine aluminum oxide, standard strips, 6 mm wide [1/4"], 10 mm [3/8"] deep.

2.2.20 Penetrant Sealer

.1 Solvent Based

- : Baracade Silane 100, by Euclid Canada Inc., Toronto, ON.
- : Sikagard SN100, by Sika Canada Inc., Mississauga, ON.

.2 VOC Compliant (water based or low VOC)

- : Baracade WB 244, by Euclid Canada Inc., Toronto, ON.
- : Planiseal WR40, by Mapei Inc, Brampton, ON.
- : Sikagard 740W, by Sika Canada Inc., Mississauga, ON
- : MasterProtect H 400 by BASF

2.2.21 Curing Blanket to ASTM C171

2.2.22 Torque Controlled Expansion Anchors

- .1 Expansion Anchor: *Provide* expansion anchors of size shown on Drawings, including matching nuts and washers:
 - .1 For dry locations within the conditioned building envelope:
 - : KWIK Bolt 3 carbon steel zinc plated, by Hilti (Canada) Corporation, Mississauga, ON
 - .2 For wet or high humidity locations or locations exterior to the conditioned building envelope, but not exposed to de-icing salt:
 - : KWIK Bolt 3 type 304 stainless steel, by Hilti (Canada) Corporation, Mississauga, ON
 - .3 For locations exposed to chlorides or other corrosive materials:
 - : KWIK Bolt 3 type 316 stainless steel, by Hilti (Canada) Corporation, Mississauga, ON
- .2 Sleeve Anchor: *Provide* sleeve anchors of size shown on drawings, including matching nuts and washers:
 - .1 For dry locations within the conditioned building envelope:
 - : HSL3 carbon steel by Hilti (Canada) Corporation, Mississauga, ON
 - .2 For wet or high humidity locations or locations exterior to the conditioned building envelope:
 - : HSL3 stainless steel by Hilti (Canada) Corporation, Mississauga, ON

2.2.23 Adhesive Anchors in Drilled Holes

- .1 Anchor Rod: *Provide* anchor rods of size, type and embedment length shown on drawings including matching nuts and matching washers.
- .2 Reinforcing Bar: *Provide* reinforcing bar as anchor rod where specified on Drawings.
- .3 Corrosion Protection: *Provide* corrosion protection specified on Drawings
- .4 Adhesive: *Provide* the adhesive specified on the Drawings.

2.3 CONCRETE MIXES

2.3.1 General Requirements

- .1 Ready mix, with 28-day compressive strength as indicated on Drawings and in specifications.

- .2 Normal Density Concrete:
 - .1 Air dry unit weight: minimum 2300 kg/m³, reduced proportionally for maximum air content listed in CSA Standard A23.1, Table 4.
- .3 Structural Semi-Low-Density Concrete:
 - .1 *Provide* concrete incorporating pelletized slag aggregate and having a maximum air-dry unit weight of 2000 kg/m³, reduced proportionally for maximum air content listed in CSA Standard A23.1, Table 4.
- .4 Do not replace more than 10 percent of Portland cement with fly ash in concrete that is exposed to view in the finished structure, or in concrete that is of CSA Standard A23.1 Class of Exposure C-XL, C1, C2, C3, C4, F1 or F2.
- .5 Design concrete mix in conformance with
 - .1 CSA Standard A23.1, Clause 4.1.2 "Alternatives for specifying concrete",
 - .2 Alternative (1) of Table 5 "Alternative methods for specifying concrete",
 - .3 Table 1 "Definitions of C, F, N, A, S, and R classes of exposure",
 - .4 Table 2 "Requirements of C, F, N, A, and S classes of exposure",
 - .5 Table 4 "Requirements for air content categories" and as follows.
 - .6 *Provide* concrete meeting water/cementing materials ratio and air content of Table 2, in accordance with Class of Exposure specified in following paragraphs, and minimum strength specified on Drawings. Note that concrete designed in accordance with water/cementing materials ratio of Table 2 may yield strength exceeding minimum strength specified on Drawings.

2.3.2 Class of Exposure

Provide concrete as follows unless otherwise indicated in Schedule of concrete mixes on Drawings:

- .1 Class of Exposure C-1 for reinforced concrete subject to de-icing chemical exposure, including but not limited to:
 - : parking garage structural floors and walls, balustrades and columns adjacent thereto
 - : footings within parking garages
 - : other areas subject to de-icing chemical exposure.
- .2 Class of Exposure C-2 (Suggestion: replace at least 25 percent of the Portland cement with cementitious hydraulic slag, except reduced to 15% replacement in cold weather; up to 40% replacement in hot weather) for unreinforced elements subject to chlorides, including but not limited to:
 - : pavements, sidewalks, curbs and gutters
 - : slab-on-grade without reinforcement.
- .3 Class of Exposure F-2 (Suggestion: replace at least 25 percent of the Portland cement replaced with cementitious hydraulic slag, except reduced to 15% replacement in cold weather; up to 40% replacement in hot weather) for elements in unheated areas not subject to chlorides, including but not limited to:
 - : walls and slabs in unheated basements
 - : exposed exterior beams, columns, walls and slabs
- .4 For other elements exposed to freezing and thawing or de-icing chemicals, conform to CSA Standard A23.1 for Class of Exposure.
- .5 Interior Concrete, other than specified above, and not exposed to freezing and thawing, de-icing chemicals, fertilizers or other corrosive materials: Select water/cementing materials ratio and cementing materials content on basis of strength, workability and finishing requirements.
- .6 Rink Slab: Class of Exposure N.

2.3.3 Slump

- .1 Slump before addition of high-range (super-plasticizer) or mid-range water reducer shall be in accordance with the mix design slump.
- .2 Slump at delivery on site after addition of water reducers, whether added at plant or on site, shall be in accordance with the specified slump.
- .3 The measured slump shall be plus or minus the tolerance for an individual batch, but the average of the slumps for the batches shall be the mix design slump or the specified slump at delivery on site, as applicable, in accordance with CSA Standard A23.1.
- .4 Add high-range or mid-range water-reducer, not water, to bring slump to level acceptable to floor finisher for placement.

2.3.4 Air Entrained Concrete

- .1 Spacing factor for air entrained concrete shall not exceed 230 microns, and no single test shall exceed 260 microns, based on tests on cores drilled from the structure, and on cylinders.
- .2 Air content in the hardened concrete shall be at least 3.0 percent.

2.3.5 Corrosion Inhibitor

Incorporate corrosion inhibitor specified in paragraph 2.2.9.6, in the reinforced concrete elements where CSA Standard Exposure Class C-XL, C1, C2, C3 or C4 is specified: *Provide* dosage of 15 litres per cubic metre unless otherwise shown in the Schedule of concrete mixes on the Drawings.

2.3.6 Slabs-on-Grade

- .1 Use type MH (or MHL) cement or replace the type GU (or GUL) cement with a sufficient percentage of cementitious hydraulic slag to obtain equivalent performance to type MH (or MHL) cement. When mean daily temperature is less than 10 deg. C, reduce the Portland cement replacement to 10 percent to 15 percent range. Do not use type MH (or MHL) cement in cold weather if it would result in excessively delayed setting time. For highly polished floors (such as Retro-Plate) do not replace more than 15% of the Portland cement.
- .2 Limit shrinkage to not more than 0.040 percent in accordance with CSA Standard A23.1 Clause 8.8 "Low Shrinkage Concrete", Clause 8.8.2 "Pre-qualification testing" and Clause 8.8.3 "Qualification of the mixture proportion", except limit shrinkage to 0.030 percent for warehouse floors, industrial floors and other floors where 38 mm [1½"] coarse aggregate is specified.
- .3 Use aggregates specified in paragraphs 2.2.3 and 2.2.4.
- .4 *Provide* cementing materials content adequate to achieve specified performance requirements and to ensure that floor can be properly finished. Floors shall have an adequately hard surface for the intended use and shall not dust.
- .5 Modulus of rupture 3.5 MPa average, 3.0 MPa minimum.
- .6 Slump at delivery, before addition of super-plasticizer: to meet design mix requirements (suggested 50 mm [2"]); add super-plasticizer, not water, to bring slump to level acceptable to floor finisher for placement.

2.3.7 Columns

Incorporate super-plasticizer to provide adequate slump (generally 175 mm to 225 mm [7" to 9"]) concrete for columns for proper consolidation without voids or honeycombing. Self consolidating concrete can be used if approved by the *Consultant*.

2.3.8 Insulated Concrete Form (ICF) Walls

- .1 Exposure class F-2 for walls on exterior of building. Refer to Drawings for concrete strength.
- .2 150 mm [6"] plus or minus 30 mm [1.20"] slump at time of deposit, unless otherwise specified on Drawings.

2.3.9 Steel Fibre Reinforced Concrete

- .1 Provide cementing materials content to meet the specified performance requirements including but not limited to hardness, dusting and durability, shrinkage strain limit, and 25 kg/m³ of steel fibres specified in paragraph 2.2.11.
- .2 Supply concrete with low slump (suggested 50 mm [2"]) and incorporate super-plasticizer at dosage sufficient to provide slump required by floor finishing *Subcontractor* (generally 100 mm to 125 mm slump [4" to 5"]).

2.3.10 Floor Hardeners

Confirm that concrete mix contains only materials compatible with floor hardener.

2.3.11 Drilled Caissons

Provide concrete with adequate slump to be placed in caisson without arching, voids or segregation, generally 150 mm [6"] slump.

2.3.12 Sulphate Exposure

Provide concrete mix in accordance with Clause 4.1.1.6 "Sulphate attack (S class)", Tables 1 to 3 of CSA Standard A23.1, for concrete subject to sulphate attack, including caissons, and other concrete in contact with soil.

2.3.13 Concrete Toppings

- .1 Provide topping with minimum 28-day compressive strength of 30 MPa.
- .2 For floors left exposed and noted as traprock finish: Provide topping with traprock aggregate specified in sub-paragraph 2.2.8 and with minimum 28-day compressive strength of 35 MPa and low slump (suggested 50 mm [2"]) before addition of mid-range or

2.3.14 Architectural Concrete

For concrete designated as architectural concrete in *Contract Documents*:

- .1 Obtain aggregate and cement from same source at same time, for entire *Project*.
- .2 Use tools and handling equipment that are absolutely clear of rust, salts, hardened concrete, and other harmful and foreign material.

2.3.15 Dry Pack Grout Under Steel Plates and Where Grout Thickness < 75 mm [3"]

- .1 Mix one part Portland cement to two parts concrete sand that conforms to CSA Standard A23.1, with only sufficient water that mix will retain its shape when made into ball by hand.

2.3.16 Dry Pack Grout for Underpinning and Where Grout Thickness ≥ 75 mm [3"]

- .1 Mix one part Portland cement, one and one-half (1½) parts concrete sand and two parts of 10 mm [3/8"] pea gravel, with only sufficient water that mix will retain its shape when made into ball by hand.

2.3.17 Premixed Grout

Mix with water in accordance with manufacturer's printed instructions.

- .1 **Dry Pack Non-Shrink Metallic**
 - : Masterflow 885, by BASF
 - : NS Metallic Grout, by Euclid Canada Inc., Toronto, ON.

- .2 **Dry Pack Non-Shrink Non-Metallic**
 - : Dry Pack Grout, by Euclid Canada Inc., Toronto, ON.
 - : Masterflow 100, by BASF
 - : M-Bed Standard Premix, by Sika Canada Inc., Mississauga, ON.
 - : Planigrout 712, by Mapei Inc., Brampton, ON.
 - : V-3 10K Grout, by W.R. Meadows of Canada Limited, Milton, ON.
- .3 **Flowable Grout**
 - Non-metallic shrinkage compensating:
 - : In-Pakt Pre-Mix, by C.C. Chemicals Limited.
 - : Masterflow 928, by BASF
 - : NS Grout, by Euclid Canada Inc., Toronto, ON.
 - : Planigrout 712, by Mapei Inc., Brampton, ON.
 - : Sika Grout 212HP, by Sika Canada Inc., Mississauga, ON.

2.3.18 **Parking Garage Walls Retaining Earth**

- .1 Incorporate into the concrete at batch plant, integral crystalline waterproofing admixture specified in paragraph 2.2.10, at the dosage recommended by the manufacturer.

2.3.19 **Cisterns, Swimming Pools, Water Tanks: Walls & Floor**

- .1 Limit shrinkage to not more than 0.040% in accordance with CSA Standard A23.1 Clause 8.8 "Low-shrinkage concrete".
- .2 Incorporate into the concrete at batch plant, integral crystalline waterproofing admixture specified in paragraph 2.2.10.

2.4 **EQUIPMENT**

2.4.1 **Vibrators for Concrete Reinforced with Epoxy-Coated Bars**

Kevlar/Polyurethane rubber headed vibrator manufactured by Oztec Industries Inc., and distributed by Castlefield Electric Tool Ltd., Toronto; Mega Industries Inc., Mississauga; and Nick's Power Tools Ltd., Weston, ON.

2.4.2 **Early-Entry Saw**

High speed dry-cut saw with spring-loaded anti-raveling skid plate, diamond-impregnated blades, up-cutting rotation of the blade to cut aggregate that permits sawcutting within 2 hours of completion of surface finishing operation, without spalling, or raveling of the concrete.
: Soff-Cut, by Husqvarna Construction Products, USA.

3 **Execution**

3.1 **EXAMINATION**

- 3.1.1 Confirm that subgrade of compacted fill conforms to requirements specified for backfilling before placing slab underbed.
- 3.1.2 Confirm that surfaces on which concrete is to be placed are free of frost and water before placing.

- 3.1.3 Confirm that reinforcement, dowels, control joints, inserts and all other built-in *Work* are in place and secured before placing concrete.

3.2 PREPARATION FOR SLABS-ON-GRADE

3.2.1 Granular Underbed

- .1 Obtain Geotechnical *Consultant's* written confirmation that prepared subgrade is acceptable for placement of granular underbed.
- .2 Place granular underbed over entire area of building and proof roll.
- .3 Obtain Geotechnical *Consultant's* confirmation that thickness, elevation and proof rolling of granular underbed are acceptable.
- .4 In small areas not accessible to proof roller, use controlled density fill in lieu of granular.

3.2.2 Vapour Barrier

- .1 Place polyethylene membrane specified in paragraph 2.2.13, on top of prepared granular underbed, lap sides and end joints 150 mm [6"], and "shingle" laps in direction of concrete placing.
- .2 Do not use polyethylene sheet under highly polished floor such as Retro-Plate.

- 3.2.3 Remove foreign materials from underbed and forms before placing concrete.

3.3 PLACING CONCRETE

3.3.1 Notification

Notify *Consultant* at least 24 hours before commencing to place concrete, and 24 hours before wall forms are closed in. Regardless of any requirement of Reference Standards to inspect all of the *Work* prior to placing concrete, field review of construction will be in accordance with random sampling program.

3.3.2 Beams, Girders, Columns

Place beams, girders, brackets, column capitals and haunches monolithically with floor slab.

3.3.3 Concrete Placed over Open Web Steel Joists

Transport and spread concrete over joist construction in a manner to prevent lateral deflection and twisting of joists.

3.3.4 Concrete Fireproofing

- .1 Encase structural steel members with concrete, where indicated on Structural Drawings or where noted "C.F." on Drawings.
- .2 *Provide* concrete of same strength as adjacent concrete framing. *Provide* 50 mm [2"] minimum cover.

3.3.5 Skim Slabs-on-Grade

Place 80 mm [3"] thick skim slab of 15 MPa concrete over compacted under-bed, where indicated on Drawings.

3.3.6 Fibre Reinforced Concrete

Arrange for fibre *Supplier's* representative to be present to review initial mixing and placing of concrete incorporating fibres.

3.3.7 **Future Extension**

Where pockets, chases, anchors, angle irons and other hardware are indicated on Structural Drawings to allow for future lateral extension, grease exposed structural steel *Work* and fill pockets and chases with 15 MPa concrete.

3.3.8 **Sloping Slabs and Other Sloping Surfaces**

Commence concrete placement at bottom of sloping surfaces.

3.3.9 **Vibration of Concrete Reinforced with Epoxy-Coated Bars**

Use rubber headed vibrators specified in paragraph 2.4.1.

3.3.10 **Elephant Trunk Chutes**

Provide elephant trunk chutes for concrete placement heights exceeding 1.5 m.

3.3.11 **Insulated Concrete Forms (ICF)**

- .1 Place concrete by boom pump equipped with 102 mm [4"] maximum diameter reducer followed by double ninety degree bend to reduce velocity of concrete entering wall and flap gate at end of the double ninety degrees to keep site clean.
- .2 Do not place concrete at greater than 1200 mm [4'] of lift per hour.
- .3 Terminate a pour at centre of longest wall where possible. Do not complete a pour against a buck or corner.
- .4 Consolidate concrete by means of hand tamping, rodding and vibrating.

3.4 **FLOOR FINISHING**

3.4.1 **Floor, Roof, Stair Treads, and Other Slab Surfaces**

- .1 Perform finishing operations on plastic concrete surfaces in accordance with CSA Standard A23.1, Clause 7.6 "Finishing of concrete floor surfaces", and as specified herein.
- .2 Be aware that finishing while bleed water is on surface, or adding water or cement to surface, are causes of scaling and dusting and are strictly forbidden.
- .3 Be aware that concrete for this *Project* may contain supplementary cementing material which may delay concrete set and onset of bleeding.
- .4 Refer to Drawings, Schedules, and other Sections of Specification, for required finishes and concrete toppings.
- .5 Verify with those responsible for *Work* of other Sections, that proposed finish is satisfactory for application of their materials.
- .6 Finish floors to match approved sample.
- .7 Screed surface to an even, level, or sloped surface, to elevations indicated on Drawings or required for specified finishes and concrete toppings.

3.4.2 **Monolithic Concrete Toppings**

Screed rough slab to level 25 mm [1"] below finished floor. Apply topping while rough slab is still plastic.

3.4.3 **Tile, Terrazzo, or Bonded Concrete Topping**

- .1 Screed slab to level below finished floor necessary to accommodate finish material or topping.

- .2 For bonded concrete topping, wire broom surface in accordance with CSA Standard A23.1, Clause 7.8.2 "Special concrete mixtures for toppings".
- .3 For bonded tile or bonded terrazzo, wire broom surface to texture approved by tile or terrazzo trade.

3.4.4 **Covered or Painted Floor Surfaces**

Provide smooth steel troweled surface, free from ridges, trowel marks or undulations, for floors that are to be painted, or to receive permanent architectural covering, such as carpet, wood, resilient flooring, sheet flooring, and fluid or trowel applied flooring.

3.4.5 **Exposed Floor Surfaces**

Provide hard, smooth, dense, steel troweled surface, free from blemishes, and of uniform appearance.

3.4.6 **Non-Slip Floor Surfaces**

Provide swirl trowel finish, or light broom finish, of texture acceptable to *Consultant*, unless otherwise specified on Drawings or Finish Schedule.

3.4.7 **Hardened Floor Finish**

- .1 Apply premixed material specified in paragraph 2.2.15, prepackaged hardener, to total of 5.0 kg/m² [100 pds / 100 ft²] of floor surface.
- .2 Apply in two shakes, of half total specified amount in each shake; the second shake at right angles to the first.
- .3 Finish as specified for "Exposed Floor Surfaces".
- .4 Follow manufacturer's special finishing instructions if concrete is air entrained.

3.4.8 **Insulation Board or Built-Up Roofing**

Hand or mechanical float surface to uniform texture, free from hollows, bumps and ridges. Finish to moderately flat classification.

3.4.9 **Fluid Elastomeric Waterproofing Membrane**

- .1 *Provide* smooth steel trowel surface, free from ridges, trowel marks, or undulations. Do not finish too smoothly.
- .2 Finish to moderately flat classification.
- .3 Arrange for waterproofing trade to inspect finish after first area is completed, and to reinspect until finish conforms to their requirements.

3.4.10 **Hot Applied Rubberized Asphalt Waterproofing Membrane, or Self-Adhering Rubberized Asphalt Sheet**

- .1 Hand or mechanical float surface to uniform texture, free from hollows, bumps, sharp edges, and ridges. Do not finish too smoothly.
- .2 Finish to moderately flat classification.
- .3 Arrange for waterproofing trade to inspect finish after first area is completed, and to reinspect until finish conforms to their requirements.

3.4.11 **Shotblast**

- .1 Shotblast floor surfaces that are to receive fluid elastomeric membrane or hot applied rubberized asphalt membrane or penetrant sealer.

- .2 Provide light sandblast to areas not accessible to shotblast equipment, such as near vertical surfaces.
- .3 Do not shotblast or sandblast until 28 days after placing concrete unless trial area of

3.4.12 **Steel Fibres**

Grind, or otherwise remove, steel fibres exposed on surfaces which will be covered by sheet or vinyl tile flooring. Fill depressions left by fibre removal, with epoxy filler.

3.4.13 **Control Joints in Slabs-On-Grade**

- .1 Use early-entry saw specified in paragraph 2.4.2.
- .2 Provide sawcutting equipment that is adequate in the number of units and the power to complete sawing in the required time before concrete temperature begins to fall.
- .3 Arrange for an ample supply of saw blades and anti-raveling skid plates to be on site before concrete placement begins.
- .4 Maintain on site at least one standby unit in good working order.
- .5 Replace early-entry saw blades and anti-raveling skid plate as required by manufacturer. Replace anti-raveling plate with every blade change.
- .6 Commence sawcutting as soon as concrete can support weight of saw and operator without marring concrete surface and within 2 hours of completion of final finishing in warm weather. Do not wait till next day to commence sawcutting.
- .7 Complete sawcutting before final set of concrete.
- .8 Unless otherwise shown on Drawings, sawcut control joints along column grid lines and additionally so that spacing does not exceed the following, where "t" is the slab thickness:
 - .1 Exterior pavement and walks exposed to the atmosphere: 20 t but ≤ 4.6 m [15'].
 - .2 Interior slabs of unheated buildings (parking garages): 24 t but ≤ 4.6 m [15'].
 - .3 Interior slabs of heated buildings: 30 t but ≤ 4.6 m [15'].
 - .4 40 t where concrete mix incorporates 40 mm [$1\frac{1}{2}$ "] aggregate proportioned to obtain maximum bulk density in accordance with paragraph 2.2.7.3.
- .9 For slabs placed in longitudinal strips, sawcut transversely in sequence at half, then quarter, then eighth points.
- .10 Sawcut 6.4 mm [$\frac{1}{4}$ "] wide to depth of $\frac{1}{4}$ of slab thickness and not less than 25.4 mm [1"] deep. Sawcut to $\frac{1}{3}$ of slab thickness if slab is reinforced with steel fibres.
- .11 Use joint protector inserts to prevent corner spalling.
- .12 Remove dry powder without disturbing finish.
- .13 Avoid traffic across sawcut until concrete gains sufficient strength that joint edges will not be damaged.
- .14 For slabs that will be covered with carpet or other materials where slab cracks will not telegraph through the finish, early-entry sawcutting is not required but sawcutting shall commence before concrete temperature starts to fall and within 18 hours of final finishing of floor surface.

3.4.14 **Joint Filler in Slabs-on-Grade Control Joints**

- .1 For floors which will be covered with finish materials which conceal joint: clean residue from floor and joint, fill with latex-sand-cement mortar worked into joint, or place fine silica sand in bottom of joint and fill top 12 mm [$\frac{1}{2}$ "] of joint with specified control joint filler to flush top with surface; do not overfill.
- .2 For permanently exposed floors: protect, prepare and fill joint in accordance with following sub-paragraphs.
- .3 Keep off floor, construction traffic which may erode concrete at edges of sawcuts.

- .4 Do not fill joints until as long as possible after placing slab, but in no case less than 90 days.
- .5 Arrange for representative of joint filler manufacturer to be present for a period of time at commencement of *Work* to verify that proper procedures are being employed.
- .6 Clean sawcut residue from floor.
- .7 Clean residue from joint by power washing with 8 MPa water jet and let dry.
- .8 Install joint filler to thoroughly dry surfaces only, at ambient air temperatures above 5 deg. C
- .9 For interior floors, fill joints full depth with semi-rigid epoxy joint filler specified in paragraph 2.2.17.1; do not overfill.
- .10 For floors exterior to building, install closed-cell polyethylene backer rod, of diameter 25 percent greater than joint width, flush with top of floor, to exclude dirt. Immediately prior to filling joint, depress backer rod to bottom of joint and fill with elastomeric sealant specified in paragraph 2.2.17.2; do not overfill.
- .11 Cut off any over-pour of filler on adjacent slab surface after filler has hardened.
- .12 Immediately prior to handover of building, re-examine joint for separation of filler from slab. Clean separations with compressed air and fill.

3.4.15 Stair Tread Non-Slip Inserts

- .1 Install non-slip inserts specified in paragraph 2.2.19, at each tread and landing; place 40 mm [1½"] from edge of nosing and extend for full width of nosing except for 80 mm [3"] at each end. Refer to architectural drawings for number of inserts per tread.
- .2 Set inserts in prepared grooves, secured with waterproof adhesive and with top set 1 mm [1/32"] above treads.

3.5 FORMED SURFACE FINISHING

- 3.5.1 Treat formed surfaces in accordance with CSA Standard A23.1, Clauses 7.9.1 "General" and 7.9.2 "Formed surface finishes", and as additionally specified herein.
- 3.5.2 *Provide* "Smooth-Rubbed Finish" in accordance with CSA Standard A23.1, Clause 7.9.4.2 "Smooth rubbed finish", for formed concrete surfaces which will be exposed to view in building and left unpainted.
- 3.5.3 Finish vertical surfaces to receive waterproofing membrane smooth with no ridges or depressions.
- 3.5.4 Finish formed surfaces to receive a hot-applied rubberized asphalt membrane smooth with no ridges or depressions, using "Sack-Rubbed Finish" in accordance with CSA Standard A23.1, Clause 7.9.4.4 "Sack rubbed finish". Clean surfaces of dust, oil, grease, salt, and loose or spalled material. Repair any honeycombed areas. Remove projecting mortar or concrete fins.
- 3.5.5 Cleaning out of cracks, and filling of holes, cracks and honeycombing at surfaces to be crystalline (chemical) waterproofed is specified under *Work* of Section 07 16 16.
- 3.5.6 Obtain *Consultant's* approval of exposed concrete. Regrind or otherwise correct surfaces *Consultant* has not approved, and to his satisfaction.

3.5.7 Plugs at Recessed Ties

- .1 Clean tie holes to remove all foreign matter.
- .2 Coat plugs by dipping in adhesive and insert in hole.
- .3 Remove excess adhesive immediately with thinner which will not stain concrete, as recommended by manufacturer.

3.5.8 Elastomeric Membrane

Provide light sandblast finish to vertical surfaces, where fluid elastomeric waterproofing membrane turns up vertical surface.

3.5.9 Curb Edging

Finish external corners of curbs rounded and smooth.

3.5.10 Architectural Finishing

- .1 Submit evidence that finishing *Contractor* has at least 3 years of experience in this type of finishing.
- .2 Sandblast concrete surfaces to medium texture evenly over each surface and consistently throughout *Project* to match approved mock-up.
- .3 Protect other surfaces and equipment against damage resulting from sandblasting operations.
- .4 Use material that will minimize environmental contamination.
- .5 Bush-hammer concrete surfaces to medium texture evenly over each surface and consistently throughout *Project* to match approved mock-up. Take care to avoid breaking external corners of bush-hammered concrete.
- .6 Remove debris from finishing operations.

3.6 BONDED CONCRETE TOPPINGS

3.6.1 General

- .1 Conform to CSA Standard A23.1, and as additionally specified herein.
- .2 Be aware that thickness of topping shown on Drawings is a minimum, and actual thickness will be greater to account for cambers or deflections of supporting floor.

3.6.2 Placing and Compaction of Topping

- .1 Place each section in one continuous operation.
- .2 Take special precautions against plastic shrinkage cracking, whenever rapid drying of the topping may occur, in accordance with CSA Standard A23.1, Clause 7.5 "Environmental protection".

3.6.3 Control Joints in Topping

- .1 *Provide* control joints for topping directly over construction joints in base slab.
- .2 *Provide* control joints in toppings over precast slabs, on centre lines of supporting members, and at 4.6 m [15'] maximum spacing parallel to span of slabs.
- .3 In all other respects, comply with sawcut control joint requirements for slabs-on-grade.

3.7 DRILLED-IN ANCHORS

- 3.7.1 Provide only installers trained by the manufacturer of the anchor. Submit copy of manufacturer's card documentation confirming the training.
- 3.7.2 Arrange for manufacturer's technical representative to be present during installation of first few anchors of each type. Submit site reports by manufacturer to *Consultant* within one week of each visit. Indicate in reports anchor sizes and types installed, locations, and whether installation procedures were in accordance with manufacturer's printed instructions.
- 3.7.3 Install anchors in strict accordance with manufacturer's printed instructions.
- 3.7.4 Do not drill holes larger in diameter than indicated in manufacturer's printed instructions.
- 3.7.5 *Provide* manufacturer's standard embedment length into solid concrete, unless otherwise noted on Drawings.
- 3.7.6 Take special care to:
 - .1 Drill the specified depth of hole. Measure each and every hole depth drilled.
 - .2 Blow out dust with hose at bottom of hole, and then clean out hole by brush, repeating the blow out and brush cleaning multiple times in accordance with manufacturer's instructions. Anchors installed in holes that are not thoroughly cleaned in strict accordance with manufacturer's instructions will not develop the required strength and are not acceptable.
 - .3 Put sufficient adhesive in the hole so that it squeezes out all around the perimeter.
- 3.7.7 Do not cut reinforcement to accommodate anchors.
- 3.7.8 Relocate anchors, at no additional cost to *Contract*, when obstructions prevent drilling holes to required depth in locations indicated on *Drawings*.
- 3.7.9 Obtain *Consultant's* approval of new location before drilling hole. Fill abandoned holes with specified grout.
- 3.7.10 Tighten expansion anchors using torque wrench unless finger-tight is indicated on Drawings.

3.8 CURING AND SEALING

- 3.8.1 Cure concrete in accordance with CSA Standard A23.1, Clause 7.7 "Curing" and as specified herein.
- 3.8.2 Be aware that proper curing is essential, and failure to cure properly causes scaling, dusting and lack of durability.
- 3.8.3 **Curing Compound Method**
 - .1 Use curing and sealing compound specified in paragraph 2.2.14 except:
 - .1 On surfaces to receive epoxy or similar paint finish.
 - .2 On surfaces to which architectural finishes will be adhered, the adhesives for which are incompatible with the curing compound.
 - .3 Air-entrained concrete for exterior slabs and sidewalks placed between October 1 and April 1.

- .4 Parking garage floors and roofs; exterior sidewalks, pavements and curbs; and other finished concrete surfaces that will be exposed to freezing and thawing or de-icing chemicals.
- .2 Select water-based compound except in colder weather when temperatures are such that manufacturer recommends solvent-based compound.
- .3 Verify with manufacturer, compatibility of curing compound with exposure and end use conditions, including but not restricted to exterior exposure, moist environment, coloured concrete, surface hardeners and shakes, adhered finishes, paints and other coatings, texture and slip resistance, and the like.
- .4 Apply curing and sealing compound in accordance with manufacturer's instructions, increasing application rate as necessary to cover surface completely.

3.8.4 **Plastic Film Method**

Where curing compound method cannot be used, cure finished floor surfaces not exposed to freezing and thawing or de-icing chemicals, as follows, except use "Curing Blanket Method" for parking garage floors and roofs:

- .1 Cover with 0.102 mm [4 mil] thick polyethylene sheets, held securely in place.
- .2 Lap edges 100 mm [4"] minimum and seal laps.
- .3 Maintain in place in accordance with CSA Standard A23.1 Table 2 "Requirements for C, F, N, A and S classes of exposure", and Table 19 "Allowable curing regimes", for the exposure classification, except not less than 7 days at ≥ 10 deg. C for exposed warehouse and industrial floor surfaces.
(For exposure Class C-XL, C-1, C-2, F-1, S-1 and S-2: 7 days minimum at ≥ 10 deg. C and for the time necessary to attain 70% of the specified strength;
For exposure Class C-3, C-4, F-2 and N (except as noted above for warehouse and industrial floors): 3 days minimum at ≥ 10 deg. C or for the time necessary to attain 40% of the specified strength).

3.8.5 **Curing Blanket Method**

For parking garage floors and roofs; exterior sidewalks, pavements and curbs; and other finished concrete surfaces that will be exposed to freezing and thawing or de-icing chemicals:

- .1 Cover with curing blanket specified in paragraph 2.2.21 and maintain in place in accordance with CSA Standard A23.1 Table 2 and Table 19 (7 days minimum at ≥ 10 deg. C. and not less than time to attain 70% of the specified strength).
- .2 Wet blanket regularly to maintain in moist condition. Do not allow to dry out.
- .3 In warm weather, place soaker hoses on top of curing blanket and turn on periodically to keep curing blanket wet. Assign workers whose responsibility is to ensure that covering material used for wet curing does not dry out.
- .4 In cold weather, place insulated blankets over curing blanket.

3.8.6 **Swimming Pool; Water Tank**

- .1 Provide 28-day wet cure to pool walls, pool floor and surrounding slab, to minimize cracking and leakage.
- .2 Provide 28-day wet cure to water tank walls, tank floor and surrounding slab, to minimize cracking and leakage.

3.8.7 Rink Slab

- .1 Provide ponded cure by diking perimeter of slab and maintaining 25 mm [1"] minimum depth of water at ≥ 10 deg. C for 14 days minimum.

3.9 GROUTING FOR STEEL MEMBERS

3.9.1 *Provide* and place grout under column base and beam bearing plates as follows:

- .1 Co-operate with other trades that supply and set plates.
- .2 Dampen concrete surfaces immediately before installing grout.
- .3 Install grout in a manner to ensure positive bearing of full area of steel plate.
- .4 Use non-shrink and shrinkage-compensating grouts only when grout will be contained against expansion and self-disintegration.

3.9.2 Slope grout beyond edge of plate at 45 degrees.

3.9.3 *Provide* same environmental protection and curing as specified for concrete.

3.9.4 Do not use flowable grout at beam bearing plates unless otherwise indicated, or approved by *Consultant*.

3.10 CAULKING

3.10.1 Caulk

- .1 Joints exposed to view in walls and slabs with elastomeric sealant specified in sub-paragraph 2.2.16.3, in colour selected by *Consultant*.
- .2 Joints not exposed to view in walls with cold poured liquid neoprene sealant specified in sub-paragraph 2.2.16.2.
- .3 Joints not exposed to view in slabs with hot poured asphalt specified in sub-paragraph 2.2.16.1, or cold poured liquid neoprene sealant specified in sub-paragraph 2.2.16.2.

3.10.2 Apply sealant to thoroughly dry surfaces only, at ambient air temperatures above 5 deg. C.

3.10.3 Confirm that preformed joint filler and backer rod are compatible with sealant.

3.10.4 Caulk control joints in slab-on-grade in accordance with paragraph 3.4.13.

3.10.5 Caulk other joints in accordance with following:

- .1 Do not commence joint preparation until concrete is at least 28 days old.
- .2 Thoroughly clean sides of joints with mason's router, or power saw, equipped with double blade where necessary to suit joint width.
- .3 Blow clean with compressed air with oil trap on line, or vacuum clean.
- .4 Install backer rod of diameter 25 percent greater than joint width, and of type recommended by sealant manufacturer to be compatible with sealant. Locate backer rod to provide for sealant depth of one-half joint width, but not less than 12 mm [1/2"].
- .5 Prime joint if required, as recommended by sealant manufacturer.

3.11 DAMPPROOFING

- 3.11.1 Apply dampproofing specified in paragraph 2.2.18, to entire surface of earth face of exterior and interior foundation walls with earth on one side only. Apply dampproofing from exterior grade level down to and including top surface of footing.
- 3.11.2 At temperatures of 5 deg. C and above, apply approved mineral colloid asphalt emulsion in accordance with CGSB 37.3, at rate of 1 litre/m² [2.4 U.S. gal/100 ft²] for each of two coats.
- 3.11.3 At temperatures below 5 deg. C, apply approved unfilled asphalt cutback in accordance with CGSB 37-GP-12Ma at rate of 1 litre/m² [2.4 U.S. gal/100 ft²] for each of two coats.
- 3.11.4 Obtain *Consultant's* approval of dampproofing before backfilling.

3.12 PENETRANT SEALER

- 3.12.1 Apply penetrant silane sealer specified in paragraph 2.2.20, to vertical surfaces, to a height of 1 m [3'-3"] above floor, and from top of footing, or bottom of grade beams, to 1 m [3'-3"] above slab-on-grade.
- 3.12.2 Lightly sandblast surfaces to receive penetrant sealer, within 72 hours before applying sealer.
- 3.12.3 Verify surfaces are dry, and concrete is at least 28 days old, before applying sealer.
- 3.12.4 Apply at manufacturer's recommended coverage rate.

3.13 FIELD QUALITY CONTROL

- 3.13.1 Inspection and Testing Company, when appointed as specified for Source Quality Control in paragraph 1.3.6, shall perform sampling, inspection and testing of concrete *Work* at site.
- 3.13.2 Perform sampling, inspection and testing in accordance with CSA Standard A23.2, and to include:
 - .1 Making of standard slump tests.
 - .2 Obtaining of three standard specimens for strength tests from each 100 m³ of concrete, or fraction thereof, of each mix design of concrete placed in any one day.
 - .3 In addition, for slabs-on-grade, obtain beam specimens for determination of modulus of rupture. Perform modulus of rupture tests at 90 days.
 - .4 Verification that test specimens are stored within an enclosure, maintained at specified temperatures.
 - .5 Making compression tests of each set of three specimens, one at 7 days and two at 28 days.
 - .6 Verification of air content of air-entrained concrete.
 - .1 For CSA Standard A23.1 Class of Exposure C-XL, C-1, C-2 and F-1 test at frequency in accordance with CSA Standard A23.1 Clause 4.4.4.1.1 "Frequency and number of tests".
 - .2 Make first test before placing any concrete.

- .3 After stable air content has been established, frequency of tests will be determined by *Consultant*.
- .4 For other Classes of Exposure, test at time of obtaining strength test specimens.
- .7 Verification of unit weight of semi-low-density concrete by the volumetric method, making one test for each 100 m³ or portion thereof placed in any one day.
- .8 Verification that concrete contains corrosion inhibitor where specified. Periodic review of batch plant records for dosage.
- .9 Testing of pullout inserts specified in paragraph 1.6.7.2 or cast-in molds specified in paragraph 1.6.7.2.2.
- .10 For parking garages, determine:
 - .1 Chloride ion content in accordance with CSA Standard A23.2, Test Method 4B.
 - .2 Air void spacing factor.

3.13.3 Inspection for Tolerances

- .1 Confirm that concrete *Work* meets tolerance requirements specified in paragraph 1.3.1.1.
- .2 Use the elevation survey records of elevations of soffit form surfaces and finished concrete surfaces specified in Section 03 10 00 and this Section as basis for judging compliance.
- .3 Use 3 m [10'] long aluminum straightedge with end sleeper pads to CSA Standard A23.1, to judge compliance with specified slab finish tolerances, except use dipstick equipment where F-number tolerance is specified.

3.13.4 Slabs-on-Grade

- .1 Monitor on a random basis acceptable to *Consultant*, that slab is being sawcut before slab temperature starts to fall.
- .2 Observe application of curing compound to sample slab, recording rate of application.

3.13.5 Drilled-in Anchors

- .1 Arrange for Inspection and Testing company to randomly select and pull test anchors as follows:
- .2 5% of each type and size of anchor installed on a weekly basis, but not less than one anchor of each type and size.
- .3 Pull test to twice the allowable design tension capacity of the anchor given by the manufacturer.
- .4 Submit reports of pull tests to *Consultant* on weekly basis. Indicate on report each anchor location, test load and mode of failure, if applicable. Notify *Consultant* immediately if anchor fails pull test.

3.13.6 Pool Leakage Test; Tank Leakage Test

- .1 Perform leakage test in accordance with ACI 350.1, before any waterproofing membrane or other architectural finishes are installed, so that leaks can be found and repaired.
- .2 Fill pool to top with water and maintain at this level to allow for absorption and stabilization for not less than 7 days.
- .3 Set up apparatus to measure evaporation rate.
- .4 After stabilization, measure drop in water level in accordance with ACI 350.1.
- .5 Acceptance Criteria: Notify *Consultant* if there is visible leakage, or if the drop in water surface exceeds the 0.1 percent of total volume for 24 hours, as measured by the drop in water surface over a period of 5 days, after correction for evaporation.
- .6 Repeat test after repairs are carried out, if test results fail the acceptance criteria.

3.14 DEFECTIVE WORK

- 3.14.1 Variations in excess of specified tolerances and marked and disfigured surfaces that cannot be repaired by approved methods will be considered defective *Work* performed by this Section.
- 3.14.2 Pool leakage that fails acceptance criteria will be considered defective *Work* performed by this Section. This may require urethane injection of leaking cracks by urethane injection specialist.
- 3.14.3 Replace or modify concrete that is out of place, or does not conform to lines, detail or grade as directed by *Consultant*.
- 3.14.4 Replace or repair defectively placed or finished concrete as directed by *Consultant*.
- 3.14.5 Testing and replacement of non-compliant concrete in place:
- .1 When initial inspection and tests indicate non-compliance with the *Contract Documents*, perform subsequent re-inspection and re-testing by the same inspection company. The costs thereof will be deducted by the *Owner* from the amounts owing to the *Contractor*.
 - .2 *Contractor* shall replace or strengthen deficient concrete *Work* as directed by *Consultant*, and pay for all testing and related expenses for replaced *Work* until approved by *Consultant*.

3.15 CLEANING UP

- 3.15.1 Remove from building site excess and waste materials, mock-up panels, test areas, and debris resulting from *Work* of this Section. Leave premises in a condition acceptable to *Consultant* before completion of *Work*.

3.16 SCHEDULE OF CONCRETE WORK

ADDENDUM “A” – ADDITIONAL REQUIREMENTS FOR LEED PROJECTS

A1. General

A1.1 SUMMARY

- .1 This is a performance specification in accordance with Alternative (1) of CSA Standard A23.1 Table 5 “Alternative methods for specifying concrete”. Nothing in this Addendum shall be construed or interpreted as rendering the specification to be Alternative (2) Prescriptive.
- .2 Nothing in this Addendum shall be construed as permitting non-conformance with existing Codes and Standards.
- .3 This addendum shall not be construed as permitting any reduction in the quality or durability of the concrete.

A1.2 OBJECTIVES

- .1 To minimize the ecological footprint of the building by specifically selecting materials that conserve raw and non-renewable resources.
- .2 To minimize the amount of energy expended in the transportation of materials to the site through intentional sourcing of regional materials.
- .3 To document for the purpose of LEED® Certification under the Canadian Green Building Councils LEED® - Canada NC – Version 1 Rating System, the Materials and Resources Credits.
- .4 To reduce the amount of portland cement by providing higher than normal amounts of supplementary cementing materials (SCM's).

A1.3 QUALITY ASSURANCE

- .1 Reference Standards
 - .1 CaGBC. “Materials & Resources Credits” Leadership in Energy and Environmental Design Reference Guide for New Construction & Major Renovations (LEED® Canada – NC Version 1.0).
- .2 Certification of Concrete Plant
 - .1 Concrete plants shall be ECO-Certified by the Ready Mixed Concrete Association of Ontario.

A1.4 DEFINITIONS

- .1 LEED: Leadership in Engineering and Environmental Design.
- .2 Regional Material: material extracted, processed and manufactured within 800 km by truck, or 2400 km by rail or boat, of project site.
- .3 Recycled Product: recycled product or product containing recycled components or recycled materials.
- .4 Recycled Content: the percentage (by mass) of constituents that have been recovered or otherwise diverted from the solid waste stream, either after the manufacturing process (post-industrial) or after consumer use (post-consumer) and as further defined as follows:
 - .1 Extraction Location: the point(s) of origin (e.g. quarry, recycling plant, etc.) for $\geq 80\%$ by mass of the material transported to the Manufacturing Location to create a product or material (e.g., if 80% of the mass of a concrete batch is aggregate, the extraction location for the concrete is the gravel pit where the aggregate was obtained).
 - .2 Manufacturing Location: the last point of processing (e.g. the concrete batch plant).
 - .3 Post-Consumer Recycled Content: the percentage (by mass) of recycled material that is derived from previously used consumer products.
 - .4 Post-Industrial Recycled Content: the percentage (by mass) of recycled material that is derived from outside industrial sources such as silica fume, fly ash and ground granulated blast furnace slag (in-house process recycling of production scrap is not included).
 - .5 SCM: Supplementary Cementing Material, such as silica fume, ground granulated blast furnace slag or fly ash.

A1.5 SUBMITTALS

- .1 LEED Documentation
 - .1 Submit Green Material Data Sheet in Section 01 35 21, for products exceeding \$50,000.00 in value that have Regional Materials as defined in paragraph A1.4.2 or that are recycled products as defined in paragraph A1.4.3.
 - .2 For products or finishes applied on site within the building envelope, submit Green Material Data Sheet and manufacturer's product literature indicating compliance with VOC limits in Project specification.
- .2 Recycled Content
 - .1 Submit documentation of the recycled content of the concrete as follows:
 - .1 Identify recycled content as *post-consumer* or *post-industrial*.
 - .2 Water: Express recycled water as percentage by weight to total weight of total concrete constituents.
 - .3 Aggregates: Express recycled aggregate as percentage by weight of total concrete constituents. Do not use recycled aggregates for any concrete except mud slabs or skim slabs.

- .4 Portland Cement: express as percentage reduction of weight of portland cement from Base Mix as defined below, to Actual SCM Mix. This can be submitted as total reduction of Portland cement for all concrete mixes used on *Project*, expressed as a percentage.
 - .5 Calculate Base Mix portland cement content as “K” times the specified 28-day design strength in MPa, where K=10 for non-air-entrained concrete and 12.5 for air entrained concrete.
 - .3 Source
 - .1 Submit documentation of where concrete constituents were extracted, processed and manufactured.
 - .4 Eco-Certification Certificate
 - .1 Submit certificate from Ready Mixed Concrete Association of Ontario confirming that concrete plant is ECO-Certified.
 - .5 Material Safety Data Sheets (MSDS)
 - .1 Submit MSDS product information confirming that concrete adhesives meet environmental performance goals including low volatile organic compounds.
- A2 Products
 - A2.1 Select materials from Regional Sources as defined in paragraph A1.4.2.
 - A2.2 Water: Provide a portion of the water content from recycled water from the concrete production, in accordance with standards established by the concrete supplier.
 - A2.3 Aggregates: Do not use recycled aggregates except for skim slabs or mud slabs, as recycled aggregates do not meet CSA Standard A23.1 grading requirements and may be contaminated with deleterious materials that reduce the concrete durability.
 - A2.4 SCM's: Provide SCM's to full advantage to reduce portland cement content. Within the context of Alternative (1) “Performance Specification” of CSA Standard A23.1 Table 5, provide not less than 25% SCM's, adjusted upward or downward where necessary for seasonal temperature variations. Note that SCM replacement levels may impact rate of strength gain, floor finishing times and form removal times.
 - A2.5 Steel Fibres: Consider fibre reinforcement with high percentage of recycled content.
 - A2.6 Curing Sealing Compound: Consider products with low or no VOC's and high recycled content such as water based or vegetable or soy-based curing agents in lieu of petroleum products.
 - A2.7 Granular Underbed for Slab-on-Grade: If offsite gravel is required, where practicable obtain crushed concrete from other projects provided it meets the criteria of 20 mm [3/4”] clear limestone specifications, can meet compaction and load requirements and is free of deleterious contaminants, including but not limited to deicing salts (chlorides) and bituminous materials.

– End of Section –

Rough Carpentry

PART 1 - GENERAL

1.1 Summary

- .1 Section includes:
 - .1 The work of this section includes, but is not necessarily limited to, the following:
 - .1 Wood grounds, nailers, blocking and sleepers.

1.2 Submittals

- .1 Submit required submittals in accordance with Section 01 33 00.
- .2 Certificates:
 - .1 Pressure treated lumber and plywood shall be accompanied by supplier's certificate of conformance with this specification.

1.3 Delivery, Storage, and Handling

- .1 When it is required that wood maintain dimensional stability and tolerances to ensure accurate installation of later work, store and install it only in dry areas, and where no further installation of moist materials is contemplated.

PART 2 - PRODUCTS

2.1 Wood Materials

- .1 General requirements:
 - .1 Except as indicated or specified otherwise lumber shall be softwood, S4S, moisture content not greater than 19% at time of installation, in accordance with following standards:
 - .1 CSA O141-05.
 - .2 NLGA-2014 Standard Grading Rules for Canadian Lumber.
- .2 Furring, blocking, nailing strips, grounds:
 - .1 Use S2S material.
 - .2 Dimension lumber sizes: in compliance with Section 12 of the NLGA-2014.
 - .3 Dimension lumber species and grades:
 - .1 Spruce-Pine-Fir.
 - .2 Light framing to NLGA-2014 Construction grade, S-Dry.
 - .3 Planks to NLGA-2014 No. 2 grade, S-Dry.
 - .4 Boards to NLGA-2014 No. 4 Common grade, S-Dry.

2.2 Panel Materials

- .1 Softwood plywood (CSP): to CSA O151-09.
- .2 Douglas Fir plywood (DFP): to CSA O121-08.

Rough Carpentry

- .3 Fire rated plywood: shall be pressure impregnated with fire-retardant chemicals to CAN/CSA O80 and have Flame Spread Value (FSV) of not more than 25 to CAN/ULC-S102-10.
- .4 Fire retardant medium density fibreboard (MDF): shall comply with the following requirements:
 - .1 To ANSI A208.2-2016, 16mm (5/8") minimum thickness, 720 kg/m³ (45 lbs/ft³) minimum density.
 - .2 Grade: Grade 130.
 - .3 Formaldehyde emission: F21 for panel thicknesses greater than 8 mm (5/16") and F13 for panels equal to or thinner than 8 mm (5/16"). No added urea-formaldehyde used in composition.
 - .4 No Ammonium Polyphosphate used in composition.
 - .5 Maximum values in accordance with CAN/ULC-S102-10:
 - .1 Flame Spread Value (FSV): Maximum 25.
 - .2 Smoke Developed Value (SDV): Maximum 50.

2.3 Wood Treatment

- .1 Fire retardant pressure treatment:
 - .1 Wood shall be pressure impregnated with fire-retardant chemicals to CAN/CSA O80 and have flame-spread rating of not more than 25 to CAN/ULC-S102-10 after wood has been subjected to an accelerated weathering test as specified in ASTM D2898-10 for exterior applications.

2.4 Fastenings and Hardware

- .1 General:
 - .1 *Provide* fasteners of size and type indicated, acceptable to authorities having jurisdiction, and that comply with requirements specified in this article for material and manufacture. *Provide* nails or screws, in sufficient length, to penetrate not less than 38 mm (1-1/2") into wood substrate.
 - .2 Anchors to concrete and unit masonry: Capability to sustain, without failure, a load equal to 6 times the load imposed when installed in unit masonry assemblies and equal to 4 times the load imposed when installed in concrete as determined by testing according to ASTM E488/E488M-18, conducted by a qualified independent inspection and testing company.
 - .3 Use surface fastenings of following types, except where specific type is indicated.
 - .1 To hollow masonry, plaster and panel surfaces use 9 mm (11/32") expansion bolts or other acceptable anchor.
 - .2 To solid masonry and concrete use expansion bolts.
 - .3 To structural steel use bolts through drilled hole, or welded stud-bolts or power driven self-drilling screws, or welded stud-bolts.
 - .4 To steel deck use bolts through drilled hole or power driven self-drilling screws.
 - .4 Fastener materials:

Rough Carpentry

- .1 Hot-dip galvanized fasteners: ASTM A153/A153M-09 Class A or B1 G185 and connectors meeting ASTM A653/A653M-13 Class G-185 sheet or better.
- .5 Hardware materials:
 - .1 Hot-dipped galvanized complying with ASTM A153/A153M-09, Class A or B1, and connectors complying with ASTM A653/A653M-13, Class G185.

2.5 Source Quality Control

- .1 Identify lumber by grade stamp of an agency certified by Canadian Lumber Standards Accreditation Board.

PART 3 - EXECUTION

3.1 General

- .1 Layout work to accommodate work of others. Cut and fit accurately. Erect in position indicated. Align, level, square, plumb, and secure work permanently in place.
- .2 Bore holes true to line and to same size as bolts. Drive bolts into place for snug fit, and use plates or washers for bolt head and nut bearings. Turn up bolts and lag screws tightly when installed, and again just before concealed by other work or at completion of work.
- .3 Include in work of this section rough hardware such as nails, bolts, nuts, washers, screws, clips, and connectors required for complete and proper installations; and operating hardware required on work of this section for temporary use.
- .4 Do not attach work by wood plugs or blocking in concrete or masonry.
- .5 Do not regard nailers, blocking, and such other fastening provision indicated as exact or complete. Install required provisions for fastening, located and secured to suit *Place of the Work* conditions, and adequate for intended support.
- .6 Verify that grounds required for fastening of components and equipment are located correctly, and sized for adequate support.
- .7 Do not rip or mill fire retardant treated lumber. Only end cuts, drilling holes, and joining cuts are permitted.

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 Cabinetry and hardware, including lab benches and countertops.
 - .2 Factory and site finishing of architectural woodwork.
 - .3 Installation of laboratory equipment items specified under Section 11 53 13 as indicated or required.

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.
- .2 Conduct a pre-fabrication 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 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 3.1 requirements.
 - .2 Indicate quality standards and grades.
 - .3 Include full scale drawings of all exposed-to-view edge conditions.

Architectural Woodwork

- .4 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.
- .5 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 3.1 finish system number, sheen, and required application steps.
- .6 Submit coordination drawings indicating locations of concealed grounds, cut-outs, plates, and other required fabrications.
- .7 Show relation to adjoining construction, details of outside and inside corners and door openings.
- .4 Selection samples:
 - .1 Casework hardware, one unit of each type and finish.
- .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 colour.
 - .2 Samples of each specified *Product*, in each specified colour and finish.
 - .3 Plastic laminates, in each specified colour and finish.

1.4 Closeout Submittals

- .1 Submit closeout submittals in accordance with Section 01 77 00.
- .2 Operation and maintenance data:
 - .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.
- .3 Maintenance materials:
 - .1 Deliver extra sets of hardware items for maintenance as follows:
 - .1 2 sets of each type actually installed.

1.5 Quality Assurance

- .1 Qualifications:
 - .1 Manufacturers:

Architectural Woodwork

- .1 Architectural woodwork shall be manufactured by a firm having a minimum of 5 years experience 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.
- .2 Installers / applicators / erectors: engage an installer who 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 3.1, 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 All edge and joint types.

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.

1.7 Field Conditions

- .1 Environmental conditions:
 - .1 During storage and installation: Obtain and comply with North American Architectural Woodwork Standards 3.1 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.

PART 2 - PRODUCTS

2.1 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 3.1 and additional or greater loading capacities as specified throughout the North American Architectural Woodwork Standards 3.1.
- .2 Maximum allowable adjustable shelf lengths shall comply with shelves assembly rules per the North American Architectural Woodwork Standards 3.1 based on shelf thickness indicated or scheduled.

2.2 Wood Materials

- .1 Lumber:
 - .1 Hardwood for concealed blocking and framing: Economy grade, any species that, when painted, will not show any defects.
 - .2 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%.
 - .3 Solid hardwood for transparent finish.
 - .1 Species: Birch.
 - .2 Cut: Plain.

2.3 Panel Materials

- .1 Panel material schedule; except where indicated otherwise:
 - .1 Thickness:
 - .1 At back panels and drawer: 13 mm (1/2") minimum.
 - .2 Otherwise: 19 mm (3/4") minimum.
 - .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: to ANSI/HPVA HP-1-2016.
 - .2 Softwood plywood: to Voluntary Product Standard: PS-1-09 Structural Plywood (with Typical APA Trademarks).
 - .2 Baltic Birch; 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 colour), premium edge quality where cut to expose, free of gaps and defects.
 - .3 Marine grade plywood: 19 mm (3/4") nominal thickness, to CSA O121-08, marine grade DFP, sanded both sides.

2.4 Plastic and Composite Materials

- .1 High pressure decorative laminate:
 - .1 General purpose grade: ANSI/NEMA LD 3-2005, Horizontal General Purpose Grade (HGS).
 - .2 Colours, finishes, and patterns: Midnight Stone, Matte.
 - .3 Basis of design:
 - .1 Formica 'Midnight Stone, 6280-58'.
- .2 Reflectix insulation:
 - .1 Fire rating: Class A.
 - .1 FSV: less than 25.
 - .2 SDV: less than 50.
 - .2 Fungal resistance: no growth.
 - .3 Acceptable *Product*:
 - .1 'Reflectix Insulation RDB1' by Reflectix, Inc.
 - .2 Substitutions: in accordance with Section 01 25 00.

2.5 Fasteners and Adhesives

- .1 Fasteners shall comply with North American Architectural Woodwork Standards 3.1
- .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 3.1

2.6 Hardware

- .1 Casework hardware; to be furnished and installed by the architectural woodwork manufacturer.
 - .1 Where casework hardware is not specified or indicated on drawings or scheduled, casework hardware shall comply with ANSI/BHMA Standards, latest edition, minimum grades, loading and other basic rules per the North American Architectural Woodwork Standards 3.1.
- .2 Hardware for 19mm thick cupboard doors:
 - .1 Hinges: Hettich 'Selekta Pro 2000', C15 finish.
 - .2 Catches: Richelieu '807V C2G'.
 - .3 Pulls: Richelieu '30135170, 153 x 28mm'.
 - .4 Flush Pulls: Knappe & Vogt '819x' ANO finish.
 - .5 Pulls at Barrier-Free Work Stations: Richelieu '0141128170' (ADA compliant).
 - .6 Cupboard lock: Hafele '235.08.358' polished nickel complete with lock cores '210.04.606' and cylinder rosettes '210.04.062'.
 - .7 Strike Plates; black:

Architectural Woodwork

- .1 Gable catch: Hafele '329.61.319'.
- .2 Bottom slot: Hafele '239.08.705'.
- .8 Elbow Latch and Strike: Richelieu '55401.8' Nickel finish.
- .3 Hardware for drawers:
 - .1 Slides: Knappe & Vogt '6505' (length to suit) Zinc finish.
 - .2 Pulls: Richelieu '30135170, 153 x 28mm'.
 - .3 Flush Pulls: Knappe & Vogt '819x' ANO finish.
 - .4 Pulls at Barrier-Free Work Stations: Richelieu '0141128170' (ADA compliant).
 - .5 Drawer locks: Hafele '235.08.303' polished nickel complete with lock cores '210.04.606' and cylinder rosettes '210.04.062'.
 - .6 Strike Plate: Hafele '239.08.705' black finish.
- .4 Hardware for Adjustable Wood Shelves:
 - .1 Pilaster Strips: Knappe & Vogt '255 ZC Steel' Zinc finish.
 - .2 Shelf Clips: Knappe & Vogt '256 ZC Steel' Zinc finish.
- .5 Hardware for 38mm thick cupboard doors Finish:
 - .1 Hinge: Stanley 'F179 114x102'.
 - .2 Locksets: Lockset Complete with Interchangeable Cylinder Supplied by Finishing Hardware Supplier.
 - .3 Closet rods & flanges:
 - .1 Knappe & Vogt '660 SS 30mm OD rod'.
 - .2 Knappe & Vogt '730 end caps' ANO finish.
 - .3 Knappe & Vogt '734 & 735 end supports' CHR finish.
 - .4 Knappe & Vogt '760 intermediate support' ANO finish.
 - .4 Roller Catches: Richelieu '504XV'.
 - .5 Surface Bolts: Richelieu '39208' 646/ANV finish.
 - .6 Door Stop/Holder: Rixson "Checkmate" 10 Series Adjust. Standard Duty Surface Mounted.
 - .7 Coat Hooks: Ives '571', cast brass, Coat & Hat Hook.
 - .8 Strike Plate: Richelieu 'M3204' SS finish.
- .6 Specialty Hardware
 - .1 Grommets: Richelieu '20692170'.
- .7 Keying:
 - .1 All locks in a room to be keyed alike.
 - .2 Provide locks on all casework.
 - .3 Provide 6 extractor keys.
- .8 Grilles; locations as indicated:

Architectural Woodwork

- .1 Hafele Startect Aluminum, with ribbed flanges, 1.5 mm thick, silver coloured anodized, dimensions as indicated.
- .2 Price 'LBPH Linear Bar Grille' as supplied by Beavermead.
 - .1 Size: 100 mm x 1500 mm (4" x 59").
 - .2 5 pieces.
 - .3 Core style: 25C.
 - .4 Finish: aluminum.
 - .5 Border: style 750.
 - .6 Fastening: style A.
- .3 Price 'LG50 Lattice Grille'.
 - .1 Size: 100 mm x 1200 mm (4" x 47").
 - .2 6 pieces.
 - .3 Finish: black, 14 gauge aluminum.
 - .4 Fastening: style H, straight holes.

2.7 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 solid wood :
 - .1 Comply with requirements indicated below for finish system, staining, and sheen.
 - .1 Sheen: Semigloss.
 - .1 Sheen range measurements in accordance with North American Architectural Woodwork Standards 3.1.
 - .2 Factory finish with transparent, Post Catalyzed Lacquer in accordance with the North American Architectural Woodwork Standards 3.1, Section 5.
 - .1 Transparent finish:
 - .1 Clear (natural).
 - .2 Stain: Stain colour: as selected by *Consultant*.

Architectural Woodwork

2.8 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 all bracing and fastening devices as required for a rigid installation, and as required to sustain the imposed loads.
- .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 3.1.
- .7 *Provide* surface mount blocking & 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 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* all 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 3.1 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.

Architectural Woodwork

- .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.

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 3.1.

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

Roofing Repairs

PART 1 - GENERAL

1.1 Summary

.1 Section includes:

- .1 Roofing repairs to the existing roofing systems damaged as a result of the *Work*.

1.2 Administrative Requirements

.1 Coordination

- .1 Coordinate with Divisions 21, 22, and 23 to ensure that roof drains are suitable for roofing system design.
- .2 Coordinate with installers of roof mounted items, equipment, and mechanical and electrical work at roof so that installation will not subvert the integrity of the roofing system.
- .3 Coordinate with installation of air barrier at walls to ensure complete continuity of air barrier system for building.

.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.
- .2 The manufacturer shall meet with the necessary parties at the jobsite to review and discuss project conditions as it relates to the integrity of the roofing assembly.
- .3 Meet with *Consultant*, testing and inspecting agency representative, roofing Installer, roofing system manufacturer's representative, deck Installer, and installers whose work interfaces with or affects roofing including installers of roof accessories and roof-mounted equipment.
- .4 Review methods and procedures related to roofing installation, including manufacturer's written requirements.
- .5 Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
- .6 Examine substrates and existing conditions for compliance with requirements, including flatness and fastening.
- .7 Review structural loading limitations of roof deck during and after roofing.
- .8 Review base flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that will affect roofing system.
- .9 Review governing regulations and requirements for insurance and certificates if applicable.
- .10 Review temporary protection requirements for roofing system during and after installation.
- .11 Review roof observation and repair procedures after roofing installation.
- .12 Forecasted weather conditions.

Roofing Repairs

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.

1.4 Closeout Submittals

- .1 Submit closeout submittals in accordance with Section 01 77 00.
- .2 Operation and maintenance data:
 - .1 Submit manufacturer's maintenance instructions for incorporation into the operation and maintenance manuals.

1.5 Quality Assurance

- .1 Qualifications:
 - .1 Installers / applicators / erectors: Work of this section, executed by competent installers with minimum 5 years experience in application of *Products*, systems and assemblies specified and with approval and training of *Product* manufacturers.
 - .1 Work of this section shall be installed by a *Subcontractor* that is a member in good standing of the Canadian Roofing Contractors Association (CRCA) and Ontario Industrial Roofing Contractors Association (OIRCA), who has been a member for at least 5 years.
 - .2 *Subcontractor* must be approved by the membrane manufacturer. Submit *Subcontractor's* certification letter prepared by the membrane manufacturer.
 - .3 Execute work of this section only under full time supervision of qualified *Subcontractor's* site supervisor.
 - .2 Manufacturers: Company specializing in manufacturing the *Products* specified in this section, with minimum 10 years experience.

1.6 Delivery, Storage, and Handling

- .1 Package materials and identify on attached labels the manufacturer, brand, contents, weight as applicable, and *Product* and specification numbers.
- .2 Protect edges of roll goods from damage during handling, and store rolls on end to prevent flattening.
- .3 Handle materials carefully to preclude damage. Follow manufacturer's written recommendations.
- .4 Keep materials and equipment free from debris, ice, snow and contaminants. Store adhesives and sealants between 16 °C and 27 °C.
- .5 *Provide* protection to building surfaces during hoisting, or application of materials. Protect adjacent surfaces in an acceptable manner from damage, marking and soiling during installation of the work of this section.
- .6 Do not store cants, insulation or roofing membrane on roof. Store them under cover while roofing work is not in progress.

Roofing Repairs

1.7 Field Conditions

- .1 Apply roofing only when ambient air and/or surface temperatures of the substrates and at the *Place of the Work* are as recommended by roofing manufacturer, and CRCA guidelines.
- .2 Protect the *Work* and the *Owner's* property from damage.
- .3 Confine equipment, material storage, and operations of workers to limits indicated by laws, ordinances, and permits.
- .4 Progressively remove debris created by the execution of the *Work* and dispose of same at appropriate disposal sites.
- .5 Do not apply roofing system during inclement weather.
- .6 Do not apply roofing system to dirty, dusty, wet, damp or frozen deck surface.
- .7 Secure the work of this section in a safe and watertight fashion before the onset of inclement weather and at the end of each day's work.
- .8 Store insulation under opaque, breathable and waterproof tarpaulins or sheds, and ventilated to prevent entrapment of moisture. Prevent compression of panels at any point and breakage of edges and corners.
- .9 Do not store gravel on roof, but deposit it in small piles for spreading as required.

PART 2 - PRODUCTS

2.1 Performance/Design Requirements

- .1 Wind uplift:
 - .1 Roofing system assemblies shall have been successfully tested by a qualified testing agency to resist project roofing uplift pressures in accordance with the building code.
- .2 Roof covering classification: Roof assembly shall have a Class C classification as determined in conformance with CAN/ULC S107-10 "Standard Methods of Fire Tests of Roof Coverings".
- .3 Roofing system: Prevent water from entering building and roofing assembly through roofing membrane.

2.2 Materials

- .1 General:
 - .1 Roofing system materials shall be sourced from one manufacturer unless otherwise specified.
- .2 Roofing repair materials: new materials, to match grade and quality of existing roofing systems.
- .3 Insulation: Thickness and type to match existing insulation.
- .4 Penetration sealer and form system: Compatible with roofing systems. Primer as recommended by sealer manufacturer.
 - .1 Acceptable *Products*:

Roofing Repairs

- .1 Chem Link Inc. 'ChemCurb System'.
- .5 Flashings: prefinished; to match existing flashings.
- .6 Fasteners and adhesives:
 - .1 Roofing nails: galvanized steel to CSA B111-1974, Table 12, and length sufficient to penetrate wood substrate 25 mm (1") minimum.
 - .2 Metal discs: flat caps of 25 mm (1") minimum diameter, 0.6 mm (0.023") sheet metal, formed to prevent dishing. No discs are required with roofing nails having 25 mm (1") diameter solid cap heads.
 - .3 Adhesives and primers as recommended by roofing system manufacturer.
 - .4 Fastening bars: Z275 galvanized or AZ150 galvalume steel, or extruded aluminum, 14 gauge, slot holes 25 mm (1") on centre.
- .7 Rough carpentry in accordance with Section 06 10 53.
- .8 Joint sealants in accordance with Section 07 92 00.
- .9 Metal flashings in accordance with Section 07 62 00.

PART 3 - EXECUTION

3.1 Examination

- .1 Before proceeding with roofing application, ensure that:
 - .1 Roof deck is constructed smoothly; in true planes; and level, or sloped to drains, whichever is design intent.
 - .2 Roof deck is clean and sufficiently dry for application under specified warranty.
 - .3 Adjacent construction and installation of work of other sections to be incorporated with roof is completed.
 - .4 Roofing surfaces are free of cracks that are wider than bridging ability of roofing materials.
 - .5 Preparations have been made for bases on which equipment will be installed.
 - .6 Work that penetrates roof has been installed.

3.2 Preparation

- .1 Remove existing roofing and flashing assemblies.
- .2 Sweep roof deck completely free of dust, dirt and debris. Remove foreign materials.
- .3 Ensure that stored porous materials absorb no moisture. Remove wet materials from *Place of the Work*.
- .4 Protect surrounding work, and adjacent building and other property from damage during roofing operations, and weather damage, taking particular care to prevent droppings and discolouration of surrounding buildings by smoke from kettles. Prevent solvents and smoke from entering building intake vents.
- .5 This section shall make payment for repair of damage caused by its work.

Roofing Repairs

- .6 Install temporary blocking and otherwise protect drains during roofing operations, and remove at completion of roofing work.

3.3 Installation

- .1 General:
 - .1 Apply roofing in accordance with the *Contract Documents*, requirements of jurisdictional authorities, and of material manufacturer's written directions which shall establish minimum requirements not otherwise specified.
 - .2 Make adjustments to specified roofing procedures caused by weather and site conditions only when approved.
 - .3 Ensure that each part of the roofing system is completely bonded to the other unless otherwise specified.
 - .4 Lay roofing free from wrinkles, air pockets, fishmouths, tears, and prominent lap joints. Embed them in a uniformly spread layer of adhesive, as applicable.
 - .5 Complete entire roofing system up to line of termination of each day's work.

3.4 Field Quality Control

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

END OF SECTION

Metal Flashing

PART 1 - GENERAL

1.1 Summary

- .1 Section includes:
 - .1 Supply and installation of stainless steel flashings for new penetrations of exterior walls.

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 Shop drawings:
 - .1 Submit shop drawings including the following:
 - .1 Plans, elevations, sections, and attachment details.
 - .2 Detail fabrication and installation layouts, expansion-joint locations, and key details. Distinguish between shop and field assembled work.
 - .3 Include identification of material, thickness, weight, and finish for each item and location in the work.
 - .4 Include details for forming, including profiles, shapes, seams, and dimensions.
 - .5 Include details for joining, supporting, and securing, including layout and spacing of fasteners, cleats, clips, and other attachments. Include pattern of seams.
 - .6 Include details of termination points and assemblies.
 - .7 Include details of expansion joints and expansion-joint covers, including showing direction of expansion and contracting from fixed points.
 - .8 Include details of roof penetrations flashing.
 - .9 Include details of edge conditions and counter flashings as applicable.
 - .10 Include details of special conditions.
 - .11 Include details of connections to adjoining work.
- .3 Samples:
 - .1 Submit full-size samples of each specified flashing material formed to detailed profile including corner, curb, cap, and parapet flashing, and coping including lock-joints and hold-down clips.
 - .2 Submit 2 - 50 mm x 50 mm (2" x 2") samples of each type of sheet metal material, colour and finish.

1.4 Quality Assurance

- .1 Qualifications:

Metal Flashing

- .1 Installers / applicators / erectors: *Provide* work of this section, executed by competent installers with minimum 5 years experience in application of *Products*, systems and assemblies specified and with approval of *Product* manufacturers.

- .1 Sealant shall be applied by a *Subcontractor* of recognized standing, having preferably not less than 5 years of proven experience in this type of work, and who has the necessary equipment and skilled mechanics to carry out the work of this section satisfactorily and can substantiate this to satisfaction of *Consultant*.

- .2 Quality standards:

1.5 Delivery, Storage, and Handling

- .1 Keep materials and equipment free from debris, ice, snow and contaminants. Allow air to circulate around metal components, sheets and break shapes.
- .2 Protect holes, and reglets from water and ice during freezing weather.

PART 2 - PRODUCTS

2.1 Stainless Steel Flashing

- .1 Stainless steel: to ASTM A240/A240M-18, Type 316, fully annealed with smooth, flat surface.
 - .1 Finish: No. 4 (linearly textured, short grain finish produced by mechanical polishing).
 - .2 Minimum thickness: 0.61 mm (0.0239") (24 gauge).

2.2 Accessories

- .1 Isolation coating: to CAN/CGSB-1.108, bituminous type.
- .2 Sealants:
 - .1 Exposed sealants: Silicone in accordance with Section 07 92 00, colour as selected by *Consultant* from manufacturer's full range.
 - .2 Concealed flashing sealants; hooked-type expansion joints with limited movement: Butyl sealant to ASTM C1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied.
- .3 Fasteners:
 - .1 Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads and recommended by manufacturer of primary sheet metal.
 - .2 General: Blind fasteners or self-drilling screws, gasketed, with hex-washer head:
 - .1 Exposed screws: 38 mm (1-1/2") long minimum at 450 mm (18") on centre maximum. Heads matching colour of sheet metal using plastic caps or factory-applied coating. Provide metal-backed EPDM washer under heads of exposed fasteners.
 - .2 Blind fasteners: High-strength aluminum or stainless-steel rivets suitable for metal being fastened.

Metal Flashing

- .3 Cleat fasteners: Corrosion-resistant barbed angular ring or screw shank nail; length to achieve approximately 32 mm (1-1/4") penetration into nailer.
- .3 Fasteners for stainless steel sheet: Series 300 stainless steel.
- .4 Fasteners and plates to meet the requirements of FM 4470-12 for wind uplift and corrosion resistance.

2.3 Fabrication

- .1 Fabricate metal flashings and other sheet metal work in accordance with applicable SMACNA "Architectural Sheet Metal Manual (Seventh Edition) details and as indicated.
- .2 Form pieces in 3048 mm (10 ft) maximum lengths. Make allowance for expansion at joints.
- .3 Sealed joints: Form non-expansion but movable joints in metal to accommodate sealant.
- .4 Fabricate cleats and attachment devices of sizes as recommended by SMACNA's "Architectural Sheet Metal Manual" and by FMG Loss Prevention Data Sheet 1-49 for application, and of greater thickness of metal being secured.
- .5 Hem exposed edges on underside 12.7 mm (1/2"). Mitre and seal corners with butyl sealant.
- .6 At parapets, provide 25.4 mm (1") minimum overlap between bottom of wood blocking or flashing anchorage support and edge of drip or termination of flashing.
- .7 Form sections square, true and accurate to size, free from distortion and other defects detrimental to appearance or performance.
- .8 Apply isolation coating to metal surfaces to be embedded in concrete or mortar.

2.4 Fabrication - Stainless Steel Work

- .1 Provide separation of stainless steel or non-ferrous metals fabrication areas from mild steel fabrication areas.
- .2 Grinders, wire brushes, and tools used on stainless steel or non-ferrous metals shall be free of materials which will leave or produce dissimilar material or metal oxides deposits. Tools previously used on mild steel shall not be used on stainless steel or non-ferrous metal work.
- .3 Do not bring iron or mild steel surfaces into contact with stainless steel or non-ferrous metals, including lifting tools, steel tables, storage racks, and other storage and handling equipment.
- .4 Cutting or grinding debris from iron or mild steel materials shall not be permitted to settle on stainless steel or non-ferrous materials and fabrications.
- .5 Perform water-wetting and drying tests during finishing indicating free iron on finished stainless work in accordance with ASTM A380-06.

Metal Flashing

PART 3 - EXECUTION

3.1 Wall Flashing Installation

- .1 General: Install sheet metal wall flashing to intercept and exclude penetrating moisture according to SMACNA recommendations and as indicated. Coordinate installation of wall flashing with installation of wall-opening components such as windows, doors, and louvers.
- .2 Through-wall flashing: Installation of through-wall flashing is specified in Division 4.
- .3 Reglets: Installation of reglets is specified in Division 3 under "Cast-in-Place Concrete".

3.2 Field Quality Control

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

3.3 Adjusting and Cleaning

- .1 Remove deposits, stains or protections and wash metals left unpainted and exposed to view as recommended by manufacturer of metal or paint finish.

3.4 Protection

- .1 Advise *Contractor* of required procedures for surveillance and protection of flashings and sheet metal work during construction to ensure that work will be without damage or deterioration other than natural weathering.

END OF SECTION

Below-Grade Vapour Barrier

PART 1 - GENERAL

1.1 Summary

- .1 Section includes:
 - .1 Below-grade vapour barrier; located beneath concrete slabs.

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* to be for used in the work of this section.
- .3 Samples:
 - .1 Submit sample of proposed *Products* for review by *Consultant*.
- .4 Manufacturer's instructions:
 - .1 Submit manufacturer's *Product* installation instruction for *Products* to be used in the work of this section.
- .5 Vapour barrier test results and certification:
 - .1 Provide certification prepared by accredited testing company for test procedures listed in Table 1 of ASTM E1745-17 and paragraphs 7.1.2, 7.1.3, 7.1.4, and 7.1.5 of ASTM E1745-17. Provide the date of the most recent test and the test results for each test.
 - .1 Accompany certification tests specified above with letter signed by *Product* manufacturer attesting that material to be *Provided* is of the same formulation and manufacture as the *Product* tested.

1.4 Quality Assurance

- .1 Qualifications: Provide work of this section, executed by competent installers with minimum 5 years experience in application of *Products*.
- .2 Mock-up:
 - .1 Construct 10 m² (100 ft²) area of typical installation for each type of *Product*.
 - .1 Construct mock-up of sheet vapour barrier installation including one lap joint , one edge termination, and one penetration. Mock-up may be part of finished work.
 - .2 Locate at the *Place of the Work* as part of final installation.
 - .3 Do not proceed until mock-up has been reviewed by *Consultant*.

Below-Grade Vapour Barrier

- .4 When accepted, mock-up will demonstrate minimum standard of quality required for this work.

PART 2 - PRODUCTS

2.1 Materials

- .1 Vapour barrier membrane:
 - .1 Performance criteria:
 - .1 Permeance, as tested after conditioning: not greater than 0.5700 ng/(Pa*s *m²)(0.010 perms (gm/ft²/in-Hg)) to ASTM E1745-17 paragraphs 7.1.2 through 7.1.5.
 - .2 Strength: Class A to ASTM E1745-17.
 - .3 Thickness of plastic:
 - .1 Minimum 0.38 mm (15 mils).
 - .2 Acceptable *Products*:
 - .1 Stego Industries 'Stego Wrap Vapor Barrier', thickness specified above.
 - .2 W.R. Meadows 'PERMINATOR', thickness specified above.
 - .3 Substitutions: in accordance with Section 01 25 00.
- .2 Vapour barrier membrane joint tape:
 - .1 Pressure sensitive high density polyethylene tape, 100 mm (4") wide, product as per vapour barrier membrane manufacturer's installation requirements.
- .3 Penetration flashing:
 - .1 Vapour barrier membrane material and vapour barrier joint tape in accordance with manufacturer's requirements.

PART 3 - EXECUTION

3.1 Installation

- .1 Install vapour barrier membrane in accordance with below-grade vapour barrier manufacturer's written requirements and ASTM E1643-18a.
- .2 Extend vapour barrier to the perimeter of the slab and seal to perimeter and penetration conditions. Seal around penetrations such as utilities and columns in order to create a monolithic membrane between the surface of the slab and moisture sources below the slab and at the slab perimeter.
- .3 Install vapour barrier membrane using largest practicable sheet size to minimize joints over compacted fill.
- .4 Inspect vapour barrier membrane sheets for continuity. Repair punctures and tears in vapour barrier membrane with sealing tape before work is concealed.
- .5 Vapour barrier membrane installation shall be continuous and vapour tight.
- .6 Overlap vapour barrier membrane joints 150 mm (6") minimum and tape seal with vapour barrier joint tape.

Below-Grade Vapour Barrier

- .7 Unroll vapour barrier membrane with longest dimension parallel with direction of concrete placement.
- .8 Lap vapour barrier membrane up foundation walls a minimum of 100 mm (4") and tape seal with vapour barrier joint tape.
- .9 Centre vapour barrier joint tape over vapour barrier membrane laps and joints. Keep area of tape adhesion free of dust, dirt, and moisture.
- .10 Cut slit around pipes, ductwork, rebar, and wire penetrations to place the initial layer of vapour barrier membrane.
 - .1 Cut a piece of vapour barrier membrane minimum width of 300 mm (12"). The length should be 1 1/2 times the pipe circumference. With a roofer's knife or scissors, cut "fingers" half the width of the film.
 - .2 Wrap vapour barrier membrane around and tape the collar onto the pipe and completely tape fingers to the bottom layer of vapour barrier membrane with vapour barrier joint tape.
- .11 In the event that vapour barrier membrane is damaged during or after installation, repairs shall be made. Cut a piece of vapour barrier membrane large enough to cover damage by minimum overlap of 150 mm (6"). Clean adhesion areas of dust, dirt, and moisture. Tape down edges using vapour barrier joint tape.

3.2 Field Quality Control

- .1 Conduct quality control in accordance with Section 01 45 00.
- .2 Inspection and testing:
 - .1 Independent inspection and testing company shall perform inspection of completed work.
- .3 Manufacturer's field review to be in accordance with Section 01 45 00.

END OF SECTION

Joint Firestopping and Smoke Seals

PART 1 - GENERAL

1.1 Summary

- .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 Repair or replacement of existing damaged joint firestopping and smoke seals.
- .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 mechanical and electrical specifications.

1.2 Administrative Requirements

- .1 Coordination:
 - .1 Coordinate joint firestopping and smoke seal work with Section 01 33 00, paragraph 1.8 Project Firestopping Manual and Coordination.
 - .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 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.

Joint Firestopping and Smoke Seals

- .2 Installation certification: Installer shall submit certification that all joint firestopping system installations are completed and that installations comply with listed systems designs.
- .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 00.
 - .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:

Joint Firestopping and Smoke Seals

- .1 Provide work of this section, executed by installers with minimum 5 years experience in application of *Products*, systems and assemblies specified and with approval, training and certification of *Product* manufacturers.
 - .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.
- .3 Aspects of the work of this section are required to be prepared by a professional engineer. Refer to Section 01 33 00 for specific details and requirements in this regard.

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.

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.

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.

Joint Firestopping and Smoke Seals

- .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 to allow for vertical movement, allowing wall to move independent of structure, due to forces such as live loads, dead loads, thermal expansion/contraction, wind sway, without damaging 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.
 - .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.

Joint Firestopping and Smoke Seals

- .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.

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.
 - .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.

Joint Firestopping and Smoke Seals

.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 E2393-20. 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 Interior building sealants.
- .2 Section excludes:
 - .1 Glazing sealants in accordance with Section 08 80 00.
 - .2 Mechanical and electrical sealant work.

1.2 Administrative Requirements

- .1 Coordination:
 - .1 Coordinate cleaning, priming and installation to avoid contamination of wet, freshly coated or adjacent finished surfaces.
- .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.
 - .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 C1248-18.
 - .1 Submit test results to *Consultant* prior to application of sealants.

1.4 Quality Assurance

- .1 Qualifications:
 - .1 Installers / applicators: Execute the work of this section only by a *Subcontractor* with minimum 5 years experience in application of *Products*, systems and assemblies specified and with approval and training of *Product* manufacturers. Installer to comply with quality assurance articles referenced in ASTM C1193-16 for installation of joint sealants.

Joint Sealants

- .2 Mock-up:
 - .1 Submit 2440 mm (96") long sealant joint mock-up.

1.5 Field Conditions

- .1 Conform to sealant manufacturer's specifications and recommendations.
- .2 Verify substrates and ambient air temperature at the *Place of the Work* before, during and after application.

PART 2 - PRODUCTS

2.1 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 Comply 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: Provide products that have undergone testing according to ASTM C1248-18 and have not stained porous joint substrates indicated for *Work*.
 - .4 Sealant supplied shall not exude any material(s) which travels into adjacent materials, or travels 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: less than 250 g/L.
 - .2 Interior sealant; in vertical surfaces, no detectible odour: one-component polyurethane sealant in accordance with the following:
 - .1 Comply with:
 - .1 ASTM C920-14, Type M or S, Grade NS, Class 25.
 - .2 CAN/CGSB 19.13-M87.
 - .2 Acceptable *Products*:
 - .1 Master Builders Solutions Canada 'MasterSeal NP100'.
 - .2 Sika 'Sikaflex 15LM'.
 - .3 Interior sealant; trafficable movement joints: one-component low modulus silicone sealant in accordance with the following:
 - .1 Comply with:
 - .1 ASTM C920-11, Type S, Grade NS, Class 100/50.
 - .2 CAN/CGSB 19.13-M87.
 - .3 SWR Institute Sealant Validation Program.

Joint Sealants

- .2 *Acceptable Products:*
 - .1 DOWSIL '790'.
 - .2 Momentive 'Silpruf LM SCS2700'.
 - .3 Sika 'Sikasil WS-290'.
 - .4 Tremco, Inc. 'Spectrem 1'.
- .4 Interior sealant, mildew resistant one part silicone sealant in accordance with the following:
 - .1 Comply with:
 - .1 ASTM C920-14, Type S, Grade NT, Class 25.
 - .2 CAN/CGSB 19.22-M89.
 - .2 *Acceptable Products:*
 - .1 DOWSIL '786'.
 - .2 Master Builders Solutions Canada 'OmniPlus'.
 - .3 Momentive 'Sanitary SCS1700 Sealant'.
 - .4 Sika 'Sikasil GP'.
 - .5 Tremco, Inc. 'Tremsil 200'.

2.2 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.

Joint Sealants

- .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.

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 Non-porous surfaces shall be cleaned using the two-cloth wipe method as referenced in ASTM C1193-16 and outlined by joint sealant manufacturer's written requirements.
- .6 Rusting or scaling surfaces shall be prepared using abrasive cleaning methods as recommended by joint sealant manufacturer prior to joint sealant installation. Efflorescence, mould, mildew and algae must be removed and neutralized 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.

Joint Sealants

3.4 Installation

- .1 Apply joint sealants for continuous waterproof sealant joint protection. Vertical joints shall be lapped 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.
- .2 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.
- .3 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 Install, providing uniform cross-sectional shapes and depths in relation to joint width for optimum sealant movement capability per joint sealant manufacturer's written requirements.
- .4 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.
- .5 Allow single-component sealants to fully cure before adhesion testing is performed as recommended by joint sealant manufacturer.
- .6 Match approved sealant mock-up for colour, finish and overall aesthetics. Remove, refinish or re-install work not in compliance with the *Contract Documents*.
- .7 When surfaces of adjacent materials are to be painted, perform sealant work before these surfaces are painted.
- .8 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.
- .9 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.

Joint Sealants

- .10 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.
- .11 On horizontal traffic surfaces, support joint filler against vertical movement which might result from traffic loads, including foot traffic.
- .12 Install bond breaker tape in bottom of joints in lieu of sealant backing where proper depth cannot be obtained when backing is installed.
- .13 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.
- .14 Fillet bead sealant joints to be sized to provide proper contact area with substrates, in accordance with manufacturer's written recommendations.
- .15 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.
- .16 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.
- .17 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.
- .18 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 exterior and 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.
 - .7 Millwork junctions with walls.
- .3 Mildew resistant sealant at wet areas:
 - .1 Perimeter joints of wet fixtures such as sinks.
 - .2 Counter/wall junctions at countertops.

Joint Sealants

3.6 Field Quality Control

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

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.
- .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).

1.2 Administrative Requirements

- .1 Coordination:
 - .1 Cooperate fully with finish hardware distributor's representative during preparation of shop drawings and execution of shop fabrication.
 - .2 Coordinate installation of doors and frames with installation of hardware specified in Section 08 71 00.
- .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 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 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).

1.5 Delivery, Storage, and Handling

- .1 Inspect materials thoroughly upon receipt and report immediately discrepancies, deficiencies and damages, in writing, to *Supplier*.

Steel Frames

- .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 upon receipt at the *Place of the Work*, and store in a vertical position, spaced with blocking to permit air circulation between them.

PART 2 - PRODUCTS

2.1 Manufacturer

- .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 Gensteel Doors.
- .7 M.J. Daley Manufacturing Co. Ltd.
- .8 Shanahan's Manufacturing Ltd.
- .9 Trillium Steel Doors Limited.
- .10 Vision Hollow Metal Limited.

2.2 Materials

- .1 Steel:
 - .1 Fabricated from tensioned levelled steel to ASTM A924/A924M-18, galvanized to 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 Adhesives:
 - .1 Heat resistant, single component, polyurethane reactive (water) hot melt, thermoset adhesive.
- .3 Primer: rust inhibitive for touch-up.
- .4 Finishing hardware: in accordance with Section 08 71 00.
- .5 Miscellaneous:
 - .1 Door silencers: single stud rubber or neoprene type.
 - .2 Exterior top caps: Rigid polyvinylchloride extrusion.
 - .3 Frame thermal breaks: Rigid polyvinylchloride extrusion.

Steel Frames

- .4 Channel glazing stops and glazing trim: formed channel of minimum 0.81 mm (0.032") (20 gauge) steel, 15.9 mm (5/8") high.

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.
 - .2 Clearances for Non-Fire-Rated Doors: Not more than 3 mm (1/8") at jambs and heads, except not more than 6 mm (1/4") between pairs of doors. Not more than 19 mm (3/4") at bottom.
- .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 Weld continuously at joints exposed to view or at joints through which air or water could penetrate from the exterior of building to the interior.
- .10 Perform welding to CSA W59-13.
- .11 Mortise, reinforce, drill and tap to receive hardware and security devices using templates provided by respective *Supplier*.
- .12 Touch up finish damaged during fabrication.
- .13 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: 1.34 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):

Steel Frames

- .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.
 - .2 Weather-stripped doors: None required.
 - .3 Transom panels: 2 at each jamb.
- .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.

Steel Frames

- .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 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 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 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.
- .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.

Steel Frames

- .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.
- .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.

Steel Frames

- .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 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 2.8 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 2.8 of this section. Intermediate hinge preparations shall be spaced equally between top and bottom cutouts.
- .3 Strike preparations for unit, integral, cylindrical and mortise locks and roller latches shall be centered 1033 mm (40-5/16") from finished floor. Strikes for deadlocks shall be centered at 1220 mm (48") from finished floor. Strikes for panic or fire exit hardware shall be located as per device manufacturer's templates.
- .4 Preparations not noted above shall be as per hardware manufacturer's templates.
- .5 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 - Frames

- .1 Set frame product plumb, square, aligned, without twist at correct elevation in accordance with NAAMM-HMMA 840-17.

Steel Frames

- .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 Execute installation and assembly using skilled forces under supervision of a competent joinery foreperson.
- .7 Adjust operable parts for correct clearances and function.
- .8 Steel surfaces shall be kept free of grout, tar or other bonding materials or sealers.
- .9 Remove grout or other bonding material from products immediately following installation.
- .10 *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.
- .11 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.
- .12 Fill and grind smooth "punch and dimpled" frame installations.
- .13 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.
- .14 Touch-up exposed field welds shall be finished to present a smooth uniform surface and with a rust inhibitive primer.
- .15 Touch-up exposed surfaces that have been scratched or otherwise marred during shipment, installation, and handling shall be with a rust inhibitive primer.
- .16 Finish paint in accordance with Section 09 91 00.
- .17 Install door silencers.
- .18 Adequately fasten units and secure in place with concealed fixings wherever possible. Include grounds and furring where required.

Steel Frames

- .19 Make allowance for deflection to ensure structural loads are not transmitted to frames.
- .20 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 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.
- .2 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 high pressure plastic laminate.
- .2 Coordination:
 - .1 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.
 - .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.

1.2 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 Submit shop drawings for the work of this section complying with the North American Architectural Woodwork Standards 3.1 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.

1.3 Delivery, Storage, and Handling

- .1 Door numbers 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.

Flush Wood Doors

1.4 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.

1.5 Extended Warranty

- .1 Repair or replace wood doors that fail or are defective within the specified warranty period. The warranty includes re-installation of hardware, re-hanging fitting, and finishing.
- .2 Failures shall include but not be limited to out of true alignment, failure to operate and 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.

PART 2 - PRODUCTS

2.1 Manufacturer

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

2.2 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.

2.3 Door Construction

- .1 Door construction, industry abbreviations and types to North American Architectural Woodwork Standards 3.1
- .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.
- .3 Solid particle board core, high pressure decorative laminate faced, non fire rated wood door construction:
 - .1 Type PC-HPDL-5, particle core to ANSI A208.1-2009 LD-2.

Flush Wood Doors

- .4 Bonding:
 - .1 Bond stiles and rails to core; abrasive sand core assembly to achieve uniform thickness prior to lamination of door faces.
- .5 Panel edge types:
 - .1 High pressure decorative laminate faced doors:
 - .1 For vertical edges (stiles) and exposed horizontal edges (rails). (Exposed horizontal edges are those edges that can be viewed from floors above.):
 - .1 High pressure decorative laminate finish, face and cross bands are covered.
- .6 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.
- .7 Thickness:
 - .1 45 mm (1-3/4") minimum unless otherwise indicated or scheduled.

2.4 Plastic Laminate Faced Doors

- .1 Type: Grade 10 General Purpose, to ANSI/NEMA LD3-2005.
- .2 Colours and patterns: as selected by *Consultant*.
- .3 Surface finish: as selected by *Consultant*.
- .4 Acceptable *Products*:
 - .1 Formica 'Sliced Red Oak Plastic Laminate'.
 - .2 Substitutions: in accordance with Section 01 25 00.

2.5 Accessories

- .1 Finishing hardware: in accordance with Section 08 71 00.

Flush Wood Doors

2.6 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 Factory cut and trim openings.

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, jambs, 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

SECTION 087100 – DOOR HARDWARE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes commercial door hardware for the following:
 - 1. Swinging doors.
 - 2. Sliding doors.
 - 3. Other doors to the extent indicated.
- B. Door hardware includes, but is not necessarily limited to, the following:
 - 1. Mechanical door hardware.
 - 2. Electromechanical door hardware.
 - 3. Cylinders specified for doors in other sections.
- C. Related Sections:
 - 1. Division 01 Section "Cash Allowances".
 - 2. Division 01 Section "Product Allowances".
 - 3. Division 01 Section "Closeout Procedures"
 - 4. Division 08 Section "Door Hardware Schedule".
 - 5. Division 08 Section "Wood Doors and Frames".
- D. Codes and References: Comply with the version year adopted by the Authority Having Jurisdiction.
 - 1. ANSI A117.1 - Accessible and Usable Buildings and Facilities.
 - 2. NFPA 70 - National Electrical Code.
 - 3. NFPA 80 - Fire Doors and Windows.
 - 4. NFPA 101 - Life Safety Code.
 - 5. NFPA 105 - Installation of Smoke Door Assemblies.
 - 6. UL/ULC and CSA C22.2 – Standards for Automatic Door Operators Used on Fire and Smoke Barrier Doors and Systems of Doors.

7. Local Building Codes, Local Amendments.

E. Standards: All hardware specified herein shall comply with the following industry standards:

1. ANSI/BHMA Certified Product Standards - A156 Series
2. UL10C – Positive Pressure Fire Tests of Door Assemblies

1.3 SUBMITTALS

A. Product Data: Manufacturer's product data sheets including installation details, material descriptions, dimensions of individual components and profiles, operational descriptions and finishes.

B. Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing fabrication and assembly of door hardware, as well as procedures and diagrams. Coordinate the final Door Hardware Schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.

1. Format: Comply with scheduling sequence and vertical format in DHI's "Sequence and Format for the Hardware Schedule."

2. Organization: Organize the Door Hardware Schedule into door hardware sets indicating complete designations of every item required for each door or opening. Organize door hardware sets in same order as in the Door Hardware Sets at the end of Part 3. Submittals that do not follow the same format and order as the Door Hardware Sets will be rejected and subject to resubmission.

3. Content: Include the following information:

- .1 Type, style, function, size, label, hand, and finish of each door hardware item.
- .2 Manufacturer of each item.
- .3 Fastenings and other pertinent information.
- .4 Location of door hardware set, cross-referenced to Drawings, both on floor plans and in door and frame schedule.
- .5 Explanation of abbreviations, symbols, and codes contained in schedule.
- .6 Mounting locations for door hardware.
- .7 Door and frame sizes and materials.
- .8 Warranty information for each product.

4. Submittal Sequence: Submit the final Door Hardware Schedule at earliest possible date, particularly where approval of the Door Hardware Schedule

must precede fabrication of other work that is critical in the Project construction schedule. Include Product Data, Samples, Shop Drawings of other work affected by door hardware, and other information essential to the coordinated review of the Door Hardware Schedule.

- C. Shop Drawings: Details of electrified access control hardware indicating the following:
 - 1. Wiring Diagrams: Upon receipt of approved schedules, submit detailed system wiring diagrams for power, signaling, monitoring, communication, and control of the access control system electrified hardware. Differentiate between manufacturer-installed and field-installed wiring. Include the following:
 - .1 Elevation diagram of each unique access controlled opening showing location and interconnection of major system components with respect to their placement in the respective door openings.
 - .2 Complete (risers, point-to-point) access control system block wiring diagrams.
 - .3 Wiring instructions for each electronic component scheduled herein.
 - 2. Electrical Coordination: Coordinate with related sections the voltages and wiring details required at electrically controlled and operated hardware openings.
- D. Keying Schedule: After a keying meeting with the owner has taken place prepare a separate keying schedule detailing final instructions. Submit the keying schedule in electronic format. Include keying system explanation, door numbers, key set symbols, hardware set numbers and special instructions. Owner must approve submitted keying schedule prior to the ordering of permanent cylinders/cores.
- E. Informational Submittals:
 - 1. Product Test Reports: Indicating compliance with cycle testing requirements, based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified independent testing agency.
- F. Operating and Maintenance Manuals: Provide manufacturers operating and maintenance manuals for each item comprising the complete door hardware installation in quantity as required in Division 01, Closeout Submittals.

1.4 QUALITY ASSURANCE

- A. Manufacturers Qualifications: Engage qualified manufacturers with a minimum 5 years of documented experience in producing hardware and equipment similar to that indicated for this Project and that have a proven record of successful in-service performance.
- B. Installer Qualifications: A minimum 3 years documented experience installing both standard and electrified door hardware similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.
- C. Door Hardware Supplier Qualifications: Experienced commercial door hardware distributors with a minimum 5 years documented experience supplying both mechanical and electromechanical hardware installations comparable in material, design, and extent to that indicated for this Project. Supplier recognized as a factory direct distributor by the manufacturers of the primary materials with a warehousing facility in Project's vicinity. Supplier to have on staff a certified Architectural Hardware Consultant (AHC) available during the course of the Work to consult with Contractor, Architect, and Owner concerning both standard and electromechanical door hardware and keying.
- D. Source Limitations: Obtain each type and variety of door hardware specified in this section from a single source unless otherwise indicated.
 - 1. Electrified modifications or enhancements made to a source manufacturer's product line by a secondary or third party source will not be accepted.
 - 2. Provide electromechanical door hardware from the same manufacturer as mechanical door hardware, unless otherwise indicated.
- E. Each unit to bear third party permanent label demonstrating compliance with the referenced standards.
- F. Keying Conference: Conduct conference to comply with requirements in Division 01 Section "Project Meetings." Keying conference to incorporate the following criteria into the final keying schedule document:
 - 1. Function of building, purpose of each area and degree of security required.
 - 2. Plans for existing and future key system expansion.
 - 3. Requirements for key control storage and software.
 - 4. Installation of permanent keys, cylinder cores and software.
 - 5. Address and requirements for delivery of keys.

- G. Pre-Submittal Conference: Conduct coordination conference in compliance with requirements in Division 01 Section "Project Meetings" with attendance by representatives of Supplier(s), Installer(s), and Contractor(s) to review proper methods and the procedures for receiving, handling, and installing door hardware.
1. Prior to installation of door hardware, conduct a project specific training meeting to instruct the installing contractors' personnel on the proper installation and adjustment of their respective products. Product training to be attended by installers of door hardware (including electromechanical hardware) for aluminum, hollow metal and wood doors. Training will include the use of installation manuals, hardware schedules, templates and physical product samples as required.
 2. Inspect and discuss electrical roughing-in, power supply connections, and other preparatory work performed by other trades.
 3. Review sequence of operation narratives for each unique access controlled opening.
 4. Review and finalize construction schedule and verify availability of materials.
 5. Review the required inspecting, testing, commissioning, and demonstration procedures
- H. At completion of installation, provide written documentation that components were applied to manufacturer's instructions and recommendations and according to approved schedule.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Inventory door hardware on receipt and provide secure lock-up and shelving for door hardware delivered to Project site. Do not store electronic access control hardware, software or accessories at Project site without prior authorization.
- B. Tag each item or package separately with identification related to the final Door Hardware Schedule, and include basic installation instructions with each item or package.
- C. Deliver, as applicable, permanent keys, cylinders, cores, access control credentials, software and related accessories directly to Owner via registered mail or overnight package service. Instructions for delivery to the Owner shall be established at the "Keying Conference".

1.6 COORDINATION

- A. Templates: Obtain and distribute to the parties involved templates for doors, frames, and other work specified to be factory prepared for installing standard and electrified hardware. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing hardware to comply with indicated requirements.
- B. Door Hardware and Electrical Connections: Coordinate the layout and installation of scheduled electrified door hardware and related access control equipment with required connections to source power junction boxes, low voltage power supplies, detection and monitoring hardware, and fire and detection alarm systems.
- C. Door and Frame Preparation: Doors and corresponding frames are to be prepared, reinforced and pre-wired (if applicable) to receive the installation of the specified electrified, monitoring, signaling and access control system hardware without additional in-field modifications.

1.7 WARRANTY

- A. General Warranty: Reference Division 01, General Requirements. Special warranties specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.
- B. Warranty Period: Written warranty, executed by manufacturer(s), agreeing to repair or replace components of standard and electrified door hardware that fails in materials or workmanship within specified warranty period after final acceptance by the Owner. Failures include, but are not limited to, the following:
 - 1. Structural failures including excessive deflection, cracking, or breakage.
 - 2. Faulty operation of the hardware.
 - 3. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
 - 4. Electrical component defects and failures within the systems operation.
- C. Standard Warranty Period: One year from date of Substantial Completion, unless otherwise indicated.

1.8 MAINTENANCE SERVICE

- A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.

PART 2 - PRODUCTS

2.1 SCHEDULED DOOR HARDWARE

- A. General: Provide door hardware for each door to comply with requirements in Door Hardware Sets and each referenced section that products are to be supplied under.
- B. Designations: Requirements for quantity, item, size, finish or color, grade, function, and other distinctive qualities of each type of door hardware are indicated in the Door Hardware Sets at the end of Part 3. Products are identified by using door hardware designations, as follows:
 - 1. Named Manufacturer's Products: Product designation and manufacturer are listed for each door hardware type required for the purpose of establishing requirements. Manufacturers' names are abbreviated in the Door Hardware Schedule.
- C. Products furnished, but not installed, under this Section include the following. Coordinating, purchasing, delivering, and scheduling remain requirements of this Section.
 - 1. Permanent cylinders, cores, and keys to match existing Owner Standards.
- D. Substitutions: Requests for substitution and product approval for inclusive mechanical and electromechanical door hardware in compliance with the specifications must be submitted in writing and in accordance with the procedures and time frames outlined in Division 01, Substitution Procedures. Approval of requests is at the discretion of the architect, owner, and their designated consultants.

2.2 HANGING DEVICES

- A. Hinges: ANSI/BHMA A156.1 certified butt hinges with number of hinge knuckles and other options as specified in the Door Hardware Sets.
 - 1. Quantity: Provide the following hinge quantity:

- .1 Two Hinges: For doors with heights up to 60 inches.
 - .2 Three Hinges: For doors with heights 61 to 90 inches.
 - .3 Four Hinges: For doors with heights 91 to 120 inches.
 - .4 For doors with heights more than 120 inches, provide 4 hinges, plus 1 hinge for every 30 inches of door height greater than 120 inches.
2. Hinge Size: Provide the following, unless otherwise indicated, with hinge widths sized for door thickness and clearances required:
 - .1 Widths up to 3'0": 4-1/2" standard or heavy weight as specified.
 - .2 Sizes from 3'1" to 4'0": 5" standard or heavy weight as specified.
3. Hinge Weight and Base Material: Unless otherwise indicated, provide the following:
 - .1 Interior Doors: Standard weight, steel, ball bearing or oil impregnated bearing hinges unless Hardware Sets indicate heavy weight.
4. Hinge Options: Comply with the following:
 - .1 Non-removable Pins: Provide set screw in hinge barrel that, when tightened into a groove in hinge pin, prevents removal of pin while door is closed; for the all out-swinging lockable doors.
5. Manufacturers:
 - .1 McKinney Products; ASSA ABLOY Architectural Door Accessories (MK) - TA Series.

2.3 CYLINDERS AND KEYING

- A. General: Cylinder manufacturer to have minimum (10) years experience designing secured master key systems and have on record a published security keying system policy.
- B. Source Limitations: Obtain each type of keyed cylinder and keys from the same source manufacturer as locksets and exit devices, unless otherwise indicated.
 1. Manufacturers:
 - .1 Sargent Manufacturing (SA).

- C. Cylinder Types: Original manufacturer small format interchangeable core cylinders that accept 6 or 7 pin SFIC permanent cores, able to supply the following cylinder formats and types:
 - 1. Threaded mortise cylinders with rings and cams to suit hardware application.
 - 2. Rim cylinders with back plate, flat-type vertical or horizontal tailpiece, and raised trim ring.
 - 3. Bored or cylindrical lock cylinders with tailpieces as required to suit locks.
 - 4. Mortise and rim cylinder collars to be solid and recessed to allow the cylinder face to be flush and be free spinning with matching finishes.
 - 5. Keyway: Manufacturer's Standard.
- D. Cylinder housing to be provided with disposable cores.
- E. Interchangeable Cores: Provide small format interchangeable cores as specified, core insert, removable by use of a special key; usable with other manufacturers' cylinders.
- F. Keying System: Each type of lock and cylinders to be factory keyed.
 - 1. Conduct specified "Keying Conference" to define and document keying system instructions and requirements.
 - 2. Furnish factory cut, nickel-silver large bow permanently inscribed with a visual key control number as directed by Owner.
 - 3. Existing System: Key locks to Owner's existing system.
 - 4. New System: Key locks to a new key system as directed by the Owner.
- G. Key Quantity: Provide the following minimum number of keys:
 - 1. Change Keys per Cylinder: Two (2) Three (3).
 - 2. Master Keys (per Master Key Level/Group): Five (5).
 - 3. Permanent Control Keys (where required): Two (2).
- H. Key Registration List (Bitting List):
 - 1. Provide keying transcript list to Owner's representative in the proper format for importing into key control software.
 - 2. Provide transcript list in writing or electronic file as directed by the Owner.
 - 3. Furnish a list of opening numbers with locking devices, showing cylinder types and quantities required when cylinders or cores are to be owner furnished.
- I. Key Control Cabinet: Provide a key control system including envelopes, labels, and tags with self-locking key clips, receipt forms, 3-way visible card index, temporary markers, permanent markers, and standard metal cabinet. Key

control cabinet shall have expansion capacity of 150% of the number of locks required for the project.

1. Manufacturers:

- .1 Lund Equipment (LU).
- .2 MMF Industries (MM).
- .3 Telkee (TK).

2.4 MECHANICAL LOCKS AND LATCHING DEVICES

- A. Mortise Locksets, Grade 1 (Heavy Duty): ANSI/BHMA A156.13, Series 1000, Operational Grade 1 certified. Locksets are to be manufactured with a corrosion resistant steel case and be field-reversible for handing without disassembly of the lock body.

- 1. Mortise locks to be certified Security Grade 1.
- 2. Extended cycle test: Locks to have been cycle tested in ordinance with ANSI/BHMA 156.13 requirements to 10 million cycles.

3. Manufacturers:

- .1 Sargent Manufacturing (SA) – 8200 Series.

- B. Cylindrical Locksets, Grade 1 (Heavy Duty): ANSI/BHMA A156.2, Series 4000, Grade 1 certified.

- 1. Furnish with solid cast levers, standard 2 3/4" backset, and 1/2" (3/4" at rated paired openings) throw brass or stainless steel latchbolt.
- 2. Locks are to be non-handed and fully field reversible.
- 3. Locksets to incorporate a free-wheeling lever design.
- 4. Extended cycle test: Locks to have been cycle tested in ordinance with ANSI/BHMA 156.2 requirements to 2 million cycles.
- 5. Extended cycle test: Locks to have been cycle tested in ordinance with ANSI/BHMA 156.2 requirements to 9 million cycles.

6. Manufacturers:

- .1 Sargent Manufacturing (SA) – 10 Line.

2.5 LOCK AND LATCH STRIKES

- A. Strikes: Provide manufacturer's standard strike with strike box for each latch or lock bolt, with curved lip extended to protect frame, finished to match door hardware set, unless otherwise indicated, and as follows:
 - 1. Flat-Lip Strikes: For locks with three-piece antifriction latchbolts, as recommended by manufacturer.
 - 2. Extra-Long-Lip Strikes: For locks used on frames with applied wood casing trim.
- B. Standards: Comply with the following:
 - 1. Strikes for Mortise Locks and Latches: BHMA A156.13.
 - 2. Strikes for Bored Locks and Latches: BHMA A156.2.
 - 3. Strikes for Auxiliary Deadlocks: BHMA A156.36.
 - 4. Dustproof Strikes: BHMA A156.16.

2.6 DOOR CLOSERS

- A. All door closers specified herein shall meet or exceed the following criteria:
 - 1. General: Door closers to be from one manufacturer, matching in design and style, with the same type door preparations and templates regardless of application or spring size. Closers to be non-handed with full sized covers including installation and adjusting information on inside of cover.
 - 2. Standards: Closers to comply with UL-10C for Positive Pressure Fire Test and be U.L. listed for use of fire rated doors.
 - 3. Cycle Testing: Provide closers which have surpassed 15 million cycles in a test witnessed and verified by UL.
 - 4. Size of Units: Comply with manufacturer's written recommendations for sizing of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Where closers are indicated for doors required to be accessible to the physically handicapped, provide units complying with ANSI ICC/A117.1.
 - 5. Closer Arms: Provide heavy duty, forged steel closer arms unless otherwise indicated in Hardware Sets.
 - 6. Closers shall not be installed on exterior or corridor side of doors; where possible install closers on door for optimum aesthetics.

7. Closer Covers: Provide metal closer covers finished to match other hardware on the project.
 8. Closer Covers: Provide PVC free closer covers with a painted finish to match other hardware on the project.
 9. Closer Accessories: Provide door closer accessories including custom templates, special mounting brackets, spacers and drop plates as required for proper installation. Provide through-bolt and security type fasteners as specified in the hardware sets.
- B. Door Closers, Surface Mounted (Heavy Duty): ANSI/BHMA A156.4, Grade 1 surface mounted, heavy duty door closers with complete spring power adjustment, sizes 1 thru 6; and fully operational adjustable according to door size, frequency of use, and opening force. Closers to be rack and pinion type, one piece cast iron or aluminum alloy body construction, with adjustable backcheck and separate non-critical valves for closing sweep and latch speed control. Provide non-handed units standard.
1. Manufacturers:
 - .1 Sargent Manufacturing (SA) - 1431 Series

2.7 ARCHITECTURAL TRIM

A. Door Protective Trim

1. General: Door protective trim units to be of type and design as specified below or in the Hardware Sets.
2. Size: Fabricate protection plates (kick, armor, or mop) not more than 2" less than door width (LDW) on stop side of single doors and 1" LDW on stop side of pairs of doors, and not more than 1" less than door width on pull side. Coordinate and provide proper width and height as required where conflicting hardware dictates. Height to be as specified in the Hardware Sets.
3. Where plates are applied to fire rated doors with the top of the plate more than 16" above the bottom of the door, provide plates complying with NFPA 80. Consult manufacturer's catalog and template book for specific requirements for size and applications.
4. Protection Plates: ANSI/BHMA A156.6 certified protection plates (kick, armor, or mop), fabricated from the following:
 - .1 Stainless Steel: 300 grade, 050-inch thick.

5. Options and fasteners: Provide manufacturer's designated fastener type as specified in the Hardware Sets.
6. Metal Door Edging: Door protection edging fabricated from a minimum .050-inch thick metal sheet, formed into an angle or "U" cap shapes, surface or mortised mounted onto edge of door. Provide appropriate leg overlap to account for protection plates as required. Height to be as specified in the Hardware Sets.
7. Manufacturers:
 - .1 Rockwood Products; ASSA ABLOY Architectural Door Accessories (RO).

2.8 DOOR STOPS AND HOLDERS

- A. General: Door stops and holders to be of type and design as specified below or in the Hardware Sets.
- B. Door Stops and Bumpers: ANSI/BHMA A156.16, Grade 1 certified door stops and wall bumpers. Provide wall bumpers, either convex or concave types with anchorage as indicated, unless floor or other types of door stops are specified in Hardware Sets. Do not mount floor stops where they will impede traffic. Where floor or wall bumpers are not appropriate, provide overhead type stops and holders.
 1. Manufacturers:
 - .1 Rockwood Products; ASSA ABLOY Architectural Door Accessories (RO).
- C. Overhead Door Stops and Holders: ANSI/BHMA A156.6, Grade 1 certified overhead stops and holders to be surface or concealed types as indicated in Hardware Sets. Track, slide, arm and jamb bracket to be constructed of extruded bronze and shock absorber spring of heavy tempered steel. Provide non-handed design with mounting brackets as required for proper operation and function.
 1. Manufacturers:
 - .1 Rixson Door Controls (RF).

2.9 ARCHITECTURAL SEALS

- A. General: Thresholds, weatherstripping, and gasket seals to be of type and design as specified below or in the Hardware Sets. Provide continuous weatherstrip gasketing on exterior doors and provide smoke, light, or sound gasketing on interior doors where indicated. At exterior applications provide non-corrosive fasteners and elsewhere where indicated.
- B. Smoke Labeled Gasketing: Assemblies complying with NFPA 105 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for smoke control ratings indicated, based on testing according to UL 1784.
 - 1. Provide smoke labeled perimeter gasketing at all smoke labeled openings.
- C. Fire Labeled Gasketing: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to UL-10C.
 - 1. Provide intumescent seals as indicated to meet UL10C Standard for Positive Pressure Fire Tests of Door Assemblies, and NPFA 252, Standard Methods of Fire Tests of Door Assemblies.
- D. Sound-Rated Gasketing: Assemblies that are listed and labeled by a testing and inspecting agency, for sound ratings indicated.
- E. Replaceable Seal Strips: Provide only those units where resilient or flexible seal strips are easily replaceable and readily available from stocks maintained by manufacturer.
- F. Hurricane and Tornado Resistance Compliance: Architectural seals to be U.L. listed for windstorm assemblies where applicable. Provide the appropriate hurricane or tornado resistant products that have been independent third party tested, certified, and labeled to meet state and local windstorm building codes applicable to project.
- G. Manufacturers:
 - 1. Pemko Products; ASSA ABLOY Architectural Door Accessories (PE).

2.10 OPENING LABELS

- A. Provide 1"W x 2"H gloss polyester label imprinted with door mark and QR-type code readable via IR and visible light scan. QR code links to a security credential protected site displaying the installed door opening information. Label constructed with a high-performance, permanent acrylic adhesive resistant to

chemicals, smear and scratch, and repeated freeze and thaw cycles. Face stock of label to be white or clear coated, 2.0 mil thickness with tensile strength meeting or exceeding 18,000 psi.

1. Approved Manufacturer: Openings Studio™ Smart Tags (AA).

2.11 FABRICATION

- A. Fasteners: Provide door hardware manufactured to comply with published templates generally prepared for machine, wood, and sheet metal screws. Provide screws according to manufacturers recognized installation standards for application intended.

2.12 FINISHES

- A. Standard: Designations used in the Hardware Sets and elsewhere indicate hardware finishes complying with ANSI/BHMA A156.18, including coordination with traditional U.S. finishes indicated by certain manufacturers for their products.
- B. Provide quality of finish, including thickness of plating or coating (if any), composition, hardness, and other qualities complying with manufacturer's standards, but in no case less than specified by referenced standards for the applicable units of hardware
- C. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine scheduled openings, with Installer present, for compliance with requirements for installation tolerances, labeled fire door assembly construction, wall and floor construction, and other conditions affecting performance.
- B. Notify architect of any discrepancies or conflicts between the door schedule, door types, drawings and scheduled hardware. Proceed only after such discrepancies or conflicts have been resolved in writing.

3.2 PREPARATION

- A. Hollow Metal Doors and Frames: Comply with ANSI/DHI A115 series.

- B. Wood Doors: Comply with ANSI/DHI A115-W series.

3.3 INSTALLATION

- A. Install each item of mechanical and electromechanical hardware and access control equipment to comply with manufacturer's written instructions and according to specifications.
 - 1. Installers are to be trained and certified by the manufacturer on the proper installation and adjustment of fire, life safety, and security products including: hanging devices; locking devices; closing devices; and seals.
- B. Mounting Heights: Mount door hardware units at heights indicated in following applicable publications, unless specifically indicated or required to comply with governing regulations:
 - 1. Standard Steel Doors and Frames: DHI's "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames."
 - 2. Wood Doors: DHI WDHS.3, "Recommended Locations for Architectural Hardware for Wood Flush Doors."
 - 3. Where indicated to comply with accessibility requirements, comply with ANSI A117.1 "Accessibility Guidelines for Buildings and Facilities."
 - 4. Provide blocking in drywall partitions where wall stops or other wall mounted hardware is located.
- C. Retrofitting: Install door hardware to comply with manufacturer's published templates and written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work specified in Division 9 Sections. Do not install surface-mounted items until finishes have been completed on substrates involved.
- D. Thresholds: Set thresholds for exterior and acoustical doors in full bed of sealant complying with requirements specified in Division 7 Section "Joint Sealants."
- E. Storage: Provide a secure lock up for hardware delivered to the project but not yet installed. Control the handling and installation of hardware items so that the completion of the work will not be delayed by hardware losses before and after installation.

3.4 FIELD QUALITY CONTROL

- A. Field Inspection: Supplier will perform a final inspection of installed door hardware and state in report whether work complies with or deviates from requirements, including whether door hardware is properly installed, operating and adjusted.
- B. Fire Door Assembly Inspection: Reference Division 01 Sections "Closeout Procedures" and "Cash Allowances" for stipulations requiring an initial fire door assembly inspection, including documentation reporting, upon completion of door hardware installation according to NFPA 80 Standard for Fire Doors and Other Opening Protectives, paragraph 5.2.4, requirements.
- C. Opening Tags: Provide readable, QR-type label with password protected link-out to Openings Studio™ BIM software suite and the installed door and hardware information. Affix label to door frame as instructed by architect or owner.

3.5 ADJUSTING

- A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

3.6 CLEANING AND PROTECTION

- A. Protect all hardware stored on construction site in a covered and dry place. Protect exposed hardware installed on doors during the construction phase. Install any and all hardware at the latest possible time frame.
- B. Clean adjacent surfaces soiled by door hardware installation.
- C. Clean operating items as necessary to restore proper finish. Provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of owner occupancy.

3.7 DEMONSTRATION

- A. Instruct Owner's maintenance personnel to adjust, operate, and maintain mechanical and electromechanical door hardware.

3.8 DOOR HARDWARE SETS

- A. The hardware sets represent the design intent and direction of the owner and architect. They are a guideline only and should not be considered a detailed hardware schedule. Discrepancies, conflicting hardware and missing items should be brought to the attention of the architect with corrections made prior to the bidding process. Omitted items not included in a hardware set should be scheduled with the appropriate additional hardware required for proper application and functionality.
- B. Quantities listed are for each pair of doors, or for each single door.
- C. The supplier is responsible for handing and sizing all products.
- D. Where multiple options for a piece of hardware are given in a single line item, the supplier shall provide the appropriate selection for the material and application.
- E. At existing openings with new hardware the supplier shall field inspect existing conditions prior to the submittal stage to verify the specified hardware will work as required. Provide alternate solutions and proposals as needed.

- 1. MK - MCKINNEY
- 2. SU - SECURITRON
- 3. RO - ROCKWOOD
- 4. SA - SARGENT
- 5. OT - OTHER
- 6. HS - HES
- 7. RF - RIXSON
- 8. NO - NORTON
- 9. PE - PEMKO

HARDWARE SETS

SET: 1.0

SINGLE 307A, 914 X 2134 X 45, WOOD X EXISTING, 20 MIN
SINGLE SC307A, 914 X 2134 X 45, WOOD X EXISTING, 20 MIN
SINGLE SC307B, 914 X 2134 X 45, WOOD X EXISTING, 20 MIN

3 HINGE, FULL MORTISE

[TA2714 X SIZE TO SUIT X](#)

US26D MK

DOOR HARDWARE

087100 - 18

April 22, 2021

	<u>NRP AS REQ'D</u>		
1 CLASSROOM LOCK	<u>LC 8237 LNL</u>	US32D	SA
1 PERMANENT CORE	TO MATCH EXISTING OWNERS STANDARD		OT
MORTISE CYLINDER C/W	<u>70 46 C/W</u>		
1 DISPOASABLE CONSTRUCTION CORE	<u>COLLARS/SPACERS AS REQ'D</u>	US32D	SA
1 DELAYED ACTION SURFACE CLOSER W/ BUILT IN STOP	<u>DA 1431 CPS</u>	EN	SA
1 KICK PLATE	<u>K1050 200MM X SIZE TO SUIT SA BEV</u>	US32D	RO
1 ACCOUSTIC/SMOKE SEAL	<u>S88BL (1 X DOOR WIDTH, 2X DOOR HEIGHT)</u>		PE

SET: 2.0

SINGLE 307B, 914 X 2134 X 45, WOOD X EXISTING,

3 HINGE, FULL MORTISE	<u>TA2714 X SIZE TO SUIT X NRP AS REQ'D</u>	US26D	MK
1 CLASSROOM LOCK	<u>LC 8237 LNL</u>	US32D	SA
1 PERMANENT CORE	TO MATCH EXISTING OWNERS STANDARD		OT
MORTISE CYLINDER C/W	<u>70 46 C/W</u>		
1 DISPOASABLE CONSTRUCTION CORE	<u>COLLARS/SPACERS AS REQ'D</u>	US32D	SA
1 SURF OVERHEAD STOP	<u>9-X36</u>	630	RF
1 KICK PLATE	<u>K1050 200MM X SIZE TO SUIT SA BEV</u>	US32D	RO

SET: 3.0

SINGLE 307C, 914 X 2134 X 45, WOOD X EXISTING, 45 MIN

3 HINGE, FULL MORTISE	<u>TA2714 X SIZE TO SUIT X NRP AS REQ'D</u>	US26D	MK
1 CLASSROOM LOCK	<u>LC 8237 LNL</u>	US32D	SA
1 PERMANENT CORE	TO MATCH EXISTING OWNERS STANDARD		OT
MORTISE CYLINDER C/W	<u>70 46 C/W</u>		
1 DISPOASABLE CONSTRUCTION CORE	<u>COLLARS/SPACERS AS REQ'D</u>	US32D	SA

DOOR HARDWARE

087100 - 19

April 22, 2021

1 SURF OVERHEAD STOP [9-X36](#)

630 RF

Glass and Glazing

PART 1 - GENERAL

1.1 Summary

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

1.2 Administrative Requirements

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.
- .4 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.
- .5 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.
- .6 Submit sample glazing warranty.
- .7 Submit letter from insulating glass unit fabricator that insulating glass units supplied will bear the certification mark of IGMAC or IGCC/IGMA.

1.4 Closeout Submittals

- .1 Submit closeout submittals in accordance with Section 01 77 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:

Glass and Glazing

- .1 Manufacturers: Fabrication processes, including low emissivity and reflective coatings, insulating, laminated, silk-screening and tempering shall be manufactured by a single manufacturer with a minimum of ten (10) years of fabrication experience and meet ANSI / ASQC 9002 1994.
- .2 Installers / applicators / erectors: *Provide* the work of this section executed by specialist *Subcontractor* who shall be thoroughly trained and experienced in skills required, be completely familiar with referenced standards and requirements of the work of this section, and personally direct installation performed under this section.
 - .1 Foreperson experience: Minimum 10 years experience as glazing mechanic.
 - .2 Glazing mechanic experience: Minimum 3 years experience as glazers.
- .3 Aspects of the work of this section are required to be prepared by a professional engineer. Refer to Section 01 33 00 for specific details and requirements in this regard.

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 Extended Warranty

- .1 Warrant work of this section in accordance with Section 01 78 36.
- .2 The glazing systems shall perform properly to the extent that the design and *Contract Documents* permit such performance for the duration of the warranty period.
- .3 Special product warranty for tempered glass products:
 - .1 Provide a written 5 year warranty from date of manufacture for fully tempered glass. 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.

Glass and Glazing

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 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.

- .2 Provide annealed, heat strengthened, and tempered lights where required by the building code, and where required for the various solar exposures on the building.
- .3 Glass thicknesses and glass types specified, indicated, or scheduled in the *Contract Documents* are minimums required. Glass designer/engineer to modify 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.

- .3 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.

- .4 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 AGC Glass North America.
- .2 Cardinal Glass Industries.
- .3 Guardian Industries, LLC.
- .4 Pilkington North America.
- .5 Vitro Architectural Glass.

Glass and Glazing

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 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.
 - .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).

2.4 Fire Protection Rated Glass

.1 Fire rated, impact safety resistant glass, non-wired:

- .1 Film faced and non-film faced glazing:
 - .1 Fire-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 to heat.
 - .2 Impact safety resistance: ANSI Z97.1-2010 and CPSC 16 CFR 1201 (Cat. I and II).
 - .3 Surface finish:
 - .1 Premium Grade: transparent glass, polished for superior optical clarity.
 - .4 Acceptable *Product*:
 - .1 Safti First 'SuperLite II-XL'.
 - .2 Saint Gobain 'Keralite F Select'.
 - .3 Schott 'Pyran Platinum F'.
 - .4 Technical Glass Products 'FireLite NT'.
- .2 Non-film faced glazing:
 - .1 Fire-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 Impact safety resistance: ANSI Z97.1-2010 and CPSC 16 CFR 1201 (Cat. I and II).

Glass and Glazing

- .3 Surface finish:
 - .1 Premium Grade: transparent glass, polished for superior optical clarity.
- .4 Acceptable *Product*:
 - .1 Safti First 'SuperLite II-XL'.
 - .2 Saint Gobain 'Keralite L Select'.
 - .3 Schott 'Pyran Platinum L'.
 - .4 Technical Glass Products 'FireLite Plus'.

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 one of the following:
 - .1 Preformed, EPDM to ASTM C864-05(2015).
 - .2 Preformed, EPDM, silicone compatible, to ASTM C864-05(2015).
 - .3 Preformed silicone to ASTM C1115-17.
- .3 Setting blocks: Moulded or extruded material with Shore, Type A Durometer hardness of 85, plus or minus 5, made from one of the following:
 - .1 Preformed, EPDM to ASTM C864-05(2015).
 - .2 Preformed, EPDM, silicone compatible, to ASTM C864-05(2015).
 - .3 Preformed silicone to ASTM C1115-17.
- .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 one of the following:
 - .1 Preformed, EPDM to ASTM C864-05(2015).
 - .2 Preformed, EPDM, silicone compatible, to ASTM C864-05(2015).
 - .3 Preformed silicone to ASTM C1115-17.
- .5 Edge blocks: Moulded or extruded material of hardness needed to limit glass lateral movement (side walking) made from one of the following:
 - .1 Preformed, EPDM to ASTM C864-05(2015).
 - .2 Preformed, EPDM, silicone compatible, to ASTM C864-05(2015).
 - .3 Preformed silicone to ASTM C1115-17.
- .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.

Glass and Glazing

- .2 Acceptable *Products*: As recommended by manufacturer suitable for conditions of application and use.
- .8 Structural glazing sealant:
 - .1 One-part or two-part, neutral-cure elastomeric silicone sealant.
 - .2 Medium or high modulus, sealant ASTM C920-11 Type M or S, Grade NS, Class 12.5, ASTM C1184-05.
 - .3 SWRI Validation.
 - .4 Colour: as selected by *Consultant* from manufacturer's full colour range.
- .9 Silicone glazing (Weatherseal) sealant:
 - .1 Non-staining, low dirt pick-up, medium-modulus, neutral-curing silicone sealant; complying with ASTM C920-11, Type M or S, Grade NS, Class 50.
 - .2 SWRI Validation.
 - .3 Colour: As selected by Consultant from full range.

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'.
- .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.

Glass and Glazing

- .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.
 - .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.

Glass and Glazing

- .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.
- .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 doors and 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 Structural Silicone Glazing

- .1 Prepare substrates and apply silicone sealant in accordance with manufacturer's written requirements and reviewed shop drawings.
- .2 Structural silicone joint design shall be approved by sealant manufacturer.

Glass and Glazing

- .3 Inspect substrates to receive silicone sealant. Ensure:
 - .1 Metal framing surfaces to receive glazing are flat and smooth without slots, serrations, and other irregularities.
 - .2 Verify aluminum framing has corrosion inhibitor pre-treatment.
 - .3 Ensure surfaces are clean, dry, and free of frost, dust, dirt, grease, oil, mildew, and other contaminants that might affect adhesion.
- .4 Clean nonporous substrates with two-cloth solvent wipe in accordance with ASTM C1193-16.
 - .1 Pour cleaning solvent onto a clean cloth. Wipe vigorously to remove contaminants.
 - .2 Immediately wipe cleaned area with a separate cloth before solvent has evaporated.
- .5 Primer: Apply primer to substrates determined by adhesion test.
 - .1 Pour primer into small, clean container. Use within 10 minutes to avoid contamination.
 - .2 Dip cloth into primer and wipe a thin film onto substrate. Use brush for inaccessible areas. Do not over-apply.
 - .3 Allow primer to dry. Apply sealant the same day surfaces are primed.
 - .4 Do not apply primer to sealant joint backing.
- .6 Masking: Apply masking tape as required to protect adjacent surfaces, to ensure straight bead line, and facilitate cleaning.
- .7 Application:
 - .1 Spacers and setting blocks: Install as indicated on drawings and reviewed shop drawings. Ensure joint openings and recesses are accurately sized.
 - .2 Sealant backing: Install without gaps, twisting, stretching, or puncturing backing material. Use gauge to ensure uniform depth to achieve correct profile, coverage, and performance.
 - .3 Bond breaker: Install on backside of joint where backing is not feasible.
 - .4 Mixing: Mix two-component sealants in accordance with manufacturer's written requirements. Use clean, airless mixing equipment. Do not hand or mechanically mix in open container that is subject entraining air in sealant.
 - .5 Temporary glass support: Use temporary fasteners, clips, two-sided adhesive, and other means to retain glass panels while sealant is applied and allowed to cure.
 - .6 Sealant:
 - .1 Use sealant-dispensing equipment to push sealant bead into opening. Fill joint opening to full and proper configuration. Apply in continuous operation. Ensure sealant fills entire joint and firmly contacts all surfaces.
 - .2 Tooling: Before skinning or curing begins, tool sealant with metal spatula.
 - .3 Provide concave, smooth, uniform, sealant finish. Eliminate air pockets and ensure complete contact on both sides of joint opening.

Glass and Glazing

- .4 Tool joints with one continuous stroke.
- .5 Do not use water, soap, or alcohol to facilitate tooling.
- .7 Complete horizontal joints prior to vertical joints. Lap vertical sealant over horizontal joints.
- .8 Cleaning: Remove masking tape and excess sealant.
 - .1 Uncured sealant: Within 10 minutes of application, remove uncured sealant with solvent-dampened cloth, wearing solvent-resistant gloves.
 - .2 Completely cured sealant: Carefully cut or scrape away.
- .9 Allow sealant to fully cure before adhesive is stressed. Use test specimens formed at time of sealant application to verify curing time. When cured, remove temporary glass supports.
- .10 Ensure installed sealant is not painted as part of other construction operations.

3.6 Field Quality Control

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

3.7 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 77 00.

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, interior ceilings, and interior assemblies as indicated.
 - .2 Engineered metal supports for platform framing.

1.2 Submittals

- .1 Submit required submittals in accordance with Section 01 33 00.
- .2 Shop drawings; for shaftwalls:
 - .1 Submit written confirmation and design for shaftwall construction showing adequacy of system in meeting fire ratings and its ability to withstand pressures and deflections that may occur.
- .3 Shop drawings; for engineered interior metal support systems:
 - .1 Shop drawings shall be engineered.
 - .2 Submit design for metal support systems at interior locations where noted as engineered.
- .4 *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*.
- .5 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 *Provide* work of this section, executed by a *Subcontractor* with minimum 5 years experience in application of *Products*, systems and assemblies specified and with approval and training of *Product* manufacturers.
 - .2 Aspects of the work of this section are required to be prepared by a professional engineer. Refer to Section 01 33 00 for specific details and requirements in this regard.

Metal Supports for Gypsum Board

PART 2 - PRODUCTS

2.1 Performance/Design Requirements - Shaftwall System Description

- .1 Gypsum board shaft systems include special purpose assemblies of gypsum boards and metal components designed for erection entirely from room side of shaft (except for application of finish layer on shaft side, where required to form an enclosure).
- .2 *Provide* gypsum board shaft systems designed and tested by manufacturer to withstand lateral design loading (air pressure) of 48 kg/m² (10 lb/ft²), applied transiently and cyclically, for maximum heights of partitions required, within deflection limit of 1/240 of partition height and in stairways.

2.2 Performance/Design Requirements - Engineered Interior Metal Support Systems

- .1 Design system members to withstand own dead load, super-imposed dead loads, to maximum allowable deflection of L/240, without permanent deformation.

2.3 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.
 - .2 Heavy duty corrosion protection where schedule or indicated: Z275 (G90) 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.

2.4 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.
- .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:

Metal Supports for Gypsum Board

- .1 To concrete and masonry: Use stub nails or power-driven fasteners.
- .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.

2.5 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: ASTM A641/A641M-09A(2014), 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-18.
 - .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.
 - .3 Hilti 'Kwik-Bolt 3' and 'HHDCA 1/4 Ceiling Hangers'.
 - .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-09A(2014).
- .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.

Metal Supports for Gypsum Board

2.6 Platform Support Systems

- .1 Interior engineered metal stud framing: to ASTM C645-18; as indicated; roll formed from 0.836 mm (0.0329") minimum thickness unless otherwise required, galvanized steel sheet. Provide service holes starting at 450 mm (18") from bottom, then 914 mm (36") on centre to top of studs.

2.7 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, corrosion resistant finish for exterior building envelope applications, load rating and spacing to support materials carried by assembly with factor of safety of 3x per fastener manufacturer data sheets.

2.8 Shaftwall

- .1 Shaftwall studs and accessories: 0.455 mm (0.0179"), 0.836 mm (0.0329") where plywood attachment is required, rolled galvanized steel sheet fabricated specially for gypsum coreboard and facing boards.
- .2 Provide manufacturer's standard shapes for shaftwall construction; of profile, size and base metal thickness designed to comply with AISI "Specification for Design of Cold Formed Steel Structural Members" for structural performance characteristics indicated. Fabricate from steel sheet complying with ASTM A653/A653M-11, Grade A or B, for structural performance of base metal, as well as with ASTM A653/A653M-11, G60, for hot dip galvanized products, and ASTM A463/A463M-15 for aluminized *Products*.

2.9 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 Dimensional wood blocking in accordance with Section 06 10 53 Rough Carpentry.
 - .4 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 Install work of this section in accordance with the 2012 Wall and Ceiling Specifications Standard Manual.
- .2 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.
- .3 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.
- .4 Give complete cooperation and direction to trades erecting framing and furring over which this work is applied. Coordinate finished joint location with framing.
- .5 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.
- .6 Provide clearances between work of this section and structural elements to prevent transference of structural loads.
- .7 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.
- .8 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.

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.
 - .1 Field tests and inspections:
 - .1 Independent inspection and testing company will perform random load tests for ceiling anchor installation.
 - .2 Allow for testing of 1 in 20 anchors.

END OF SECTION

Gypsum Board

PART 1 - GENERAL

1.1 Summary

- .1 Section includes:
 - .1 Plain gypsum board.
 - .2 Impact resistant gypsum board.
 - .3 Glass scrim gypsum shaftwall liner panels.
 - .4 Concrete subfloor at platforms.
 - .5 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* executing the work of this section shall have a minimum of 10 years continuous experience in successful installation of work of type and quality indicated and specified.

1.4 Delivery, Storage, and Handling

- .1 Store materials in protected dry areas. Store gypsum board flat in piles with edges protected.
- .2 Ensure that finish metal members are not bent, dented, or otherwise deformed.
- .3 Deliver *Products* supplied under the work of this section only to those who are responsible for installation, to the place they direct, and to meet installation schedules.
- .4 Package fire rated materials with labels attached.

1.5 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.

Gypsum Board

- .2 When ambient outdoor temperatures are below 12°C maintain continuous, uniform comfortable building working temperatures of not less than 12°C for a minimum period of 48 hours before, during and following application of gypsum board and joint treatment materials or bonding of adhesives.
- .3 Ventilate building spaces as required to remove water in excess of that required for drying of joint treatment material immediately after its application. Avoid drafts during dry, hot weather to prevent too rapid drying.
- .4 Protection:
 - .1 *Provide* adequate protection of materials and work of this section from damage by weather and other causes. Protect work of other trades from damage resulting from work of this section. Make good such damage at no additional cost to the *Owner*.
 - .2 Exterior sheathing board's exposure to weather: Comply with manufacturer's written requirements. Provide protection prior to exposure for periods greater than manufacturer's recommendations and warranty.

PART 2 - PRODUCTS

2.1 Performance/Design Requirements

- .1 Fire resistance rating:
 - .1 Where gypsum board systems with fire resistance ratings are indicated or required, provide materials and installations that are identical with those of applicable assemblies tested by fire testing laboratories acceptable to authorities having jurisdiction.

2.2 General

- .1 Single source responsibility: Obtain gypsum board products from a single manufacturer, or from manufacturers recommended by the prime manufacturer of gypsum boards.
- .2 Panel boards: 16 mm (5/8") minimum thickness and greater thickness as indicated, 1220 mm (48") wide x maximum practical length, ends square cut, tapered edges where available.

2.3 Gypsum Board Panels

- .1 Plain gypsum board:
 - .1 Paper faced gypsum core panel solid set core enclosed in paper, to ASTM C1396/C1396M-14.
 - .2 *Acceptable Products:*
 - .1 CertainTeed 'Regular Gypsum Board'.
 - .2 CGC 'Sheetrock Brand Gypsum Panel'.
 - .3 Georgia-Pacific 'ToughRock Gypsum Board'.
 - .4 Continental Building Products 'Regular Drywall'.
 - .5 National Gypsum 'Gold Bond Gypsum Board'.

Gypsum Board

- .2 Fire-rated gypsum board:
 - .1 Paper faced gypsum core panel with a specially formulated core for use in fire-resistive Type X or Type C designs, to ASTM C1396/C1396M-11.
 - .2 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 Continental Building Products 'Type C and Type X.
 - .5 National Gypsum 'Gold Bond Brand Fire-Shield Gypsum Board and Gold Bond Fire Shield C Gypsum Board'.
 - .6 PABCO Gypsum 'QuietRock ES'.
- .3 Impact resistant, paper-faced:
 - .1 Mould and moisture resistant, meets ASTM D3273-16, with a panel score of 10.
 - .2 Paper faced gypsum core impact resistant, mould and moisture resistant, to ASTM C1396/C1396M-11 and to ASTM C1629/C1629M-18, fire rated where indicated.
 - .3 Abuse resistance performance:
 - .1 Surface abrasion surface damage: Level 3 to ASTM D4977/D4977M-03(2013)e1.
 - .2 Surface indentation surface damage: Level 1 to ASTM D5420-16.
 - .3 Soft-body impact penetration: Level 3 to ASTM E695-03(2015)e1.
 - .4 Hard Body Impact resistance: Level 3 to ASTM C1629/C1629M-18, App.1.
 - .4 Acceptable *Products*:
 - .1 CGC 'Sheetrock Brand Panels Mold Tough VHI Firecode X'.
 - .2 CertainTeed 'AirRenew Extreme Impact Resistant' Gypsum Board.
 - .3 CertainTeed 'Extreme Impact' Gypsum Board.
 - .4 Continental Building Products 'Protecta HIR 300 Type X with Mold Defense'.
 - .5 Gold Bond 'Hi-Impact XP' Gypsum Board.
- .4 Glass scrim gypsum shaftwall liner panels; mould resistant:
 - .1 Glass scrim faced gypsum core, 25 mm (1") thick, mould resistant glass scrim gypsum board, fire rated where indicated.
 - .2 Acceptable *Products*:
 - .1 CertainTeed 'GlasRoc Shaft Liner'.
 - .2 CGC 'SHEETROCK Glass-Mat Liner Panels'.
 - .3 Continental Building Products 'Weather Defense Shaftliner Type X'.
 - .4 Georgia-Pacific 'Dens-Glass Shaftliner'.

Gypsum Board

2.4 Concrete Subfloor Panels

- .1 Durable, dimensionally stable, non-combustible concrete subfloor panels:
 - .1 Acceptable *Products*:
 - .1 CGC 'Structural Panel Concrete Subfloor'.
 - .2 Panel Dimensions:
 - .1 Thickness: 19 mm (3/4")
 - .2 Width: 1220 mm (4')
 - .3 Lengths: 2440 mm (8').
 - .4 Long Edges: Tongue and Groove
 - .3 Fasteners: as recommended by subfloor manufacturer.

2.5 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 to ASTM C1002-07/ASTM C954-11. 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.

2.6 Accessories

- .1 Accessories: to ASTM C1047-14a 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 Casing trim; "L" or "LC" beads: Fillable edge trim, 0.55 mm (0.022") base thickness commercial grade sheet steel with zinc wiped coating to ASTM A653/A653M-13; perforated flanges.
 - .1 Acceptable *Product*:
 - .1 Bailey 'D200' and '4411'.
 - .2 Substitutions: in accordance with Section 01 25 00.
- .3 Corner bead: Fillable edge trim, 0.55 mm (0.022") base thickness commercial grade sheet steel with zinc wiped coating to ASTM A653/A653M-13; perforated flanges.
 - .1 Acceptable *Product*:
 - .1 Bailey 'D100'.
 - .2 Substitutions: in accordance with Section 01 25 00.
- .4 Reveal trim at junctions to exposed masonry and concrete:
 - .1 Gordon Series 300, 312-5/8, or matching style by Fry Reglet.
- .5 Reveal trim; at acoustic tile to gypsum board transitions:

Gypsum Board

- .1 Fry Reglet 'Drywall/Acoustical Reveal DRMAD-50-50, or matching style by Gordon Interior Specialties.
- .6 Z reveal types:
 - .1 Fry Reglet DRMZ-625-100, or matching style by Gordon Interior Specialties.
 - .2 Fry Reglet DRMZ-625-50, or matching style by Gordon Interior Specialties.
 - .3 Fry Reglet DRMZ-25-25, or matching style by Gordon Interior Specialties.
- .7 Control joints:
 - .1 No. 093 Zinc Control Joint by CGC Inc. or approved alternate, certified by manufacturer for use at fire resistance rated assemblies.
 - .2 Fry Reglet DRM-50-25 2-PC, or matching style by Gordon Interior Specialties.
 - .3 093V Expansion Bead by Trim-Tex Drywall Products Inc.

2.7 Related Support Assemblies and Backer Plates

- .1 Dimensional wood blocking at interior assemblies: in accordance with Section 06 10 53.
- .2 Metal support systems and backer plates at interior assemblies: in accordance with Section 09 22 00.

2.8 Joint Treatment Materials

- .1 General: Comply with ASTM C475/C475M-17.
- .2 Joint tape:
 - .1 Interior paper faced gypsum boards: Paper.
- .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.
 - .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.

2.9 Acoustic Wall Assembly Materials

- .1 Smoke and acoustic sealant; concealed and exposed locations, non-fire-rated acoustic assemblies:
 - .1 Acrylic smoke and acoustic sealant, to ASTM C834-10 maximum VOC content 60 g/L, paintable, Flame Spread Value of maximum 25 to CAN/ULC S102.
 - .2 Sealant shall not deteriorate (stain or bleed into) painted surfaces.
 - .3 Acceptable *Products*:
 - .1 Hilti Canada Corp 'CP 506'.
 - .2 Substitutions: in accordance with Section 01 25 00.

Gypsum Board

- .2 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.
- .3 Acoustic compound: premixed perlite plaster.
- .4 Acoustic (sound attenuation) insulation:
 - .1 Mineral-fibre sound attenuation batts: to CAN/ULC S702-09, 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 'SAFB'.
 - .3 Rockwool 'AFB'.
 - .2 Mineral-fibre sound attenuation batts: to CAN/ULC S702-09, Type 1, and non-combustible to CAN/ULC-S114-05.
 - .1 Acceptable *Products*:
 - .1 CertainTeed 'Sustainable Insulation NoiseReducer'.
 - .2 Johns Manville 'MinWool Sound Attenuation Fire Batts'.
 - .3 Johns Manville 'Sound-SHIELD'.
 - .4 Rockwool 'AFB'.
 - .5 Owens-Corning 'SAFB'.
 - .6 Owens-Corning 'QuietZone'.
 - .3 Mineral-fibre formaldehyde-free sound attenuation batts: to CAN/ULC S702-09, Type 1, non-combustible to CAN/ULC-S114-05, formaldehyde-free.
 - .1 Acceptable *Products*:
 - .1 Johns Manville 'Sound-SHIELD'.
 - .2 Rockwool 'AFB evo'.
 - .3 CertainTeed 'Sustainable Insulation NoiseReducer'.
 - .4 Owens-Corning 'QuietZone'.
 - .4 Fasteners: use mechanical fasteners where required to secure insulation into position in accordance with insulation manufacturer.

PART 3 - EXECUTION

3.1 Installation

- .1 General: Comply with ASTM C840-13, GA 216-13, GA 600-12, and manufacturer's requirements, except as otherwise indicated. Do not bridge building expansion joints with support system. Frame both sides of joints with furring and other supports as indicated.

Gypsum Board

- .1 Install work of this section in accordance with the 2012 Wall and Ceiling Specifications Standard Manual.
- .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.
- .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:

Gypsum Board

- .1 Alignment with board panels shall not exceed tolerances specified above.
- .2 End joints shall be flush aligned to maximum offset of 0.5 mm (0.020").

3.3 Board Application - General

- .1 Before application of gypsum board commences, ensure that internal services have been installed, tested, and approved; that 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, center of joints. 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.
 - .3 At typical board ceilings at 305 mm (12") on centre at edges and field unless otherwise required.
- .8 Offset gypsum board joints 150 mm (6") minimum from corners of openings.
- .9 Gypsum panel product joints shall be located so that no joint will align with the edge of an opening unless control joints are to be installed at these locations.
- .10 Section 09 31 00 to install tile setting material over tape installed by this section. Tape joints and angles.
- .11 Maximum fastener spacing
 - .1 Walls: fasten at 150 mm (6") on centre.
 - .2 Ceiling: fasten at 150 mm (6") on centre.
 - .3 Perimeters: minimum 9.5 mm (3/8") and maximum 15.9 mm (5/8") from ends and edges.
- .12 Section 09 31 00 to install tile setting material over tape installed by this section. Tape joints and angles.

3.4 Acoustic Wall Assemblies

- .1 Acoustical sealant and plaster:
 - .1 Apply acoustical sealant to seal gaps in accordance with ASTM C919-12(2017) and in accordance with the STC rated assembly.

Gypsum Board

- .2 Apply single bead or double, one for each base and face layer of gypsum board as applicable to STC rated assembly, of acoustic sealant to seal both sides of partition assembly between gypsum board and adjacent floor, wall, and ceiling assembly of partitions which contain sound attenuation insulation, and where noted.
- .3 Apply bead of acoustic sealant to seal both sides of partition assembly at top and bottom of control joints.
- .4 Apply bead of acoustic sealant to seal intersections with sound-isolating partitions that are extended to reduce sound flanking paths.
- .5 Apply bead of acoustic sealant to seal joint between penetrations and gypsum board.
- .6 Completely seal objects at wall and gypsum board penetrations (such as electrical boxes, piping, and fasteners) with heavy coating of premixed perlite plaster.
- .7 Apply sealant to clean, dry surfaces.
- .8 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

3.5 Concrete Subfloor

- .1 Install subfloor in accordance with manufacturer's written requirements.
- .2 Use maximum board lengths to minimize number of joints.
- .3 Provide and install fasteners in accordance with manufacturer's written requirements.

3.6 Finishing

- .1 Provide levels of gypsum board finish for locations as follows, in accordance with GA-214.
 - .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 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 directions.
 - .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 Joint gaps not greater than 3.2 mm (1/8") shall be prefilled with either ready-mix or setting type joint compound; joint gaps greater than 3.2 mm (1/8") shall be prefilled with setting-type joint compound.
 - .2 Taping (Level 1):
 - .1 Butter taping compound into inside corners and joints.
 - .2 Center 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 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 Fastener heads and accessories shall be covered 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 Fastener heads and accessories shall be covered 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 Fastener heads and accessories shall be covered 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.
- .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.
 - .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.

Gypsum Board

- .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, blocking shall be provided 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.
- .11 Board joints shall be located 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.

Gypsum Board

3.8 Access Doors

- .1 Install access doors to mechanical and electrical fixtures specified in respective sections of Divisions 21, 22, and 23 and Divisions 26, 27, and 28.
- .2 Install access panels in locations to be determined by coordination with trades installing mechanical, electrical and other building services and consultation with *Consultant*.
- .3 Rigidly secure frames to furring or framing systems.

3.9 Adjusting and Cleaning

- .1 Remove debris and rubbish from wall and ceiling cavities before enclosing with board.
- .2 Clean up and remove surplus materials and rubbish resulting from the work of this section upon completion.
- .3 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.

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*.

1.4 Closeout Submittals

- .1 Submit closeout submittals in accordance with Section 01 77 00.

Acoustical Tile Ceiling Systems

.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 *Provide* work of this section, executed by competent installers with minimum 5 years experience in application of *Products*, systems and assemblies specified and with approval and training of *Product* manufacturers.
- .2 Aspects of the work of this section are required to be prepared by a professional engineer. Refer to Section 01 33 00 for specific details and requirements in this regard.

.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, and cut tegular tile demonstrating rectified edge. 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.

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-17 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.
- .3 Regulatory Requirements:
 - .1 Fire resistance rated system: Listed by accredited listing agency.

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 III, Form 2, Pattern CE in accordance with ASTM E1264-14.
 - .2 Size: 610mm x 1220mm (24" x 48")
 - .3 CAC: 0.40 minimum.
 - .4 NRC: 0.70 minimum.
 - .5 Material: wet-formed mineral fibre.
 - .6 Edge: square.
 - .7 Colour: White.
 - .8 Flame spread:
 - .1 Maximum values in accordance with CAN/ULC-S102-10:
 - .1 Flame Spread Value (FSV): 25.
 - .2 Smoke Developed Value (SDV): 50.
 - .9 Acceptable *Products*:
 - .1 CGC 'Radar Firecode High-NRC/High-CAC Acoustical Ceiling Panels, 22541'.
 - .2 Substitutions: in accordance with Section 01 25 00.

Acoustical Tile Ceiling Systems

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-18, conducted by a qualified independent testing laboratory.
 - .1 Dynabolt Sleeve Anchor 'TW-1614' or Readi-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 CertainTeed 'WA15-15'.
 - .3 CGC 'M7'.
 - .3 Stepped wall mouldings; hemmed with prefinished exposed flanges:
 - .1 For 24 mm (15/16") grid applications; shadow moulding with exposed bottom flange of 22 mm (7/8") and reveal of 19 mm (3/4").
 - .1 Armstrong '7871'.
 - .2 CertainTeed 'SM1020'.
 - .3 CGC 'MS154'.
- .5 Fire rated suspension system:
 - .1 Intermediate duty to ASTM C635/C635M-17, interlocking tee system designed to support acoustical panels in patterns indicated in fire rated ceiling assemblies, consisting of main tees and cross tees, 24 mm (15/16") exposed tee. The system shall provide lock joint intersections of cross and main tees.
 - .2 Acceptable *Products*:
 - .1 Armstrong 'Prelude Plus XL 15/16" Exposed Tee Systems'.

Acoustical Tile Ceiling Systems

- .2 CertainTeed '15/16" FireSecure Stab System'.
- .3 CGC 'DXL'.

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 Install suspension system rigid, secure, square, level and plumb, framed and erected to maintain dimensions and contours indicated, and in accordance with ASTM C636/C636M-13, Cisca installation standards and any other applicable national or local code requirements. Make allowance for thermal and structural movement.
- .2 Attach hangers to structure with inserts and hanger supports. Do not use powder activated fasteners.
- .3 Support hangers for suspended ceiling grid independent of walls, columns, pipes and ducts.
- .4 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.
- .5 Locate hangers at not more than 150 mm (6") from ends of main tee members.
- .6 Install exposed tee members to pattern indicated. Securely attach hangers to main tee members.
- .7 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.
- .8 Space tee bars to suit ceiling panels and as detailed, and to accommodate lighting fixtures, diffusers and return grilles.
- .9 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.
- .10 Restrict creep inside module panels so that in all cases strips are centred on module lines.
- .11 Install edge moulding as detailed where ceiling abuts vertical surfaces. Lap corners, use maximum lengths to minimize joints. Make joints square, tight and flush.

Acoustical Tile Ceiling Systems

- .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: to ASTM C636/C636M-13.
- .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

Resilient Base

PART 1 – GENERAL

1.1 Summary

- .1 Section includes:
 - .1 Resilient base.

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 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.
- .4 Test and evaluation reports:
 - .1 Submit adhesive bond test results.
- .5 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 77 00.
- .2 Operation and maintenance data:
 - .1 Submit manufacturer's operation and maintenance instructions for inclusion in the operation and maintenance manuals.
 - .2 Provide minimum 2% of each colour, pattern and type of resilient base required for this project.

1.5 Quality Assurance

- .1 Qualifications:
 - .1 Installers / applicators / erectors:

Resilient Base

- .1 *Provide* work of this section, executed by competent installers with minimum 5 years experience 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 Ensure 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.

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.

2.2 Resilient Base

- .1 Rubber base types:
 - .1 Manufactured from thermoplastic rubber formulation meeting ASTM F1861-16, Type TP, Group 1 (Solid).
 - .2 Acceptable manufacturers:
 - .1 Amtico.
 - .2 Burkemercer.
 - .3 Johnsonite.
 - .4 Roppe.
 - .5 Substitutions: in accordance with Section 01 25 00.
- .3 Basis of design:

Resilient Base

- .1 Rubber base: Johnsonite 'TightLock Resilient Wall Base, 111.1 mm (4-3/8") nominal overall height, in a 6.3 mm (1/4") tapered wedge thickness, complete with preformed outside corners.
- .2 Colour: Black; to match existing.

2.3 Accessories

- .1 Primers and adhesives: Types as recommended by resilient product manufacturer compatible with materials and to suit substrate types.

PART 3 - EXECUTION

3.1 Examination

- .1 Ensure 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 Sweep and vacuum clean substrates minimum 24 hours prior to alkalinity, moisture, and adhesion testing. Do not use sweeping compounds.
- .5 Notify *Consultant* of any substrate or levelling compound defects or installation conditions that may result in unsatisfactory performance.
- .6 Do not install products until they are same temperature as space where they are to be installed.
- .7 Sweep and vacuum clean substrates to be covered by floor coverings immediately before installation. Do not use sweeping compounds.

Resilient Base

- .8 Where flooring adjoins thicker floor materials, apply levelling screed, feather out to make up difference in level between materials.
- .9 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 Transition Trim

- .1 Coordinate transitions with work of other sections and install transition trim to transitions between different flooring types.
- .2 Locate thresholds directly beneath the door (in a closed position).
- .3 Set to ensure installation is free of gaps.
- .4 Install in longest lengths possible.
- .5 Scribe and fit to obstructions.
- .6 Fit joints tightly, straight and vertical as applicable. Transition trim joints shall be not less than 610 mm (24") from corners.
- .7 Mitre corners.

3.5 Installation - Resilient Subfloor Leveller System

- .1 Where flooring adjoins thicker floor materials use resilient subfloor leveller system to create uniform ramp support transition between flooring products installed at different levels.
 - .1 Trim, fit, and dry lay prior to adhesive application.

Resilient Base

- .2 Install in accordance with manufacturer's written requirements and in recommended order.
- .3 Apply adhesive to clean substrate with manufacturer's recommended V-notch trowel and allow to dry to the touch.
- .4 Install leveller strip within adhesive's allotted time and roll immediately with a 45 kg (100 lb) three-section roller.
- .5 Feather edge any irregularities between leveller strip section and substrate with patching compound specified.

3.6 Installation Tolerances

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

3.7 Field Quality Control

- .1 Conduct quality control in accordance with Section 01 45 00.
 - .1 Field tests and inspections:
 - .1 Adhesion bond test:
 - .1 Proceed with bond test after substrates have been prepared and alkalinity and moisture test have been completed.
 - .2 Adhesions tests shall be completed in accordance with product manufacture's written requirements.
 - .2 Manufacturer's field review to be in accordance with Section 01 45 00.

3.8 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 Tile Flooring

PART 1 – GENERAL

1.1 Summary

- .1 Section includes:
 - .1 Vinyl composition tile (VCT) flooring.
 - .2 Moisture control system:
 - .3 Patching and levelling compound:

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 Samples:
 - .1 Selection samples:
 - .1 Submit manufacturer's range of pattern and colours available for *Consultant's* selection.
 - .2 Samples for verification:
 - .1 Flooring: In manufacturer's standard size, but not less than 150 mm x 150 mm (6" x 6") of each different colour and pattern of floor covering required.
 - .2 Transition trim: Manufacturer's standard size samples, but not less than 100 mm (4") long, of each colour required.
- .4 Test and evaluation reports:
 - .1 Submit moisture, alkalinity, and adhesive bond test results.

1.4 Closeout Submittals

- .1 Submit closeout submittals in accordance with Section 01 77 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 2% of each colour, 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.

Vinyl Tile Flooring

- .4 Tag and store where directed by *Owner*.

1.5 Quality Assurance

.1 Qualifications:

.1 Installers / applicators / erectors:

- .1 *Provide* work of this section, executed by competent installers with minimum 5 years experience in application of *Products*, systems and assemblies specified and with approval and training of *Product* manufacturers.

.2 Mock-up:

- .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 Do not proceed with flooring specified in this section until mock-up has been accepted by *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.

1.7 Field Conditions

.1 Ambient conditions:

- .1 Install materials of this section only when surfaces and air temperatures have been maintained between 18°C and 32°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.
- .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.

PART 2 - PRODUCTS

2.1 Vinyl Tile Flooring

.1 Vinyl tile flooring:

- .1 Conforming to CSA A126.1. Vinyl composition tile, asbestos free, 305 mm x 305 mm x 3.2 mm.
- .2 Colours: Allow for 2 colours per room and 3 colours in corridors, to later selection by *Consultant* from manufacturer's full range.
- .3 Acceptable *Products*:
 - .1 Armstrong 'Standard Excelon Imperial Texture'.

Vinyl Tile Flooring

- .2 Tarkett 'Tarkett VCT'.
- .3 Substitutions: in accordance with Section 01 25 00.
- .4 Base:
 - .1 Acceptable *Products*:
 - .1 Tarkett 'Tightlock'.
 - .2 Colour: to later selection by Consultant from manufacturer's full range.
- .5 Metal Edge Trim:
 - .1 Aluminum or brass alloy with lip of edge strip extending under and with shoulder finishing flush with top of resilient floor

2.2 Accessories and Accessory Materials

- .1 Primers and adhesives: Type as recommended by flooring manufacturer compatible with materials and to suit substrate.
- .2 Moisture control system:
 - .1 Performance and Physical Properties: Meet or exceed the following values for material cured at 70° F+/-3°F (21° C+/-3°C) and 50% +/-5% relative humidity:
 - .1 Application: Manual.
 - .2 Material Requirements on CSP 3 Prepared Concrete: Approx. 170 – 190 sq. ft. (16 – 18 m2) per unit for 14 mils.
 - .3 Permeability (ASTM E96): 0.06 perms.
 - .4 14 pH solution (ASTM D1308): No effect.
 - .5 Working Time: 20 minutes.
 - .6 Pot Life: 20 minutes.
 - .7 VOC: 19.9 g/L, A+B, ASTM D2369 Walkable: Minimum of 4 hours.
 - .8 Prime and Install Underlayment: Minimum 4 hours, maximum 24 hours.
 - .2 Acceptable *Products*:
 - .1 Ardex 'MC Rapid'.
 - .2 Substitutions: in accordance with Section 01 25 00.
- .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 or ASTM C472.
 - .3 Gypsum based compounds are not acceptable.
 - .4 Acceptable manufacturers:
 - .1 Mapei.
 - .2 Ardex.
 - .3 Substitutions: in accordance with Section 01 25 00.

Vinyl Tile Flooring

- .5 Acceptable product: type as recommended by flooring manufacturer for existing substrate conditions.
- .4 Cleaning solution:
 - .1 Acceptable *Products*: type as recommended by flooring manufacturer for existing substrate conditions.
- .5 Transition strips:
 - .1 Resilient transition trims: in accordance with Section 09 65 13.
- .6 Temporary protection material: Install suitable protection sheeting, lap joints of material by 150 mm (6") and seal with non-asphaltic tape.

PART 3 - EXECUTION

3.1 Examination

- .1 Ensure that field conditions have been provided as requested and specified.
- .2 Ensure 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 F710-19e1.
- .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.

Vinyl Tile Flooring

- .5 Moisture reduction barrier:
 - .1 Apply moisture reduction barrier at following locations:
 - .1 To below-grade and on-grades slabs where slab moisture content is above recommended RH level by floor covering manufacturer after performing pre installation testing
 - .2 To suspended slabs, regardless of pre-installation moisture testing results
 - .3 Concrete Substrate: Prepare concrete to manufacturer's instructions.
 - .4 Apply moisture emissions barrier system in accordance with manufacturer's recommendations.
 - .5 Do not proceed with work until unsatisfactory conditions have been resolved.
 - .6 Fill surface cracks, holes, score marks, depressions, and grooves, and repair surface spalls with Portland cement patching or levelling compound.
 - .7 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.
 - .8 Expansion joints, isolation joints, and other movement joints in substrates shall not be filled with patching or levelling compound.
 - .9 Remove bumps, high spots, peaks and ridges to produce a uniform and smooth substrate.
 - .10 Prepare substrates so that installation of flooring shall not show telegraphing of substrate.
 - .11 Remove chalking and dusting and loose material from concrete surfaces with wire brushed or by scraping.
 - .12 Sweep and vacuum clean substrates minimum 24 hours prior to alkalinity, moisture, and adhesion testing. Do not use sweeping compounds.
 - .13 Notify *Consultant* of any substrate or levelling compound defects or installation conditions that may result in unsatisfactory performance.
 - .14 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.
 - .15 Alkalinity, moisture, and adhesion bond testing:
 - .1 Test substrates in accordance with paragraph 3.5 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*.

Vinyl Tile Flooring

- .16 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.
- .17 Sweep and vacuum clean substrates to be covered by floor coverings immediately before installation. Do not use sweeping compounds.
- .18 Where flooring adjoins thicker floor materials, apply levelling screed, feather out to make up difference in level between materials.
- .19 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 Before commencing installation, verify product type, size, thickness, and colour. Do not install flooring with visual imperfections, colour variations or apparent defects.
- .2 Mark a chalk line through centre of room to ensure that tile installation is square to walls.
- .3 Mix vinyl tiles from a minimum of 3 boxes.
- .4 Adjust chalk line to eliminate small vinyl tiles so that no small vinyl tiles are laid at perimeter of room and at thresholds to adjacent flooring. Minimum plank strip cut length shall be 150 mm (6") and minimum plank strip cut width shall be 75 mm (3").
- .5 Prime floor where recommended by adhesive manufacturer. Allow to dry.
- .6 Apply adhesive uniformly using recommended trowel and with recommended rate in accordance with the adhesive manufacturer's requirements.
- .7 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.
- .8 Roll the flooring in both directions using 68 kg (150 lb) three-section roller.
- .9 Cut plank and fit neatly around fixed objects.
- .10 Flooring installation shall not show telegraphing of substrate. Flooring installation shall be homogenous free of substrate lines, pockets, bumps and unevenness.

3.4 Installation - Transition Strips

- .1 Coordinate transitions with work of other sections and install transition trim to transitions between different flooring types.
- .2 Locate thresholds directly beneath the door (in a closed position).
- .3 Set to ensure installation is free of gaps.
- .4 Install in longest lengths possible.
- .5 Scribe and fit to obstructions.

Vinyl Tile Flooring

- .6 Fit joints tightly, straight and vertical as applicable. Transition trim joints shall be not less than 610 mm (24") from corners.
- .7 Mitre corners.

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 Test for moisture vapour transmission in accordance with ASTM F710-19e1 and ASTM F1869-16a or ASTM F2170-19a in accordance with manufacturer's written flooring installation requirements. Results must not exceed 170 $\mu\text{g}/\text{m}^2$ (3 pounds per 1,000 square feet) in 24 hours when tested to ASTM F1869-16a, 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 F710-19e1.
 - .3 For each test type: Conduct 3 tests for flooring applications up to 93 m^2 (1000 square feet) in area, and 1 additional test for each additional 93 m^2 (1000 square feet) of flooring area.
 - .2 Manufacturer's field review to be in accordance with Section 01 45 00.

3.6 Adjusting and Cleaning

- .1 Remove excess adhesive from surfaces of the flooring as work progresses.
- .2 Thoroughly clean surfaces in accordance with vinyl tile manufacturer's written requirements.
- .3 Only use materials and products recommended by flooring manufacturer to remove excess adhesive.

3.7 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. Install masonite sheets and seal with tape as recommended by flooring manufacturer.
- .3 Install floor protection in areas where other work, repairs and installation of equipment, and foot traffic will occur.

END OF SECTION

Terrazzo Repair and Patching

PART 1 - GENERAL

1.1 Summary

- .1 Section includes:
 - .1 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 Samples:
 - .1 Submit 200 mm x 300 mm (8" x 12") samples, on rigid backing, of each material and system proposed for use in the work of this section, demonstrating colour/recipe and showing successive applications of each coat, for verification by *Consultant* of match with existing.
- .4 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.
- .5 Qualification data: Shall submit 2 copies of qualification data for installation *Subcontractor*.
 - .1 Include list of projects indicating name and location of project, name of *Owner*, name and contact information for general contractor, and name and contact information for *Consultant*.
 - .2 Include letter from TTMAC with the name of the *Project* and name of member installer, stating current member status

1.4 Closeout Submittals

- .1 Submit closeout submittals in accordance with Section 01 77 00.
- .2 Operation and maintenance data:
 - .1 Submit manufacturer's operation and maintenance instructions for inclusion in the operation and maintenance manuals.

Terrazzo Repair and Patching

1.5 Quality Assurance

.1 Qualifications:

.1 Manufacturers:

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

.2 Manufacturer shall be a member in good standing with the Terrazzo, Tile and Marble Association of Canada, providing materials meeting the minimum standards of TTMAC. 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 Execute work of this section only under full time supervision of qualified *Subcontractor's* site supervisor.

1.6 Delivery, Storage, and Handling

.1 Deliver materials to job site in sealed undamaged containers clearly labelled with name and batch number.

.2 Store materials at site in an area specifically set aside for purpose that is locked, ventilated, and maintained at temperatures recommended in manufacturer's literature.

.3 Comply with health and fire regulations in storage area, and during handling and application.

1.7 Field Conditions

.1 Maintain ambient temperature of not less than 13°C 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 Ensure substrate is sound, dry, free of dust, dirt, paint, grease, oil or other foreign substances that may adversely affect proper adhesion of the coating.

.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.

PART 2 - PRODUCTS

2.1 Performance/Design Requirements

.1 Terrazzo, Tile and Marble Association of Canada (TTMAC) - TTMAC 2016-2017 Specification Guide 09 30 00, Tile Installation Manual.

.2 Terrazzo standards: Terrazzo Contractor shall furnish materials and install terrazzo according to TTMAC's "TTMAC 2016-2017 Specification Guide 09 30 00, Tile Installation Manual" and with written recommendations for terrazzo type indicated unless more stringent requirements are specified.

Terrazzo Repair and Patching

2.2 Materials

- .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 Materials shall be sourced from one manufacturer unless otherwise specified.
- .3 All components and *Products* of the matrix terrazzo shall be manufactured and supplied by a single manufacturer.
- .4 Cement: to CSA A3001-13, Type 10.
- .5 Sand: Clean, washed, and locally available, CSA-A23.1-14.
- .6 Water: potable.
- .7 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.
- .8 Terrazzo cleaner:
 - .1 Ph factor between 7 and 10, where applicable.
 - .2 Biodegradable and phosphate free.
- .9 Sealer:
 - .1 Ph factor between 7 and 10, where applicable.
 - .2 Shall not discolour or amber.
 - .3 Flash point; ASTM D56, 80F minimum, where applicable.
 - .4 Finish: Slip Resistant.
- .10 Cleaners, sealers and floor finish: to TTMAC standard 1001, 1002, 1003, 1004, 2001, 2002, and 3001 as applicable, or as recommended by terrazzo flooring manufacturer.
- .11 Divider strips: White alloy zinc, 'L' shaped, depth to match flooring system thickness, to locations as indicated.
- .12 Termination and transition strips: Termination strips: White alloy zinc, 'L' shaped, depth to match flooring system thickness, to locations as indicated.
 - .1 Transition strips: Schluter 'Schiene-AE'.
- .13 Control joints: Control joints: Back to back white alloy zinc strips with black neoprene filler.
- .14 Anti-fracture membrane:
 - .1 100% solids polyurethane, 500 microns (20 mils) DFT, as recommended by epoxy resin manufacturer.
 - .2 Joint filler as recommended by floor system manufacturer.

2.3 Mixes

- .1 Terrazzo mix:

Terrazzo Repair and Patching

- .1 To match existing.
- .2 Proportions:
 - .1 Underbed: 1 part Portland cement to 4 parts sand by volume and sufficient water to provide workability at as low a slump as possible. Use no more than 18 litres (4.8 gal) of water per bag of cement for underbed mix.
 - .2 Scratch coat: 1 part Portland cement to 3 to 4 parts sand and sufficient water to provide workability at as low a slump as possible.
 - .3 Terrazzo topping: as per manufacturer's installation requirements, colour pigment if scheduled, and sufficient potable water to produce a workable mix.
- .3 Mixing:
 - .1 Underbed:
 - .1 Charge and mix sand and Portland cement.
 - .2 Add water and mix.
 - .2 Terrazzo topping:
 - .1 Charge and mix marble chips and colour pigment if scheduled.
 - .2 Add water and mix to a uniform workable consistency.

PART 3 - EXECUTION

3.1 Examination

- .1 Verify that specified environmental conditions are ensured before commencing work of this section.
- .2 Examine surfaces to receive floor coatings. They shall be smooth, sound, dry, and free from conditions that will adversely affect execution, permanence, or quality of work. Test surfaces for moisture content to ensure that they are suitable for application, and fully cured. Moisture content of the concrete shall be checked using a Delmhorst moisture meter. Moisture content shall be within the limits set by the flooring manufacturer prior to commencing work of this section.
- .3 Surfaces to receive coating shall be equivalent to a light steel trowel finish for new or patched concrete surface.
- .4 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.
- .5 Examine concrete slab surfaces for slope to drain irregularities which could create non-sloping or ponding conditions on the flooring system surface.
- .6 Defective work resulting from application to unsatisfactory surfaces will be considered the responsibility of those performing the work of this section.
- .7 Ensure that floor drains are installed flush with top of floor slabs.

Terrazzo Repair and Patching

3.2 Preparation

- .1 Removal of Existing
 - .1 Strip existing flooring in areas requiring patching or repair to nearest existing divider strip, unless directed otherwise by *Consultant*.
- .2 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.
- .3 Fill open control joints, and other cracks and voids with sealant material compatible with floor coating materials.
- .4 Clean surfaces by steel shotblast, sandblast, or other method approved by manufacturer. Thoroughly vacuum clean floors upon completion of blast operation. Prime and seal surfaces as recommended by floor coating manufacturer. 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.
- .5 Cover or mask surfaces adjacent to those receiving floor coating to protect work of others and property from damage and soil.

3.3 Floor Levelling

- .1 Install in accordance with manufacturer's and TTMAC 2016-2017 Specification Guide 09 30 00, Tile Installation Manual recommendations and guidelines.
- .2 Underbed: Apply over prepared substrate and screed level making allowances for applicable terrazzo topping. Permit underbed to cure minimum 24 hours prior to receiving terrazzo topping.

3.4 Anti-Fracture Membrane

- .1 Install in accordance with flooring manufacturer's and TTMAC 2016-2017 Specification Guide 09 30 00, Tile Installation Manual recommendations and guidelines.
- .2 Concrete joints and cracks shall be routed, cleaned and filled with joint filler. Provide 150 mm (6") wide membrane, centred on joints, applied in accordance with manufacturer's written requirements.

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.

Terrazzo Repair and Patching

- .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.
- .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, uninterrupted except at divider strips, or other types of joints, indicated or required.
- .5 Apply sealer in accordance with manufacturer's written requirements. Wipe off excess water before it dries.
- .6 Apply second coat of sealer in same manner as first, but not until Work is complete and terrazzo has been cleaned again as previously specified above. Apply two coats of surface finish.
- .7 Base detail as indicated.
- .8 *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.
- .9 Match approved samples in sheen, colour and texture.
- .10 Finish overall terrazzo and strip surface shall be smooth, flush, and imperfections shall be indiscernible when viewed from distance of 762 mm (30").
- .11 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.

3.7 Adjusting and Cleaning

- .1 Existing Terrazzo Clean-up
 - .1 Strip existing finish to approval of *Consultant* using equipment and method as recommended by manufacturer.
 - .2 Cleaning and Sealing:
 - .1 Wash surfaces with a neutral cleaner, rinse with clean water and allow to dry. Apply 2 coats of sealer in accordance with flooring manufacturer's directions.
- .2 Touch up and refinish minor defective work of this section. Refinish entire coated surface areas where finish is damaged or otherwise unacceptable.

Terrazzo Repair and Patching

- .3 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.
- .4 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.
- .5 Final cleaning is specified in Section 01 77 00.

END OF SECTION

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 Stainless steel, weathering steel, copper, bronze, chromium plate, nickel, anodized or lacquered or mill finished aluminum, Monel metal.
 - .5 Insulation, glass, plastic, brick, stone.
 - .6 Metallic and mastic insulation finishes.
 - .7 Abrasive material finishes on floors, stair treads, stair nosing and landings.
 - .8 Insulated electric cables.
 - .9 Machined parts of machinery and equipment.
 - .10 Concealed surfaces.
 - .11 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:
 - .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*.

Painting

- .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 Submit 1 copy of MPI Manual – latest edition, and maintain at site office for reference.

1.4 Closeout Submittals

- .1 Submit closeout submittals in accordance with Section 01 77 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 of 5 years proven satisfactory painting experience of projects of similar size and class subject to *Consultant's* approval.
 - .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:

Painting

- .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 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:
 - .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.

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:

Painting

- .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.

2.2 Materials

- .1 *Product* 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.
- .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.
- .6 Paints and coatings materials used within the weatherproofing system shall not exceed the VOC content limits of the following criteria.
 - .1 Interior paints and coatings: to following Green Seal GS-11 VOC limits:
 - .1 Flat coating type: 50 gm/L.
 - .2 Non-flat coating type: 150 gm/L.
 - .2 Anti-corrosive and anti-rust paints applied to interior ferrous metal substrates: Green Seal Standard GC-03, Anti-Corrosive Paints, maximum 250 gm/L.
 - .3 Clear wood finishes, floor coatings, stains, and shellacs applied to interior elements: South Coast Air Quality Management District (SCAQMD) Rule 1113, Architectural Coatings.

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.

Painting

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 Colour and gloss schedule: as indicated on drawings.
- .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.
- .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.

Painting

- .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 Concrete substrates: Remove release agents, curing compounds, efflorescence, and chalk.
- .6 Masonry substrates: Remove efflorescence and chalk.
- .7 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.
- .8 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.
- .9 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.
- .10 Aluminum substrates: Remove loose surface oxidation.
- .11 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.
- .12 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.
 - .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.

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.

Painting

- .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.
- .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 Fire hose cabinets.
 - .10 Fire extinguisher cabinets.
 - .11 Louvres.
 - .12 Radiators.
 - .13 Stacks.
 - .14 Vents.

Painting

- .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.
- .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.

Painting

- .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").
 - .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, Low VOC (Green Seal GS-11), High Performance Architectural, unless otherwise indicated:
 - .1 Concrete vertical surfaces: (including ceilings)
 - .1 INT 3.1C High performance architectural latex.
 - .2 Primed ferrous metal; touch-up and finish coats required under this section:
 - .1 Ferrous metal fabrications: Prepared and primed in accordance with Section 05 50 00.
 - .2 INT 5.1R High performance architectural latex.
 - .3 Galvanized metal: (doors, frames, railings, misc. steel, pipes, overhead decking, ducts, etc.)
 - .1 INT 5.3M High performance architectural latex.

Painting

- .4 Dressed lumber: (including doors, door and window frames, casings, mouldings, etc.)
 - .1 INT 6.3A High performance architectural latex.
- .5 Plaster and gypsum board: (gypsum wallboard, drywall and textured finishes)
 - .1 INT 9.2B High performance architectural latex finish:

END OF SECTION

Visual Display Surfaces

PART 1 - GENERAL

1.1 Summary

- .1 Section includes:
 - .1 Whiteboards.
 - .2 Interactive whiteboards (smart boards).
 - .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 77 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.

Visual Display Surfaces

1.6 Extended Warranty

- .1 Provide manufacturer's standard product warranty in accordance with Section 01 78 36.

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 Interactive Whiteboards (Smart boards)

- .1 Interactive dry erase application screen surface to consist of a proprietary surface permanently bonded to a magnetic substrate that allows use of dry erase markers, interactive stylus and touch interactivity. Projection surface to have a gain of 2.5 and a viewing half angle of 25 degrees. Frame shall be 25 mm thick with a 9.5 mm bezel in aluminum with a silver finish. Bezel thickness at the screen surface is 1.5 mm.
- .2 Include top mounting bracket, lower mounting brackets, 24" long marker tray, set of three dry erase markers, foam eraser, cleaning cloth, and cleaning solution.
- .3 Viewing area: 135 cm x 215 cm.
- .4 Basis of design:
 - .1 Da-Lite 'IDEA Screen'.

2.3 Whiteboards

- .1 Acceptable manufacturers:
 - .1 ASI Visual Display Products.
 - .2 Claridge – CPE Design Solutions.
 - .3 Delta Products Ltd.
 - .4 Global School Products Inc.
- .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.
 - .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: 11 mm (7/16") MDF.
 - .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:

Visual Display Surfaces

- .1 Aluminum trim in accordance with Trim Components paragraph below.

2.4 Trim Components

- .1 Acceptable Manufacturers:
 - .1 ASI Visual Display Products.
 - .2 Claridge – CPE Design Solutions.
- .2 Aluminum trim:
 - .1 Basis of design: ASI '200 Series' trim or similar equivalent.
- .3 Accessories:
 - .1 Perimeter: No. 205..
 - .2 Divider Bar: No. 207.
 - .3 Maprail: No. 206.
 - .4 Tray: No. 212.
- .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

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

3.2 Installation - Trim Components

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

3.3 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.

3.4 Adjusting and Cleaning

- .1 Verify under work of this section that installed *Products* function properly, and adjust them accordingly to ensure satisfactory operation.

Visual Display Surfaces

- .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

Signage

PART 1 - GENERAL

1.1 Summary

- .1 Section includes:
 - .1 Signage.

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.
 - .2 Submit manufacturers' installation instructions.
- .3 Samples:
 - .1 Submit 3 - 305 x 305 mm (12" x 12") samples for each sign type, each fastener type and finish specified.
- .4 Templates:
 - .1 Submit templates to *Contractor* for use by installers and fabricators as required for proper location and installation of signage.

1.3 Closeout Submittals

- .1 Submit closeout submittals in accordance with Section 01 77 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 *Provide* work of this section, executed by competent fabricators and installers with minimum 5 years experience in application of *Products*, systems and assemblies specified and with approval and training of *Product* manufacturers.
- .2 Mock-ups:
 - .1 Provide when requested, at the *Consultant's* discretion, mock-ups of items as requested by *Consultant*.
 - .2 Reviewed mock-ups become the standard for the work of this section.

Signage

1.5 Delivery, Storage, and Handling

- .1 Package or crate, and brace and wrap *Products* to prevent damage during shipment and handling. Label packages and crates according to signage numbers as listed in the signage schedule, and protect finish surfaces from environmental conditions where required.
- .2 Deliver *Products* to location at building site designated by *Contractor*.
- .3 *Provide* methods for lifting or hoisting units into place without causing damage.

PART 2 - PRODUCTS

2.1 Interior Signage

- .1 Interior signage:
 - .1 Material: minimum 6 mm thick acrylic with minimum 0.8 mm thick applied vinyl letters and Braille beads.
 - .2 Text: as indicated on drawings.
 - .3 Font: Helvetica Medium and Grade 2 Braille.
 - .4 Symbols, letters, and numbers shall be raised tactile.
 - .5 Text colour: white letters on black background, final colours as selected by *Consultant*.
 - .6 Corners: 6 mm radius, unless otherwise indicated.
 - .7 Fastening:
 - .1 Install signs with mechanical tamperproof, stainless steel fasteners.
 - .8 Refer to drawings for room names and sign sizes.
 - .9 Where indicated, use universally accepted male, female, and barrier-free symbols.

PART 3 - EXECUTION

3.1 Installation

- .1 Examine surfaces to which signage is to be anchored and report any unacceptable conditions. Commence work only after surfaces are acceptable.
- .2 Install in accordance with signage manufacturer's specifications and templates as required for installation of work of this section.
- .3 Install signage level and securely at locations indicated.

3.2 Adjusting and Cleaning

- .1 Verify under work of this section that installed *Products* function properly, and adjust them accordingly to ensure satisfactory operation.
- .2 Refinish damaged or defective work so that no variation in surface appearance is discernible. Refinish work at site only if acceptable.
- .3 Remove excess materials from the *Place of the Work*.

Signage

- .4 Upon completion of the work of this section, or at such time or times as the *Contractor* shall direct, remove protective coverings and clean down the finished work.
- .5 Clean adjacent surfaces which have been soiled or otherwise marred, in an acceptable manner, to completely remove evidence of material causing same.

END OF SECTION

Classroom Control Panels

PART 1 - GENERAL

1.1 Summary

- .1 Section includes:
 - .1 Classroom control panels, including coordination with electrical for clock and electrical devices.

1.2 Submittals

- .1 Submit required submittals in accordance with Section 01 33 00.
- .2 *Product* data:
 - .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 finish specified.
- .5 Templates:
 - .1 Submit templates 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 77 00.
- .2 Operation and maintenance data:
 - .1 Submit manufacturer's operation and maintenance instructions for inclusion in the operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 Classroom Control Panels

- .1 Control panels shall be constructed of a structurally sound 6063 T5 Alloy satin anodized aluminum frame, 0.08 mm thick with high pressure plastic laminate faced panels of lightweight particle core and a .5mm plastic laminate backing sheet. Plastic laminate colours are selected by the architect. They can be selected from standard furniture colour ranges.
- .2 Units to be complete with 1104 backboxes fabricated from heavy duty gauge satin coat steel with suitable barriers and continuous knockouts. Clear, smooth facias (faceplates) shall be prepunched to accept detailed components.
- .3 Recessed phone tubs shall be constructed of .050 satin anodized aluminum.
- .4 All panels shall be vandal resistant and removable with special tools for service access.
- .5 Panels to have all openings, mounting hardware, and the like for services as required for installation of mechanical, and electrical services.

Classroom Control Panels

- .6 All units will be fabricated in accordance with reviewed shop drawings with extruded frames, and solid plastic laminate face panels.
- .7 Units to be full height from 200mm off floor to underside of ceiling panels.
- .8 Units shall include the following:
 - .1 Light switches, 120V.
 - .2 Duplex recept (Standard style).
 - .3 Provision for clock.
 - .4 Provision for PA call switch.
 - .5 Decorative plastic laminate panels.
 - .1 Colour and pattern: to match existing.
 - .6 Blank provision.
 - .7 Provision for space sensor.
 - .8 PA speaker grille.
 - .9 Provision for fire alarm.
- .9 Acceptable *Product*: 'Classmate Model CM327' by Interspec.

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 manufacturer's specifications and installation requirements, 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 it 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 finished installation will remain free of warping, buckling, opening of joints and seams, and distortion within limits of intended use.

3.2 Adjusting and Cleaning

- .1 Verify under work of this section that installed *Products* function properly, and adjust them accordingly to ensure satisfactory operation.
- .2 Refinish damaged or defective work so that no variation in surface appearance is discernible.
- .3 Final cleaning shall be in accordance with Section 01 77 00.

Classroom Control Panels

END OF SECTION

Laboratory Equipment

PART 1 - GENERAL

1.1 Summary

- .1 Section includes:
 - .1 Peg board drying rack.

1.2 Administrative Requirements

- .1 Coordination:
 - .1 Work of this section is closely integrated with laboratory work of other sections. Coordinate work of this section with work of:
 - .1 Architectural Woodwork under Section 06 40 00.

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 Shop drawings shall clearly indicate materials being supplied and finishes, connections, attachments, reinforcing, locations of exposed fastening, colours, gloss intensities and coating types by name.

1.4 Closeout Submittals

- .1 Submit closeout submittals in accordance with Section 01 77 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 Manufacturer shall have minimum of 10 years of continued experience, having successfully completed other laboratory projects of similar or greater magnitude.
 - .2 Installers / applicators / erectors:
 - .1 Provide work of this section, executed by competent installers with minimum 5 years experience in application of *Products*, systems and assemblies specified and with approval of *Product* manufacturers.

1.6 Delivery, Storage, and Handling

- .1 Delivery, storage, and handling of *Products* in accordance with manufacturer's written requirements.

Laboratory Equipment

1.7 Field Conditions

- .1 Environmental requirements shall be in compliance with manufacturer's written requirements.

PART 2 - PRODUCTS

2.1 Peg Board Drying Rack

- .1 Type 304 stainless steel peg board with AISI No. 4 satin finish, complete with integral drip through and catch drain.
- .2 Polypropylene pegs shall be removable without tools.
- .3 Complete with funnel rack, drain basket and screen insert.
- .4 Acceptable *Product*.
 - .1 CiF Lab Solutions 'Model SP502'.
 - .2 Substitutions: in accordance with Section 01 25 00.
- .5 Locations where indicated.

PART 3 - EXECUTION

3.1 Examination

- .1 Take measurements of construction at *Place of the Work* to which work of this section must conform, and through which access must be made, before work of this section are delivered to *Place of the Work*.
- .2 Before installation commences, ensure that mounting devices, members and surfaces are satisfactory for fitting and adequate for securing of equipment; and that services are adequate and located correctly.
- .3 Installation is not to proceed until completion of floor finishes so that flooring is continuous below floor supported assemblies, unless otherwise specified.

3.2 Installation

- .1 Install work of this section in accordance with manufacturer's written requirements and in compliance with reviewed shop drawings.
- .2 Install true, tightly fitted, and level or flush to adjacent surfaces, as suitable for installation, and coordinated with work of Divisions 21, 22, and 23 and Divisions 26, 27, and 28, and section 06 40 00.

END OF SECTION

Roller Window Shades

PART 1 - GENERAL

1.1 Summary

- .1 Section includes:
 - .1 Roller window sun shades at interior locations.
 - .2 Roller window room darkening (black-out) shades at interior locations.

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 77 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 minimum 10 years experience.
 - .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.

PART 2- PRODUCTS

2.1 Manufacturers

- .1 Subject to compliance with requirements, provide *Products* by one of the following manufacturers:
 - .1 Altex – SunProject.
 - .2 Elite Window Fashions.
 - .3 MechoShade Systems, Inc.
 - .4 Solarfective Products by Legrand Global.
 - .5 Sun Glow Window Covering Products of Canada Ltd.
 - .6 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 Must 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.
 - .1 *Provide* child-safe chain retainers.
- .2 Control shades and room darkening shades independently.

2.3 Hardware - Motor Controlled Shades

- .1 Electrical shade motors:

Roller Window Shades

- .1 Somfy roller motor, size 500 series or better, 4-wire, instantly reversible, adjustable limit switches, thermal overload protector, and electric brake.
- .2 Torque limiter with self-adjusting shut-off.
- .3 Motor sized to suit roller size.
- .4 Shade motor shall be equipped with externally located control wheels which allow exact control of shade limits in raised and lowered positions, preventing over winding of the fabric/shade cloth.
- .2 Motor Control systems:
 - .1 Manual switch controls:
 - .1 Group(s) of roller shades controlled by one switch.
 - .2 Switch types:
 - .1 Key switch:
 - .1 Maintained.
 - .2 Group control and or zone control:
 - .1 Each roller shade motor shall be powered by a 3 conductor (plus ground) wire connected to an MC2 dry contact 120/240V motor control relay. 2 motors connected to each relay.
 - .2 Each MC2 shall be mounted in a properly identified junction box (or cabinet) supplied under this section and installed by others. Identifications labels shall clearly show zone(s) and group(s) that are controlled.
 - .3 High voltage wiring shall terminate to screw down terminals low voltage wiring shall terminate to RJ45 connectors.
 - .4 Control system shall have the ability to upgrade to a matrix intelligent motor controller without additional wiring.
- .3 Control shades and room darkening shades independently.

2.4 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.
- .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 molded 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 Hembar: Extruded aluminum with matching plastic end finials.
- .7 Mounting: Removal of shade system shall not require the disassembly of the shade unit.

Roller Window Shades

- .8 Room darkening (black-out) shade features: 13 mm (1/2") pile mounted in prefinished 38 mm x 28 mm (1-1/2" x 1-1/8") extruded aluminum side and bottom channels finished to match mullions. Include Dynamic hembar to allow for variance in window sill level.

2.5 Shade Mounting System

- .1 Extruded aluminum bracket designed to accept preassembled shade system.
 - .1 Brackets to be used to facilitate the alignment with shade opening.
- .2 Modular construction: Shades must be removable as a complete modular unit without any component disassembly required.

2.6 Aluminum Finish

- .1 Exposed aluminum: Clear anodized AA-M12C22A31.
- .2 Unexposed aluminium: mill finish.

2.7 Shade Fabric Types

- .1 Sun control fabric; dimensionally stable shade fabric:
 - .1 Acceptable *Products*; 3% open area:
 - .1 Solarfective 'Solarblock 300 Series'.
 - .2 Substitutions: in accordance with Section 01 25 00.
 - .2 Colour: as selected by Architect from manufacturer's full range.
- .2 Room darkening (black-out) fabric; dimensionally stable fabrics:
 - .1 Acceptable *Products*:
 - .1 Phifer SheerWeave Style 7000.
 - .2 Substitutions: in accordance with Section 01 25 00.
 - .2 Colour: as selected by Architect from manufacturer's full range.
- .3 Fabric shall 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.
- .4 Fabric shall be colour fast, retain its shape, and not be affected by moisture or heat.
- .5 Flammability performance:
 - .1 Certified by an independent laboratory, shade fabric shall pass CAN/ULC S109-14 Flame Tests of Flame Resistant Fabrics and Films.

2.8 Fabrication

- .1 Finished assemblies shall be, square, true to size and free from distortion, twist, or other defects that could affect their strength, operation or appearance. Factory applied finish shall be uniform, smooth and without blemishes.

Roller Window Shades

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.
- .7 Room darkening shades (black-out) to be installed to eliminate passage of light from exterior.
- .8 Electrical wiring, hook-up, switches; motorized shades: in accordance with Divisions 26, 27, and 28.

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



THE MITCHELL PARTNERSHIP INC.
CONSULTING ENGINEERS

MECHANICAL SPECIFICATION

FOR

**CHEMONG PUBLIC SCHOOL UPGRADES
BRIDGENORTH, ONTARIO**

ISSUED FOR PERMIT AND TENDER

PREPARED BY:

**THE MITCHELL PARTNERSHIP INC.
285 YORKLAND BLVD.
TORONTO, ONTARIO
M2J 1S5**

(416) 499-8000

**DATE: MAY 3, 2021
TMP FILE NO. 21-1029-000**

SECTION	TITLE	ISSUE DATE
	DIVISION 20 MECHANICAL	
Division 20	Mechanical General Requirements	
20 01 00	Table of Contents	May 3, 2021
20 04 00	Mechanical General Provisions	May 3, 2021
20 05 00	Basic Mechanical Materials and Methods	May 3, 2021
20 07 00	Insulation	May 3, 2021
20 94 00	Mechanical Demolition	May 3, 2021
Division 22	Plumbing	
22 11 00	Plumbing and Drainage Systems	May 3, 2021
22 30 00	Plumbing Specialties	May 3, 2021
22 40 00	Plumbing Fixtures	May 3, 2021
22 66 00	Laboratory Drainage Systems	May 3, 2021
Division 23	Heating, Ventilation and Air Conditioning	
23 05 93	Testing and Balancing (TAB)	May 3, 2021
23 21 13	Hydronic Piping Systems	May 3, 2021
23 23 00	Refrigerant Piping	May 3, 2021
23 31 00	Sheet Metal	May 3, 2021
23 34 00	Fans	May 3, 2021
23 60 00	Refrigeration Condensing Units	May 3, 2021
23 75 00	Packaged Air Handling Units	May 3, 2021
Division 25	Integrated Automation	
25 30 00	EMCS Instrumentation	May 3, 2021

END OF SECTION

PART 1 - GENERAL	1
1.1. WORK INCLUDED	1
1.2. INTENT/PHASING	1
1.3. CONTRADICTION AND AMBIGUITY	2
1.4. METRIC PRACTICE	2
1.5. COORDINATION	2
1.6. REFERENCE STANDARDS	2
1.7. DRAWINGS AND MEASUREMENTS	3
1.8. REGULATORY REQUIREMENTS	4
1.9. WARRANTY	5
1.10. INSTRUCTIONS TO BIDDERS	5
1.11. SEPARATE PRICES	5
1.12. QUALITY ASSURANCE	5
1.13. WORKPLACE SAFETY	6
PART 2 - SUBMITTALS	6
2.1. SHOP DRAWINGS	6
2.2. ALTERNATIVE MANUFACTURER AND SUPPLIER	8
2.3. SAMPLES	9
2.4. COORDINATION DRAWINGS	9
2.5. RECORD DRAWINGS	10
2.6. OPERATING AND MAINTENANCE MANUALS	11
PART 3 - EXECUTION	12
3.1. INSPECTION, TESTING AND CERTIFICATES	12
3.2. TEMPORARY SERVICES	12
3.3. CUTTING AND PATCHING	12
3.4. PROTECTION	13
3.5. TEMPORARY AND TRIAL USE	13
3.6. COMPLETION	13
3.7. INSTRUCTIONS TO OWNER	14
3.8. INTERRUPTION OF EXISTING SERVICES	15
3.9. REMOVAL AND REUSE OF EXISTING MATERIALS	15
3.10. PROTECTION OF OWNER'S PREMISES	16

PART 1 - GENERAL

1.1. WORK INCLUDED

- .1 These Specifications are an integral part of the Contract Documents. Tendering and Contract Requirements and Division 01 00 00, General Requirements apply to all Specification Sections.
- .2 Ensure that all mechanical and electrical services are arranged so that "layering" of services is minimized. Offset as required to maximize ceiling space.
- .3 Maintain the specified ceiling height while allowing 200 mm for lighting below all mechanical services.
- .4 Work in the Specifications is divided into descriptive Sections which are not intended to delegate functions or work to any specific Subcontractor or identify absolute contractual limits between Subcontractors or between the Contractor and his Subcontractor. The requirements of any one Section apply to all Sections. Refer to other Sections to ensure a complete operational product and fully coordinated standard of work.
- .5 Refer to architectural drawings for finish required for mechanical systems. Where a discrepancy exists between finish listed in mechanical and architectural specifications, the more expensive specifications will be enforced.
- .6 The responsibility for determining which Subcontractor or supplier shall provide labour, material, products, equipment, and services to complete the work rests solely with the Contractor.
- .7 The direction to 'provide' equipment, materials, products, labour and services shall be interpreted to 'supply, install and test' the Division 20 00 00 work indicated on the Drawings and specified. All products and equipment shall be new.
- .8 Provide mechanical components and normal system accessories not shown on the Drawings or stipulated in the Specifications but required to ensure complete operational systems acceptable to the Consultant and all authorities having jurisdiction.
- .9 Obtain and pay for all permits required by Authorities Having Jurisdiction, testing agencies, regulatory agencies and for other permits required to complete the work of this Division.

1.2. INTENT/PHASING

- .1 Mention in the Specifications or the indication on the Drawings of equipment, materials, operation and methods, requires of the quality noted, the quantity required, and that the systems are complete in every respect.

- .2 Consider the Specifications as an integral part of the accompanying Drawings. Any item or subject omitted from one or the other, but which is either mentioned or reasonably implied, shall be considered as properly and sufficiently specified.
- .3 Be completely responsible for the acceptable condition and operation of all systems, equipment and components forming part of the installation or directly associated with it. Promptly replace defective materials, equipment and parts of equipment and repair related damages.
- .4 Phasing shall be scheduled with the Owner.

1.3. CONTRADICTION AND AMBIGUITY

- .1 Where there is apparent contradiction or ambiguity in the documents, or where there are apparent discrepancies in or omissions from the documents, or if there is any doubt as to the intent of the documents, the bidder shall request and obtain written clarification(s) from the Consultant prior to submitting a tender.
- .2 Consideration will not be granted for misunderstanding of the intent of the documents or the extent of the work to be performed.

1.4. METRIC PRACTICE

- .1 Conform to Canadian Metric Practice Guide CSA CAN3-Z234.1-89.
- .2 Provide adapters between metric and imperial installations.
- .3 Metric descriptions in this Division are nominal equivalents of Imperial values.

1.5. COORDINATION

- .1 Coordinate and schedule the work of this Division with other work to facilitate mutual progress.
- .2 Identify and resolve interference problems prior to prefabrication and installation of equipment. Submit interference drawings for review prior to installing anything on site. Do not proceed until drawings have been reviewed.
- .3 Examine the site and all Contract Documents prior to bid submission. No allowance will be made for any difficulties encountered due to any features of the building, methods of construction, site or surrounding public and private property which existed up to the bid close.

1.6. REFERENCE STANDARDS

- .1 Provide new materials and equipment of design and quality defined in Section 20 25 00. Provide current models of equipment manufactured in North America, unless specified otherwise, with published ratings certified by recognized North American testing and standards agencies.
- .2 Workmanship and installation methods shall conform to best practice. Employ tradesmen to perform work under the direct supervision of qualified personnel.
- .3 Install equipment in accordance with manufacturer's recommendations.

- .4 Meet ASHRAE/IES 90.1, 2013 (or most recent edition) Standards for the supply and installation of all equipment.
- .5 Meet the additional selection, sizing and performance criteria specified in this Specification.
- .6 Be responsible for all aspects of your work including any damage resulting.

1.7. DRAWINGS AND MEASUREMENTS

- .1 Read the mechanical work drawings in conjunction with all other structural, architectural, sprinkler, electrical, etc., drawings and, where applicable, the Code Consultant's report.
- .2 The mechanical drawings are performance drawings, diagrammatic, and show approximate locations of equipment and connecting services. Any information regarding accurate measurement of the building is to be taken on site. Do not scale the drawings, and do not use the drawings for prefabrication work.
- .3 The drawings are intended to convey the scope of work and do not show architectural and structural details. Provide, at your cost, all offsets, fittings, transformations, and similar products required as a result of obstructions and other architectural and structural details but not shown on the drawings.
- .4 The locations of equipment and materials shown may be altered, when reviewed by the Consultant, to meet requirements of the equipment and/or materials, other equipment systems being installed, and of the building, all at the responsibility of the contractor and at their cost.
- .5 Sections of the mechanical specification 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 the Sections are to be read as a whole.
- .6 The mechanical specification does not generally indicate the specific number of items or extent of material required. The specification is intended to provide product data and installation requirements. It is necessary to refer to drawing schedules, layouts, schematic diagrams, riser diagrams, and details to determine correct quantities.
- .7 The mechanical drawings and specification are intended to be cooperative. Perform all work that is shown, specified, or reasonably implied on the drawings but not mentioned in the specification, or vice-versa, as though fully covered by both.
- .8 The mechanical drawings and specifications have been prepared solely for the use by the party with whom the Consultant has entered into a contract and there are no representations of any kind made by the Consultant to any other party.
- .9 When a discrepancy exists within the drawings or specification, the most costly arrangement will take precedence.
- .10 Drawings do not indicate exact new or existing architectural, structural or electrical features. Coordinate with other contractors prior to commencement

of work. Site measure all existing architectural, structural and electrical systems as required.

- .11 Do not scale Drawings. Take field measurements before ordering and fabricating materials.
- .12 Obtain 'roughing-in' requirements of equipment which is not part of Division 20 00 00 work before proceeding.
- .13 Leave areas clear for future equipment and maintenance including coil/fan removal.

1.8. REGULATORY REQUIREMENTS

- .1 Meet the requirements of Section 01 41 00.
- .2 Meet the requirements and recommendations of all Municipal, Provincial and Federal Bylaws and Ordinances.
- .3 In general, the physical and chemical properties and characteristics of Division 20 00 00 work shall meet the requirements of recognized agencies which shall include;

AMCA	-	Air Moving & Conditioning Association
ADC	-	Air Diffusion Council
ANSI	-	American National Standards Institute
AHRI	-	Air Conditioning & Refrigeration Institute
ASHRAE	-	American Society of Heating, Refrigeration and Air Conditioning Engineers
ASME	-	American Society of Mechanical Engineers
ASTM	-	American Society for Testing and Materials
AWWA	-	American Water Works Association
CGA	-	Canadian Gas Association
CGSB	-	Canadian General Standards Board
CSA	-	Canadian Standards Association
CTI	-	Cooling Tower Institute
EGC	-	Enbridge Gas Company
MTC	-	Ministry of Transportation and Communication
NBCC	-	National Building Code of Canada
NFPA	-	National Fire Protection Association
OBC	-	Provincial Ontario Building Code
OFM	-	Local Fire Codes or Standards Ontario Fire Marshall
OH	-	Ontario Hydro Special Inspection Department
OME	-	Ontario Ministry of Environment
OML	-	Ministry of Labour and Workmen's Compensation Requirements
OSBIE	-	Ontario School Board's Insurance Exchange
OWRA	-	Ontario Plumbing Code
TBD	-	Local Building Codes City of Bridgenorth, Buildings Department
TSSA	-	Technical Standards & Safety Authority
UL	-	Underwriter's Laboratories Inc.
ULC	-	Underwriter's Laboratories of Canada

- .4 Give all necessary notices, obtain all permits and pay for fees, taxes and other costs in connection with the work. File all necessary forms, Contract Documents and prepare submissions and obtain approvals of regulatory bodies having jurisdiction.
- .5 Comply with the requirements of the Model National Energy Code for Buildings or ASHRAE 90.1-2013 in the selection, application and installation of all mechanical equipment and systems.

1.9. WARRANTY

- .1 Meet the requirements of Tendering and Contract Requirements.
- .2 Warranty all equipment, material and workmanship for not less than one year from date of Substantial Performance of the Work, or for longer periods when stated elsewhere in the Specifications.
- .3 If any equipment or material does not match the manufacturer's published data or rating schedules during performance tests, replace without delay. Bear all associated costs of replacement. Adjust all components to achieve the specified ratings.
- .4 The Owner will give notice of observed defects promptly in writing.
- .5 Promptly correct defects and deficiencies which originate during the warranty period. Pay for resulting damage.

1.10. INSTRUCTIONS TO BIDDERS

- .1 Submit Supplementary Mechanical Bid Form. Failure to comply with the stated requirements of the Bid Form may nullify the bid.
- .2 Pay attention to "Basis of Design", "Alternative" and "Alternate" manufacturers and supplier defined in Section 20 25 00.
- .3 The Bidder is invited to submit additional alternate prices not specifically requested with the Bid.
- .4 Alternate prices may be used to establish the lowest Contract Price.
- .5 The lowest or any Bid will not necessarily be accepted.

1.11. SEPARATE PRICES

- .1 Submit separate prices on the Bid Form and express as a credit or an extra to the Stipulated Bid Sum. Do not include Separate prices in the Stipulated Bid Sum.
- .2 Calculation of the Contract Price will include separate prices consistent with their acceptance or rejection by the Owner.

1.12. QUALITY ASSURANCE

- .1 All mechanical work is to be done by journeyman tradesmen who perform only the work that their certificates permit, or by apprentice tradesmen under direct on-site supervision of an experienced journeyman tradesman. The use of

apprentice tradesmen is to be limited and the journeyman/apprentice ratio is subject to the Consultant's approval.

- .2 All journeyman tradesmen are to have valid trade certificates available at the site for review by the Consultant at any time.
- .3 An experienced and qualified superintendent is to be onsite at all times when mechanical work is being performed.

1.13. WORKPLACE SAFETY

- .1 Comply with requirements of the Workplace Hazardous Materials Information System (WHMIS) regarding the use, handling, storage, and disposal of hazardous materials. Submit WHMIS MSDS (Material Safety Data Sheets) for all products where required and maintain one copy at the site in a visible and accessible location available to all personnel.
- .2 Comply with all requirements of Occupational Health and Safety Regulations and all other regulations pertaining to health and safety, including worker's compensation/insurance board and fall protection regulations.
- .3 If at any time during the course of the work asbestos containing materials, black mould, lead paint, or any other such materials are encountered or suspected, immediately report the discovery to the Consultant and cease all work in the area in question. Do not resume work in affected areas until the situation has been properly corrected and without written approval from Owner.

PART 2 - SUBMITTALS

2.1. SHOP DRAWINGS

- .1 Submit shop drawings via email in pdf format only. Provide hard copy reproduction of all shop drawings for manuals, authorities having jurisdiction, the Owner and for coordination among other Trades. Identify Shop Drawing by Specification index reference and project name.
- .2 Review all Shop Drawings prior to submittal and clearly certify as 'Correct for Review by Consultant'. Show company name, date and sign all Shop Drawings.
- .3 Consultant review of Shop Drawings does not relieve the Contractor of full responsibility for errors, necessity to check Shop Drawings, furnish materials and equipment and perform work required by the Contract Documents.
- .4 Clearly identify all components, accessories, including options to be supplied with each item.
- .5 Submitted product data shall include sufficient detail to allow a reasonable assessment of the equipment being provided. The data shall include, but not be limited to:
 - .1 dimensions, including service clearance requirements
 - .2 design and working pressure ratings of pressure vessels and line components

- .3 shipping and operating weight including accessories and working fluids, together with point loadings
- .4 performance specifications including pump and fan curves/charts
- .5 part load operational capabilities and limitations
- .6 sound power levels
- .7 materials of construction including exterior and internal finishes
- .8 factory test standards rating conformance to recognized and applicable industry standards
- .9 extended warranty coverage
- .10 electrical requirements, including complete wiring diagrams clearly defining field, internal and factory wiring scope
- .11 motor, power or control wiring requirements including rated voltage, phase and cycle, rated power draw, full load current, motor size and speed, motor frame size, type of enclosure and maximum rated temperature rise
- .12 product installation, startup and operation manuals
- .13 statement of compliance with the Model National Energy Code of Canada, as applicable.
- .6 Incomplete submissions will be returned as unacceptable.
- .7 Bind one set of reviewed Shop Drawings in each Operating and Maintenance Manual.
- .8 Provide shop drawings for specified items as follows:

Section	Title	Equipment
20 05 00	Basic Mechanical Materials and Methods	Thermometers & Pressure Gauges Expansion Joints & Guides Pipe Riser Anchors Pipe Reaction Forces Drawing Hangers Access Doors
20 07 00	Insulation	Insulation Materials Spec Sheets
22 11 00	Plumbing and Drainage Piping Systems	Valves Balancing Valves Pipe Couplings
22 30 00	Plumbing Specialties	Drainage Products Backflow Preventers

Section	Title	Equipment
22 40 00	Plumbing Fixtures	Plumbing Fixtures Emergency Equipment
22 66 00	Laboratory Drainage Systems	Piping and Connections Acid Neutralizers
23 05 93	Balancing	Air Balancing Reports Water Balancing Reports
23 21 13	Hydronic Piping Systems	Gate and Globe Valves Butterfly Valves Piping Joints Circuit Balancing Valves Hydronic Terminal Valves
23 31 00	Sheet Metal	Access Doors Backdraft Dampers
23 34 00	Fans	Fans
23 60 00	Condensers	Condensing Units
23 75 00	Packaged Air Handling Units	Air Handling Units
25 30 00	BMS Instrumentation	Sensors and Thermostats Control Valves and Actuators

2.2. ALTERNATIVE MANUFACTURER AND SUPPLIER

- .1 Equipment and materials are specifically described for the purpose of indicating standards of quality and workmanship. Base Bid on the items specified in Section 20 25 00 as "Basis of Design" or "Alternative Manufacturer".
- .2 Maximize the Canadian content of all equipment and materials used on this project.
- .3 Alternate equipment or materials may be submitted with the Bid Form, indicate appropriate cost saving. Supply with each alternative, following bid submission, upon request by Consultant, the following information:
 - .1 details of manufacture
 - .2 dimensions including required clearance
 - .3 performance data
 - .4 the cost saving for piping, ductwork and electrical changes imposed by the alternative
 - .5 the effect upon and estimated cost to other trades

- .6 Canadian content percentage
- .4 Where alternates are accepted, there will be no further cost allowances for subsequent changes in Division 20 00 00 work or other Contracts to make the alternates complete and equal to the specified equipment and materials.
- .5 If alternate equipment is accepted, prepare when requested, equipment layouts at no extra cost. Show clearly in plan, elevations and sections, all equipment details including dimensional changes. Show location changes to ducts, pipes and wiring and the effect of these changes on the building. Drawings shall be 1:50 scale.
- .6 The right is reserved to accept or reject any alternative.

2.3. SAMPLES

- .1 Submit samples or provide site mockup of proposed materials upon request of the Consultant, including:
 - .1 valve tags and equipment identification plates
 - .2 insulation and adhesives
 - .3 hangers, pipe supports, inserts and fastening devices
 - .4 pipe and duct identification
 - .5 flexible ductwork
 - .6 thermostat, cover and guards
 - .7 access doors and panels
 - .8 diffusers, registers and grilles
 - .9 air filters
 - .10 thermometers
 - .11 EMCS instrumentation
- .2 Provide site mockup of proposed materials before proceeding.

2.4. COORDINATION DRAWINGS

- .1 Division 20 00 00 shall take the lead role in preparation of electronic interference/coordination drawings. Use all other disciplines electronic drawings as basis for preparation of interference drawings. Position all Division 20 00 00 services to accommodate the work of other divisions.
- .2 Prior to commencement of work, submit for Consultant review, pipe, duct and equipment interference and sleeving drawings for each floor level and for all Division 20 00 00 work. Drawings must be coordinated and certified correct for review.

- .3 Coordination drawings shall be to a scale sufficient to show the necessary details. Submit for review, using the same procedures as specified for Shop Drawings.
- .4 Prepare drawings in conjunction with other Divisions, wherever possible conflict due to the positioning of Division 20 00 00 equipment, piping or ductwork exists.
- .5 Dimension proposed location of Division 20 00 00 work with respect to building elevations and established grid lines.
- .6 Prepare fully dimensioned detail drawings of all shafts, duct spaces and pipe spaces. Show sleeving, recessed and formed holes required in concrete for Division 20 00 00 work. Include information pertaining to access, clearances, tappings, housekeeping pads, drains and electrical connections.
- .7 Base information used to prepare drawings on reviewed Shop Drawings.
- .8 Provide field drawings with position of various services when required by Consultant.
- .9 Submit a list of access doors and panels showing proposed type, size and location. Coordinate drawings with Architectural detail drawings and reflected ceiling plans prior to submission.
- .10 Revise or alter the arrangement of work that has been installed without proper coordination, study and review, even if it was completed in accordance with the Contract Documents, in order to conceal the work behind finishes, or to allow the installation of other work, at no additional cost. In addition, pay for the cost of alterations in other work required by the alterations to your work.
- .11 All 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.
- .12 Use the project's CAD files as the starting point for the creation of coordination drawings. Use the structural steel contractor's CAD files and not the design files. The contractor's drawings will show angles, braces, supports, etc. that are not in the design model. Use the electrical contractor's CAD file in combination with the electrical consultant's model.
- .13 Continuously update the CAD model to accurately reflect all instructions issued by the architect and consultants in whatever format these instructions are issued. They most likely will not be issued as CAD files.

2.5. RECORD DRAWINGS

- .1 Meet the requirements of Section 01 78 39.
- .2 Suitably store and protect drawings on site and make available at all times for inspection.

- .3 Record inverts of underground piping at building entry/exit and below floor slab at each branch, riser base, change in direction as well as at least three points on straight runs.
- .4 Show locations of access doors and panels and identify the equipment and components that they serve.
- .5 Transfer all record drawings to AutoCAD prior to submission to Consultant.
- .6 Submit record drawings for review in PDF format and hard copy.

2.6. OPERATING AND MAINTENANCE MANUALS

- .1 Meet the requirements of Section 01 78 00. Arrange manuals into system sections or subsections.
- .2 Submit one hard copy and one digital copy (PDFs supplied/organized on CD/DVD or USB Key) for review at least two weeks before instructions to Owner are commenced.
- .3 Submit one digital copy (PDFs supplied/organized on CD/DVD or USB Key) of final manuals to the consultant.
- .4 Ensure that the terminology used in various sections of the manual is consistent.
- .5 Each manual shall contain the following information:
 - .1 description of each system with description of each major component of system
 - .2 complete sets of page size equipment Shop Drawings
 - .3 equipment manufacturer's installation, startup and operation manuals
 - .4 equipment manufacturer's recommended spare parts lists
 - .5 equipment wiring diagrams
 - .6 lubrication schedule for all equipment
 - .7 equipment identification list with serial numbers
 - .8 page size valve tag schedule and flow diagrams
 - .9 final balancing reports
 - .10 water treatment procedure and tests
 - .11 control drawings, sequences of operation
 - .12 extended warranty documentation if applicable

PART 3 - EXECUTION

3.1. INSPECTION, TESTING AND CERTIFICATES

- .1 Periodic inspections of the work in progress will be made to check general conformity of the work to the Contract Documents. Observed deficiencies will be reported. Correct deficiencies immediately.
- .2 Meet the requirements of all laws, bylaws, codes, regulations and authorities having jurisdiction.
- .3 Where the Contract Documents, instructions or the governing authorities require Division 20 00 00 work to be tested, inspected, or approved, give sufficient notice of its readiness for inspection and schedule the date and time for such inspection.
- .4 Uncover Division 20 00 00 work that is covered up without consent, upon Consultant request, for examination and restore at no extra cost to the Owner.
- .5 Furnish certificates and evidence that Division 20 00 00 work meets the requirements of authorities having jurisdiction.
- .6 Correct deficiencies immediately upon notification.

3.2. TEMPORARY SERVICES

- .1 Provide temporary mechanical services in accordance with the requirements of Section 01 50 00.
- .2 Make connections to temporary power source for use by Division 20 00 00.
- .3 Provide and maintain temporary fire protection services as required by the authorities having jurisdiction.
- .4 When the permanent water service is installed, it shall be used to supply water for the use of Other Contractors.
- .5 Perform operations necessary for checking, testing and balancing after written approval is given to start up systems. Ensure that care is taken to protect equipment from damage and to prevent distribution of dust through duct systems.
- .6 Do not use permanent plumbing, heating or air conditioning systems for temporary services during construction, except with written permission from Consultant.

3.3. CUTTING AND PATCHING

- .1 Meet the requirements of Section 01 73 29.
- .2 Give notification in time to Other Contractors of openings required for Division 20 00 00 work. Supply accurate details of location and size. When this requirement is not met, bear the cost of cutting and patching.
- .3 In existing work, cutting, patching and restoration of finished work to original condition will be carried out by Other Contractors at the expense of Division 20 00 00.

- .4 Obtain written Consultant approval before cutting openings through structure.
- .5 Where new work connects with existing and where existing work is altered, cut, patch and restore to match existing work.

3.4. PROTECTION

- .1 Protect all work from damage. Keep all equipment dry and clean at all times.
- .2 Cover openings in equipment, pipes and ducts, with caps or heavy gauge plastic sheeting until final connections are made.
- .3 Repair any damage caused by improper storage, handling or installation of equipment and materials.
- .4 Protect equipment, pipes and temporary services from weather damage.

3.5. TEMPORARY AND TRIAL USE

- .1 Obtain written permission from Consultant to use and test permanent equipment and systems prior to Substantial Performance acceptance by Consultant.
- .2 Consultant may use equipment and systems for test purposes prior to acceptance. Provide labour, fuel, material and instruments required for testing. Rectify incomplete work immediately to satisfaction of Consultant.
- .3 Protect equipment and system openings from dirt, dust and other foreign materials during temporary usage. Whenever air handling systems are used for temporary services, in addition to other requirements specified, provide minimum 12 mm thick glass fibre filter media in all supply openings, exhaust opening and all return air openings, transfer openings and other identified openings.
- .4 In all HVAC equipment serving construction areas, provide temporary 15 mm thick glass fiber filter media upstream of all equipment filter assemblies.
- .5 Maintain all temporary filters described above throughout duration of project. Replace filters as necessary.
- .6 Clean and renew equipment and systems used prior to acceptance.
- .7 Warranty, including duration and commencement date, shall not to be affected by startup date of equipment.

3.6. COMPLETION

- .1 Meet the requirements of Section 01 78 13.
- .2 Remove all debris from inside systems and equipment.
- .3 Rectify deficiencies and complete work before submitting request for Substantial Performance inspection.
- .4 Follow manufacturer's written instructions regarding bearing lubrication.
- .5 Check and align all drives to manufacturer's acceptable tolerances.

- .6 Adjust belts for proper tension.
- .7 Check and align all pumps to manufacturer's acceptable tolerances.
- .8 Remove all temporary protection and covers.
- .9 Remove oil and grease from equipment and bases.
- .10 Clean all fixtures and equipment. Polish all plated surfaces.
- .11 Vacuum clean the inside of all air handling systems, including fans, ducts, coils and terminal units to ensure that they are free from debris and dust.
- .12 Change air and water filters.
- .13 Remove, clean and reinstall pipeline strainer screens.
- .14 Leave Division 20 00 00 work in as new working order.

3.7. INSTRUCTIONS TO OWNER

- .1 Meet the requirements of Section 01 79 00.
- .2 Submit check lists for each system or piece of equipment, indicating that all components have been checked and are complete prior to instruction period.
- .3 Thoroughly instruct the Owner in the safe and efficient operation of the systems and equipment.
- .4 Arrange and pay for the services of qualified manufacturer's representatives to instruct Owner on specialized portions of the installation, such as refrigeration machines, boilers, automatic controls and water treatment.
- .5 Submit a complete record of instructions given to the Owner. For each instruction period, supply the following data:
 - .1 date
 - .2 duration
 - .3 system or equipment involved
 - .4 names of persons giving instructions
 - .5 names of persons being instructed
 - .6 other persons present
- .6 Submit receipted verification of completed training to Consultant prior to final release of retentions.
- .7 Carry out instructional period during a period of 5 days scheduled at Owner's convenience.

3.8. INTERRUPTION OF EXISTING SERVICES

- .1 Arrange, schedule and perform work with minimum disturbance to existing facilities and services.
- .2 Submit a complete schedule of service interruptions and changeovers with approximate dates required, durations and times of day, for approval at commencement of project and during the shop drawing phase.
- .3 Include for all pipe freezing and hot tap procedures to connect to existing systems.
- .4 Notify Owner at least 72 hours in advance of planned interruption to existing services.
- .5 Interruption of services must occur after hours at the times and for the duration stipulated by the Owner.
- .6 Keep service interruption duration to an absolute minimum. Carry out all preparatory work, measurements, prefabrication, etc., without interruption of existing services.
- .7 If service interruptions are required by the Owner during the night or on weekends, etc., premium time shall be included in the Contract Price. No extra charges will be allowed at a later date for failure to include same.

3.9. REMOVAL AND REUSE OF EXISTING MATERIALS

- .1 Carry out demolition work in accordance with the Occupational Health and Safety Code.
- .2 Remove existing equipment, services and obstacles where required for refinishing or restoring existing surfaces. Replace same as work progresses.
- .3 Include for removal and disposal of all equipment and systems hazardous substances including refrigerant, oil, fuel oil and other hazardous substances to meet all local laws, regulations and bylaws.
- .4 Turn over to the Owner existing material and equipment removed but not identified for reuse on site. Acceptance of removed material and equipment is at discretion of Owner. Remove such items from site when deemed unsuitable.
- .5 Period to be scheduled.
- .6 Prepare new site for immediate conversion and connection of reused equipment. Carry out all preparatory work, measurements, prefabrication, etc., without interruption of existing services. All work to disconnect, remove, relocate, convert, connect, test and commission reused equipment shall be performed during a two-day weekend shutdown period. Include premium time in the Contract Price.
- .7 Execute work with least possible interference or disturbance to Owner and to other work taking place over the same time period.
- .8 Use only elevators assigned for Contractor use for moving men and material within buildings. Protect walls of elevators to satisfaction of Owner prior to

use and accept liability for damage, safety of equipment and overloading of existing equipment.

3.10. PROTECTION OF OWNER'S PREMISES

- .1 Adhere strictly to the Owner's requirements.
- .2 Confer with the Owner concerning schedule, dust and noise control prior to commencing work in or adjacent to existing facilities where such work might affect either those facilities or their occupants.
- .3 Execute work with least possible interference or disturbance to occupants, public and normal use of premises.
- .4 Provide temporary means to maintain security when security has been reduced by work under this Division.
- .5 Only elevators, dumbwaiters, conveyors or escalators assigned for Contractor's use may be used for moving men and material within building. Protect walls of passenger elevators, to approval of Owner prior to use. Accept liability for damage, safety of equipment and overloading of existing equipment.
- .6 Provide temporary dust screens, barriers, warning signs in locations where renovations and alteration work is adjacent to areas which will be operative during work.
- .7 Drawings indicate approximate locations of known existing underground and above ground facilities. Avoid damage to existing services. Bear cost of repairs and replacements.
- .8 Immediately advise Consultant when unknown services are encountered and await instructions.
- .9 Accept liability for costs incurred by the Owner in repairing and cleaning equipment, etc., resulting from failure to comply with the above requirements.

END OF SECTION

PART 1 - GENERAL	1
1.1. WORK INCLUDED	1
1.2. IDENTIFICATION OF MECHANICAL SERVICES	1
1.3. PIPE AND DUCTWORK IDENTIFICATION	1
1.4. VALVE TAGS	2
1.5. EQUIPMENT NAMEPLATES	2
1.6. CONTROLS IDENTIFICATION	2
1.7. FLOW DIAGRAMS	2
PART 2 - PRODUCTS	2
2.1. INSERTS	2
2.2. PIPING HANGERS AND SUPPORTS	2
2.3. PIPE ESCUTCHEON PLATES	5
2.4. EQUIPMENT RIGGING SUPPORTS	5
2.5. SLEEVES, WALL AND FLOOR PLATES	5
2.6. PROVISION FOR PIPE EXPANSION, CONTRACTION AND BUILDING SHRINKAGE	5
2.7. PIPE GUIDES AND ANCHORS	6
2.8. DRAINS	7
2.9. ACCESS DOORS AND PANELS	7
2.10. FLASHING	8
2.11. CURBS	8
2.12. CONCRETE	8
2.13. STEEL	8
2.14. FIRESTOPPING	9
2.15. WELDING AND BRAZING	9
PART 3 - EXECUTION	10
3.1. EXCAVATION AND BACKFILL	10
3.2. PIPE, DUCT AND EQUIPMENT INSTALLATION	11
3.3. CONNECTIONS TO EQUIPMENT	12
3.4. INSERTS	12
3.5. HANGERS	13
3.6. SLEEVES, WALL PLATES, FLOOR PLATES	15
3.7. FIRESTOPPING	15
3.8. PROVISION FOR PIPE EXPANSION, CONTRACTION AND BUILDING SHRINKAGE	16
3.9. PIPE GUIDES AND ANCHORS	16
3.10. PAINTING	17
3.11. ADDITION OF NEW CIRCUITS	17
3.12. WELDING AND BRAZING INSPECTION	17
3.13. GENERAL PIPING AND DUCTWORK INSTALLATION REQUIREMENTS	18
3.14. PIPE JOINT REQUIREMENTS	20
3.15. PIPE LEAKAGE TESTING	21
3.16. EQUIPMENT BASES AND SUPPORTS	22
3.17. USE OF MECHANICAL SYSTEMS FOR TEMPORARY HEATING	23
3.18. MAINTAINING EQUIPMENT PRIOR TO ACCEPTANCE	23

PART 1 - GENERAL

1.1. WORK INCLUDED

- .1 Provide all labour, materials, products, equipment and services to supply and install the basic mechanical materials indicated on the Drawings and specified in all mechanical specifications including, but not limited to, Division 20, 21, 22, 23, 25 of these Specifications.

1.2. IDENTIFICATION OF MECHANICAL SERVICES

- .1 Identify all mechanical services after finish painting is complete.
- .2 Use terminology consistent with the Drawings and Specifications.
- .3 Identify lay-in type acoustic ceilings used for access to equipment and components by a method acceptable to Consultant.
- .4 Mark valve and equipment identification on Record Drawings.
- .5 Provide typewritten master lists for each Equipment Room. Frame under glass. Insert copies in Operating and Maintenance Instruction Manuals.

1.3. PIPE AND DUCTWORK IDENTIFICATION

- .1 Provide SMS Wrap-Mark or Primark Pipe Markers on all pipe coverings, using Wrap-Mark pipe markers with flow arrow and alternating wording. For outside diameters up to 150 mm, allow marker to completely wrap pipe. For larger outside diameters, secure markers with stainless steel springs. Secure markers on vertical piping and elsewhere where markers could be inadvertently moved.
- .2 Use stencils and stencil paint on ductwork or ductwork insulation. Apply solid black capitalized lettering 50 mm high and solid black flow arrows 150 mm long x 50 mm wide.
- .3 Locate identification and flow arrows so they can be seen clearly from floor and service platforms:
 - .1 at least once in each room
 - .2 at each piece of equipment
 - .3 at each branch close to connection point to main piping and ductwork
 - .4 at not greater than intervals of 15 metres on straight runs of exposed piping and ductwork
 - .5 at entry and leaving point to pipe and duct chases, or other concealed spaces
 - .6 both sides where piping and ductwork passes through walls, partitions and floors
 - .7 on vertical pipes and ducts approximately 1800 mm above floor
 - .8 behind each access door and panel

- .9 at valves, identify piping upstream of valves and identify branch, equipment, building part or building serviced downstream of valve
- .4 Colour code pipes to meet code and Owner's requirements.
- .5 Identify electrical tracing of pipes on pipe insulation.
- 1.4. VALVE TAGS
 - .1 Provide 40 mm dia., 1 mm thick brass tags with 10mm high die-stamped black letters.
 - .2 Attach to valves with 100 mm long brass chains.
 - .3 Tag all valves except for small valves isolating a single piece of equipment such as a unit heater, fan coil unit, terminal reheat coil and radiation section.
- 1.5. EQUIPMENT NAMEPLATES
 - .1 Identify equipment, starters, and remote control devices in a manner consistent with the Drawings.
 - .2 Use solid black capitalized lettering 100 mm high.
 - .3 Where equipment size does not permit stencil identification, use lamacoid labels, engraved white on black, mechanically fastened to the equipment. Minimum lettering size 10 mm.
- 1.6. CONTROLS IDENTIFICATION
 - .1 Meet Section 25 30 00 requirements.
- 1.7. FLOW DIAGRAMS
 - .1 Prepare neat diagrams 1200 mm x 900 mm of piping systems to identify equipment and valves.
 - .2 Insert legible page size copies into each Operating and Maintenance Manual.
 - .3 Install diagrams, framed under glass, on Equipment Room walls where directed by Owner.
- PART 2 - PRODUCTS
- 2.1. INSERTS
 - .1 Submit proposed materials and methods for cast-in-place inserts.
 - .2 Where inserts must be placed after concrete is poured, use Phillips Red Head Multiset II Anchor system or equivalent Hilti System.
- 2.2. PIPING HANGERS AND SUPPORTS
 - .1 Pipe hanger and support materials, including accessories, are to be, unless otherwise specified, in accordance with the 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 the following requirements:

- .1 unless otherwise specified, all ferrous hanger and support products are to be electro-galvanized
- .2 hangers and supports for insulated piping are to be sized to fit around the insulation and the insulation jacket
- .2 Horizontal suspended piping/hangers and supports shall be:
 - .1 adjustable steel clevis hanger - Anvil Fig. 260 - MSS Type 1
 - .2 adjustable swivel ring band type hanger - Anvil Fig. 69 - MSS Type 10
 - .3 adjustable roller hanger - Anvil Fig's 171, 177 & 181 - MSS Types 41, 43, and/or 45, with Anvil Fig. 160 to 166A - MSS Type 39 steel protection saddle
- .3 Horizontal pipe on vertical surfaces shall be:
 - .1 steel offset pipe clamp - Anvil Fig. 103 or Myatt Fig. 170
 - .2 heavy-duty steel pipe bracket - Anvil Fig. 262 or Myatt Fig. 161 - 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 shall be:
 - .1 copper tubing riser clamp - Anvil Fig. CT-121, Anvil Fig. CT-121C (plastic coated), or Myatt Fig. 150CT - MSS Type 8
 - .2 heavy-duty steel riser clamp - Anvil Fig. 261, or Myatt Fig's. 182, 183, 190 and 191 - MSS Type 8
- .5 Vertical piping on vertical surfaces shall be:
 - .1 steel offset pipe clamp - Anvil Fig. 103 or Myatt Fig. 170
 - .2 heavy-duty steel pipe bracket or soil pipe bracket - Anvil Fig. 262 or Myatt Fig. 161 - MSS Type 26
 - .3 extension split pipe clamp - Anvil Fig.'s 138R or Myatt Fig. 129 - MSS Type 12
 - .4 for piping on an existing roof - Portable Pipe Hangers (Canada) Inc. "PP" Series prefabricated portable pipe support system components to suit the pipe, complete with all required accessories including bases, galvanized structural steel frames, and galvanized steel pipe hangers and/or 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, all required accessories, channel type aluminum cross members, and galvanized steel pipe hangers and/or supports conforming to MSS Type SP-58, complete with all required accessories
- .6 for glass drain and vent piping – special padded hangers supplied by the pipe supplier
 - .7 for plastic piping – generally as specified above but in accordance with the pipe manufacturer's printed recommendations
 - .8 for fire protection piping – generally as above but ULC listed and/or FM approved, and in accordance with Chapter requirements of the NFPA Standard applicable to the 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 the pipe from the clamp
 - .11 insulation protection shields to and including 40 mm dia. – equal to Anvil "Rib-Lok" Fig. 168 galvanized steel shields with ribs to keep the shield centred on the hanger.
 - .12 Epoxy coated steel pipe stays are not permitted.
- .6 Hanger rods shall 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 the loading in accordance with Table 3 in MSS SP-58, but in any case, minimum 9.5 mm dia.
 - .7 Base of vertical risers supports for vertical risers in excess of 6 m high extending out from base mounted equipment is to consist of a base elbow support with flange equal to Empire Tool & Mfg. Co. Fig. 830.
 - .8 Horizontal pipe on racks shall be Unistrut or equal galvanized steel pipe racks with pipe securing hardware as follows:
 - .1 standard galvanized steel U-bolts/clamps supplied by the rack manufacturer
 - .2 adjustable roller chair – Anvil Fig. 175 with Fig. 160-165 steel protection saddle.
 - .9 Special hangers and supports for various applications are 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 the clamp and the floor
 - .2 for groups of pipes having the same slope – Anvil Fig. 195 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

2.3. PIPE ESCUTCHEON PLATES

- .1 One-piece chrome plated brass or #4 finish type 302 stainless steel plates with matching screws for attachment to the building surface, each plate sized to completely cover the pipe sleeve or building surface opening, and to fit tightly around the pipe or pipe connection.

2.4. EQUIPMENT RIGGING SUPPORTS

- .1 Provide eyebolts suitable for block and tackle connection, adequately supported by the structure above for equipment which will require block and tackle handling.

2.5. SLEEVES, WALL AND FLOOR PLATES

- .1 For pipe sleeves, use machine cut and reamed standard weight steel piping.
- .2 Concealed perimeter risers and runouts may have sleeves of 1.31 mm galvanized steel set around section of insulation to provide freedom of movement of piping. Extend 50 mm above finished floor level.
- .3 For piping through exterior walls, cooperate with the waterproofing trade at all times, and do not break any waterproofing seal without consent of the waterproofing trade. Provide waterproof link seals as detailed on Drawings.
- .4 Provide leak plates where pipe sleeves pass through exterior building walls. Each leak plate shall be a 3.42 mm steel plate, welded to the sleeve, 100 mm diameter greater than sleeve outside diameter.
- .5 Provide 1.31 mm galvanized steel duct sleeves. Provide adequate bracing for support of sleeves during concrete and masonry work. For fire rated floors and walls, build fire damper assemblies into structure to attain fire rated construction, in a manner acceptable to the governing authorities.
- .6 Cover pipe sleeves in walls and ceilings of finished areas, other than Equipment Rooms, with satin finish stainless steel, or satin finish chrome or nickel plated brass escutcheons, with non-ferrous set screws. Do not use stamped steel split plates. Split cast plates with screw locks, however, may be used.
- .7 Cover exposed duct sleeves in finished areas with 1.31 mm galvanized steel plates in the form of duct collars. Fix in position with non-ferrous metal screws.

2.6. PROVISION FOR PIPE EXPANSION, CONTRACTION AND BUILDING SHRINKAGE

- .1 Provide expansion loops and offsets to permit the safe expansion and contraction of piping due to thermal effects, building shrinkage and movement. Where space limitations do not permit the use of expansion loops or offsets, provide Flexonics Expansion Joints properly selected for system operating pressures according to the following:

- .1 For piping up to and including 65 mm, select ends to suit specified pipe fittings. Pressure ratings for Model H and HB expansion compensated as 1400 kPa and 1050 kPa.
- .2 Steel Piping - Flexonics Model H expansion compensator with two ply stainless steel bellows.
- .3 Copper Piping - Flexonics Model HB expansion compensator with two ply bellow, all bronze construction.
- .4 For piping 75 mm and above, use flanged ends.
- .5 Steel Piping - Flexonics controlled, flexing expansion joint with stainless steel pressure carrier, flanged ends.
- .6 Copper Piping - Flexonics controlled, flexing expansion joint with monel pressure carrier, and brass flanged ends.
- .7 Flexible hose connectors for chilled or heating water shall be Goodyear SS Braided rubber hose with crimped on brass ends, 2400 kPa pressure rating, -40°C to 93°C temperature rating, EPDM liner size and length to suit application.
- .8 Flexible hose connectors for glycol media shall be Weatherhead SS braided with smooth bore Teflon hose, complete with crimped on steel hose ends. 2070 kPa pressure rating, -53°C to 230°C temperature rating, size and length to suit application.

2.7. PIPE GUIDES AND ANCHORS

- .1 Pipe reaction and loads where indicated on the drawings are for reference only. Refer to Architectural and structural drawings for location of embedments and structural beams required to be provided by this Division for the support of pipe risers.
- .2 Be responsible for the design and installation of guides and anchors in all vertical and horizontal piping, including piping such as generator exhaust piping, boiler flues, etc.
- .3 Submit to Consultant, drawings showing the riser sizes, offsets, location of expansion joints, anchors and guides and other pertinent information. Provide details of the design of riser anchors, guides, attachments and loads imposed on structure. All designs and calculations shall be stamped and sealed by a Professional Engineer Contracted by the Division.
- .4 The concrete structure will undergo elastic shortening as it is built. Make due allowance for shrinkage of the building. The exact amount is to be determined by the Structural Engineer and will be approximately 8 mm per floor. Ensure sleeve openings are adequate to accommodate movement and that sufficient resilient packing is left. Ensure that pipe and duct will not shear as a result of shrinkage.
- .5 The Contractor shall review all sleeved penetrations in the core and shall provide a written report testifying that all sleeves and anchorages have provision for shrinkage.

2.8. DRAINS

- .1 Provide 40 mm minimum size copper pipe drains from overflows, condensate pans and pump bases to floor drains.
- .2 Provide minimum 20 mm ball valve with hose end adapter, metal cap and chain at all low points of all systems. Locate to allow easy connection of hose.
- .3 Provide 20 mm valves with metal caps and chains at the base of all pipe risers. Install hose end ball valve in conjunction with 450 mm minimum length full line size dirt leg.

2.9. ACCESS DOORS AND PANELS

- .1 Provide access for concealed mechanical equipment and install systems and components to minimize number of access doors and panels. Install equipment and components to be readily accessible through doors and panels.
- .2 Supply for installation by Other Contractors, doors, panels and frames.
- .3 Select access doors and panels to suit finishes as noted and large enough to provide adequate access to equipment and components. Where personnel must pass through, provide minimum 600 mm x 600 mm doors and panels. Otherwise, provide minimum 300 mm x 300 mm doors and panels. Provide access doors as follows:
 - .1 Drywall and Block Partition
 - .1 16 gauge steel completely prime coated flush style door with rounded safety corners, one piece seamless 38mm wide trim flange, fully concealed continuous one piece pivot rod hinge, 16 gauge return wall frame and screwdriver operated cam locks (doors larger than 300 mm x 300 mm to have multiple cam locks).
 - .2 Ceilings
 - .1 14 gauge steel, 25 mm recessed door suitable to accept drywall insert, complete with 16 gauge steel frame with 25 mm wide perforated frame of 24 gauge galvanized steel, concealed one piece pivot rod hinge and screwdriver operated cam locks.
 - .3 2 Hour Fire Rated Partitions
 - .1 18 gauge completely baked grey enamel prime coated insulated fire rated door with rolled safety edge and 16 gauge trim and return. Door to have 1-1/2 hour "B" label rating with maximum 250°F temperature rise after 30 mins for vertical wall installation. Door shall be self-closing and locking complete with one fully concealed, pivot type hinge allowing 170° opening. Door shall be complete with self latching latch and be furnished standard with access key and knurled knob.

2.10. FLASHING

- .1 Flashing shall be by Division 07 60 00 for roof curbs shown on the Architectural or Structural Drawings.
- .2 Provide flashing for pipe openings, duct openings, or premanufactured roof curbs required for all mechanical systems.
- .3 Provide counterflashing for roof mounted mechanical equipment and for pipes and ducts passing through roof. Fit counterflashing over flashing or curb. Pitch pockets are not acceptable.

2.11. CURBS

- .1 Curbs required for Division 20 00 00 work and shown on the Structural or Architectural Drawings will be carried out under other Divisions.
- .2 Premanufactured curbs for roof mounted mechanical equipment will be supplied by equipment manufacturer and are specified under other Sections.
- .3 Provide curbs for roof mounted equipment, around ducts passing through roof and surrounding groups of pipes and/or ducts pass through Equipment Room floors, Kitchens and similar areas.
- .4 Provide roof curbs of a sufficient height to be at least 450 mm above finished roof assembly, unless exceeded by Architectural considerations.
- .5 Provide concrete curbs around holes in Equipment Room floors, extending at least 150 mm above finished floor. Make watertight connection between curb and floor.

2.12. CONCRETE

- .1 Provide 100 mm concrete housekeeping pads under all floor mounted mechanical equipment and supports. Extend pads over the full equipment base and isolator area.
- .2 Provide floating reinforced concrete bases, and floating floors which are specified under Section 09 62 48. Meet Division 03 00 00 requirements.
- .3 Concrete work, including housekeeping pads, required for Division 20 00 00 work and shown on the Structural or Architectural Drawings will be provided by Division 03 00 00.
- .4 Provide other concrete work required for Division 20 00 00 work, including reinforcing steel.

2.13. STEEL

- .1 Provide steel required for Division 20 00 00 not shown on Structural or Architectural Drawings Provide steel for framing, lintels, etc. is.
- .2 Provide steel of adequate strength to support equipment and materials during all operating and test conditions. All support steel shall be secured and supported by/from building structure.

- .3 Support suspended equipment from the bottom or from manufacturer's designated suspension points. Support tanks and similar equipment with adequate beam strength by saddles with curvature to match the equipment. Continuously support other equipment.
- .4 Provide base supports for all pipe risers. Design to distribute operating and static loads.
- .5 Fabricate steel supports in contact with water or humidity conditions from materials having approved corrosion resistance or galvanize after fabrication or brush welds clean and apply a prime coat of rust inhibiting paint.

2.14. FIRESTOPPING

- .1 Provide ULC classified firestopping products by 3M, Hilti or Specified Technologies Inc. which have been tested in accordance with CAN4-S115.

2.15. WELDING AND BRAZING

- .1 All welding and brazing shall conform to the following codes and standards:
 - .1 Building Services Piping Code ANSI/ASME B 31.9 (latest edition)
 - .2 CSA B51 (latest edition), Boiler, Pressure Vessel and Pressure Piping Code
 - .3 ASME Boiler Code - Section IX
 - .4 All requirements of the Technical Standards and Safety Authority (TSSA)
- .2 Welding shall conform to a welding procedure which must be in accordance with TSSA requirements and include materials, weld preparation, heat treatment and welding equipment to be used.
- .3 Qualify welders according to ASME equivalent testing procedures. Do not use welders, on or off site, who are not qualified for the work. Maintain records for all qualification testing and provide copies to the Consultant on request.
- .4 Identify work in accordance with codes and standards. Welds shall be full penetration, continuous and without defects. After deposition, each layer of weld shall be cleaned to remove slag and scale by wire brushing or grinding, then chipped where necessary to prepare for proper deposition of the next layer. The weld reinforcement shall not be less than 1.6 mm and not more than 3.2 mm above the normal surface of the joined sections. The reinforcement shall be crowned at the centre and shall merge into the base material without excessive shoulder or undercut.
- .5 Welding shall be made by machine or manual shielded metallic arc process. Direct current shall be used exclusively with the base material on the negative side of the line. Electrodes used shall be an approved all position rod type.
- .6 Provide a copy of TSSA registration and include with Maintenance Manuals.

PART 3 - EXECUTION

3.1. EXCAVATION AND BACKFILL

- .1 Read subsurface information data. See Division 31 23 00.
- .2 Excavation and backfill required for Division 20 00 00 work inside the building and to a point 1.5 m outside building shall be carried out by the Division listed in the following schedule:

Work	Description	Responsibility
Excavation	Initial excavation to 150 mm above pipe inverts	Division 20 00 00
	Final excavation to pipe inverts	Division 20 00 00
Backfill	Initial backfill with sand to 300 mm above top of pipes	Division 20 00 00
	Final backfill to finished grade	Division 20 00 00

- .3 Ensure that excavation work is executed to attain required inverts and grades.
- .4 Remove material excavated and not to be reused, from the site.
- .5 Do all excavation, backfill and related work required for your work. Perform such work in accordance with requirements of the Division 31 23 00 Excavation and Backfill work Section, except as modified by this Article. Obtain a copy of the soil test report and review during the bidding period.
- .6 Grade the bottom of trench excavations as required.
- .7 In firm, undisturbed soil, lay pipes directly on the soil, unless otherwise directed.
- .8 Unless otherwise specified, backfill trenches within the building with clean sharp sand in individual layers of maximum 150 mm thickness compacted to a density of 100% Standard Proctor. Hand compact the first layers up to a compacted level of minimum 300 mm above the top of the pipe. Hand or machine compact the balance up to grade.
- .9 The location and inverts of existing underground site services shown on the drawings are based on available information and are assumed to be correct, however, prior to excavation, carefully check inverts and locations and report any serious discrepancy and contact Utilities to accurately locate their services.
- .10 You will be held responsible for any damage done to existing underground services caused by neglect to determine and mark out the location of such services prior to excavation work commencing.
- .11 Ensure that all underground piping subject to freezing and located outside the building has a minimum of 1370 mm of cover.
- .12 After the first lift of backfill has been compacted, mark the entire path of pipe using continuous 75 mm wide detectable identified marking tape equal to SMS Ltd. D-UGMT.

- .13 Where excavation is necessary close to and below the level of any footing, backfill with 14,000 kPa concrete to the level of the highest adjacent footing. Do not proceed with the work prior to receiving written approval from Consultant.
- .14 Obtain approval from governing authorities and Consultant before backfilling.

3.2. PIPE, DUCT AND EQUIPMENT INSTALLATION

- .1 Locate distribution systems, equipment and materials for maximum usable space, optimum service clearances and to accommodate current requirements and identified future expansion.
- .2 Coordinate Division 20 00 00 services installation above ceilings to allow installation and future relocation of lights and air terminals without interfering with or requiring relocation of mechanical, electrical or other services, or removal of ceiling grid.
- .3 Plumbing stub outs in ceiling voids for future connection by others shall be located as low as possible to provide maximum drainage runs. Vents and supply lines shall be located as high as possible to eliminate interference with other services.
- .4 Include all pipe and duct offsets required to eliminate interference with the work of other Divisions.
- .5 Install equipment and materials to present a neat appearance. Run piping, ducts and conduit parallel to or perpendicular to building planes. Conceal piping, ducts and conduit in finished areas. Install so as to require a minimum amount of furring.
- .6 Install pipe, duct and conduit straight, parallel and close to walls and slab or deck underside, with specified pitch.
- .7 Use standard fittings for all direction changes. Do not use drilled tees and other field fabricated fittings.
- .8 Install eccentric reducers in horizontal piping to permit drainage and eliminate air pockets.
- .9 Where pipe sizes differ from connection sizes of equipment, provide reducing fittings between inline components such as valves, strainers and fittings, and equipment. Reducing bushings are not permitted.
- .10 Cap open ends of piping during installation.
- .11 Lay copper tubing so that it is not in contact with dissimilar metal and will not kink or collapse.
- .12 Use non-corrosive lubricant or teflon tape equal to and apply on male thread.
- .13 Provide brass adaptors or dielectric couplings wherever dissimilar metals are joined.
- .14 No pipe to be laid in water or when, in opinion of Consultant conditions are unsuitable.

- .15 Protect buried copper and steel piping with Tapecoat materials using procedures recommended by Tapecoat Company of Canada Limited, or other approved manufacturer.
- .16 Ensure that pipe installation does not transmit vibration to the walls and floors through which they pass.
- .17 Make provisions for neat insulation finish around equipment and materials. Do not mount equipment within insulation depth.
- .18 In electrical rooms and elevator machine rooms, provide drip trays under the entire length of all pipe within the confines of the room. Pipe drip tray to nearest floor drain.
- .19 Perform pipe welding to meet ANSI B31.9.
- .20 Provide isolation valves at all take-offs from risers and as shown on drawings.
- .21 Provide isolation valves at all take-offs from piping systems as shown on drawings.

3.3. CONNECTIONS TO EQUIPMENT

- .1 Provide unions or flanges at all connections to equipment. Ensure that piping adjacent to equipment is readily removable for servicing and/or removal of equipment without shutting down entire system.
- .2 Install unions in piping up to and including 50 mm pipe size. Install flanges in piping 65 mm pipe size and larger.
- .3 Prevent galvanic corrosion by isolating copper and steel. Use red brass adapters, or completely isolate flanges using full face gaskets with bolts installed through phenolic sleeves with insulating fibre washers. Where the Plumbing Code prohibits the use of red brass adapters, use insulating couplings. Where valves are required, solid brass isolating valves may be used in lieu of adapters or couplings.
- .4 Provide metallic code rated continuity link between flanges or unions, where pipes carry flammable fluids or gases.
- .5 Make all plumbing and sheet metal connections to equipment provided by the Owner.

3.4. INSERTS

- .1 Size and space for the loads to be supported.
- .2 Properly locate and firmly secure inserts to forms before concrete is poured.
- .3 Place inserts only within main structure and not in any finishing materials.
- .4 When inserts are required in precast concrete, supply inserts and location drawings to the precast concrete supplier for casting into material. Otherwise, have precast concrete supplier install inserts at site.
- .5 Do not use powder actuated tools.

3.5. HANGERS

- .1 Suspend piping, ductwork and equipment with all necessary hangers and supports for a safe and neat installation. Ensure that pipes are free to expand and contract and are graded properly. Adjust each hanger to take its full share of the weight.
- .2 Suspend hanger rods directly from the structure. Do not suspend pipes, ducts or equipment from other pipes, ducts, equipment, or ceilings.
- .3 Provide auxiliary structural steel angles, channels and beams (vertical and horizontal) where ductwork, piping and equipment is suspended between joists or beams. All support assemblies shall be secured and supported by building structure.
- .4 Use galvanized rods, steel support angles, channels and beams where exposed to direct contact with water or to possible high humidity conditions where condensation can occur.
- .5 Space hangers to ensure that structural steel members are not over stressed. Do not space hangers further apart than indicated in the tables. When requested, submit detailed drawings showing locations and magnitude of ductwork, piping and equipment loads on the structure. Provide calculations when requested by Consultant.
- .6 Do not use trapeze type hangers for support of piping, without prior review by Consultant. Where permitted, fabricate from angle or channel frames, and space hangers to suit the smallest pipe size.
- .7 Do not use hooks, chains or straps to support equipment and materials.
- .8 Ensure that copper materials are completely isolated from ferrous materials. Use plastic or epoxy coated hangers and clamps. Use non-lead inserts between copper piping and other ferrous materials.
- .9 Provide round steel threaded rods meeting ASTM A-36. Provide cadmium plated rod and accessories where exposed to direct contact with water or to possible high humidity conditions where condensation can occur.
- .10 The following table establishes minimum standards of rod sizes and hanger spacing for steel and copper piping.

Maximum Horizontal Spacing of Supports			
Pipe Size mm	Rod Size mm	Steel m	Copper m
12	10	1.5	1.5
20	10	1.8	1.8
25	10	1.8	1.8
32	10	2.4	2.1
40	10	2.7	2.4
50	10	2.7	2.7
65	12	3.0	3.0

Maximum Horizontal Spacing of Supports			
Pipe Size mm	Rod Size mm	Steel m	Copper m
75	12	3.0	3.0
90	12	3.0	3.3
100	16	3.0	3.7
125	16	3.7	3.7
150	20	3.7	3.7
200	22	3.7	
250	22	3.7	
300	22	3.7	
350	25	3.7	
400	25	3.7	
450	29	3.7	
500	32	3.7	
600	32	3.7	

- .11 For steel pipe sizes larger than 600 mm, refer to Drawings.
- .12 In addition to these basic requirements, provide hangers in the following location:
 - .1 to eliminate vibration
 - .2 at points of vertical and horizontal change of direction of pipe
 - .3 at valves and strainers
 - .4 on mains at branch takeoffs
 - .5 to avoid stress on equipment connections
- .13 Install spring hangers or other special supports specified in Section 20 05 48.
- .14 Support horizontal cast iron soil pipe at each hub. Where groups of fittings occur, support at every three joints.
- .15 Refer to applicable articles of the Specification regarding thermal insulation requirements. Unless shown specifically on Drawings, provide the following support methods.
 - .1 For insulated warm and hot water piping, for condensate piping and for steam piping up to 65 mm diameter, support with hangers directly on piping.
 - .2 For chilled water and domestic cold water piping, hangers shall be large enough to fit over specified pipe covering. At each point of support, install specified saddles with sufficient length to prevent crushing of insulation.

- .16 Generally, support ducts with 2.7 mm by 25 mm wide galvanized hangers or with 12 mm dia. rods and 40 mm rolled angle saddles to meet SMACNA or ASHRAE Standards.
- .17 Support vertical duct risers at each floor with rolled angle collars bearing on building structure.

3.6. SLEEVES, WALL PLATES, FLOOR PLATES

- .1 Set sleeves for piping and ductwork in conjunction with erection of floors and walls. Locate sleeves accurately in accordance with submittal drawings, and as follows:
 - .1 Through interior walls, set sleeves flush with finished surfaces on both sides.
 - .2 Through exterior walls above grade, set sleeves flush with finished surfaces on inside and to suit flashing on outside.
 - .3 For floors in Mechanical Equipment Rooms, Janitors Closets, Kitchens and similar areas where a water dam is required, set sleeves flush to underside of structure and extending 50 mm above finished floor.
 - .4 For other floors, set sleeves flush to both finished surfaces. Refer to Room Finish Schedule.
- .2 Size sleeves to provide 25 mm clearance around insulated piping and ductwork.
- .3 Provide continuous insulation runs through fire separations. Ensure piping and ductwork does not touch sleeves or for warm and hot water piping and ductwork terminate insulation cover on each side of sleeve. For chilled water and domestic cold water piping, provide same thickness Manville Thermo-12 pipe insulation with all purpose vapour barrier jacket through fire separation to a point 100 mm on each side of fire separation.
- .4 Install leak tight seals to meet the manufacturer's requirements. Select inside diameter of wall sleeve opening to fit the pipe and seal leak tight.
- .5 Additional sleeving requirements:
 - .1 Provide sleeves for systems not part of Contract but identified to be required on Drawings.
 - .2 Provide sleeves to accommodate compressed air piping and wiring conduits required for Division 20 00 00 work.
 - .3 Provide sleeves to accommodate future services Include for the cost of drilling and setting sleeves.
 - .4 Fill unused sleeves through fire separations with firestop material (see Firestopping article). Fill other unused sleeves with suitable noncombustible materials.

3.7. FIRESTOPPING

- .1 Ensure that fire ratings of floors and walls are maintained.

- .2 Fill 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.
- .3 Install firestopping systems using personnel trained or instructed by the product manufacturer.

3.8. PROVISION FOR PIPE EXPANSION, CONTRACTION AND BUILDING SHRINKAGE

- .1 Make provision for pipe expansion, contraction and building shrinkage with suitable anchors, offsets or expansion loops.
- .2 Install piping to allow freedom of movement in all planes without imposing undue stress on any section of main piping, branch piping, equipment or structure.
- .3 Use offsets at takeoffs to radiation, unit heaters, fan coil units, risers and other branch lines.
- .4 Select expansion joints for the calculated movement according to the following temperature ranges.
 - .1 For cold pipes, from minimum operating temperature to 38°C, plus 25% safety factor.
 - .2 For warm and hot pipes, from minimum ambient, but not lower than - 5°C, to maximum operating temperature plus 25% safety factor.
- .5 Where ambient temperature during installation is higher than operating temperature, use precompressed expansion joints.
- .6 Select expansion joints to withstand system test pressure, as well as operating pressures and temperatures.
- .7 Install expansion joints in accordance with manufacturer's published instructions.
- .8 During the construction and warranty periods, regularly review provisions for building shrinkage and make necessary adjustments to ensure freedom from binding and stress.

3.9. PIPE GUIDES AND ANCHORS

- .1 Install pipe guides for expansion joints according manufacturer's published recommendations. Use at least two guides on each side of expansion joint.
- .2 Install manufactured or field fabricated alignment guides to allow movement in axial direction only.
- .3 Install vertical risers properly anchored and guided to maintain accurate vertical position of piping. At time of startup, clean and lubricate guides, and adjust to allow free sliding at operating conditions.
- .4 For piping up to and including 75 mm, guide pipes at every floor or every 3900 mm. Guide larger pipes at every second floor or every 7500 mm.

- .5 Fabricate anchors from structural steel channels, plates or angles. Submit detailed shop drawings of anchors.
- .6 Secure anchors to the structure. Avoid introduction of excessive reactive forces and operating weights into the structure and onto equipment and piping.
- .7 Where guides are provided on cold piping, provide thermal break to prevent sweating.
- .8 Where mains or branches connect to risers, the first point of support of the main or branch shall be a spring type hanger to allow movement of the riser.

3.10. PAINTING

- .1 Paint all ferrous metal work except piping, galvanized and stainless steel ductwork, with one factory prime coat, or paint one prime coat on site.
- .2 Clean and steel brush surfaces with welds. Then prime coat all steel supports and brackets.
- .3 On uninsulated piping, steel brush and prime coat welds.
- .4 Touchup or repaint surfaces damaged during shipment or installation and leave ready for finish painting.
- .5 Prime coat material shall conform to Canadian General Standards Board Standard No. 1-GP-48.
- .6 Finish painting will be provided by Division 09 90 00.
- .7 All exposed mechanical services shall be painted as specified by architectural drawings and specifications.

3.11. ADDITION OF NEW CIRCUITS

- .1 Before any new system is connected to an existing system, the new system shall be separately cleaned and treated by the specified method. No system may be connected to an existing system unless certified clean by the Contractor and inspected by the Consultant.

3.12. WELDING AND BRAZING INSPECTION

- .1 Make welding and brazing work for all welded piping including HTHW and high pressure steam available at any time for inspection by the Consultant. Welded joints shall be gamma-ray radiographed by an independent specialized firm, whose appointment shall be subject to the Consultant's approval. Submit name and qualifications to the consultant for review. Perform radiography in accordance with CSA Code B51.
 - .1 Ten (10) line joints in piping subject to high working pressure and five (5) in other piping, as selected by the Consultant from the first 50 production welds in each pressure category.
 - .2 Additional joints to a maximum of 1% of all weld joints.
 - .3 Radiograph all above joints over the full circumference.

- .4 For every failure, two additional joints shall be selected by the Consultant for testing.
- .2 Examine weld preparation and welding on site and off site at various stages of fabrication.
- .3 Testing firm shall submit written evaluations of all testing.
- .4 Make all radiographic film evidence of tested welds available for examination by the Consultant. Turn over original films for Owner's files.
- .5 Failure of any retests by one welder shall result in examination of that welder's qualifications and test work. Further testing will be required in that welder's work without additional cost to the Contract.
- .6 Any welds found to be of poor or doubtful quality shall be cut out and replaced with satisfactory welds.
- .7 One or more of the following defects shall be cause for rejection of a weld:
 - .1 failure to meet radiographic requirements or other code tests
 - .2 welding performed by unqualified personnel
 - .3 welds not reasonably uniform in appearance
 - .4 evidence of peeling
 - .5 cracks
 - .6 oxidation around welds
 - .7 lack of fusion
 - .8 the presence of porosity, slag inclusion or overlaps
 - .9 undercutting adjacent to completed welds or evidence of undercutting by grinding
- .8 Maintain full records of testing and submit copies to Consultant. Show details of each inspection, with the radiograph recording and the name and identification of the welder. Provide the test results within 24 hours of test.

3.13. GENERAL PIPING AND DUCTWORK INSTALLATION REQUIREMENTS

- .1 It is critical that all mechanical services be installed as tight to the underside of structure as possible. Locate and arrange all pipes and ducts as high as possible above the ceiling on floors on which they are shown, arranged so that under consideration of all other work in the area, the maximum ceiling height and/or usable space is maintained. If required to maintain ceiling heights, reroute and/or resize ductwork as required when directed to do so by Consultant.
- .2 Install mechanical systems as high as possible. Coordinate scope of work with other trades prior to installation to ensure a coordinated installation. Where required, install mechanical systems in joist/structure space. Install all sprinkler

mains and branches in joist space where joists existing or tight to underside of concrete.

- .3 Coordinate mechanical and electrical services and install such that "layering" of services is minimized. Offset services as required to minimize crossing.
- .4 Maintain the specified ceiling height while allowing 200 mm clear for lighting below all mechanical services.
- .5 Unless otherwise specified, install all work concealed in finished spaces, and concealed to the degree possible in partially finished and unfinished spaces. Refer and examine the Architectural drawings and room finish schedules to determine finished, partially finished, and unfinished areas. Note that walls which are painted are considered finished.
- .6 Install all pipes and ducts parallel to building lines and to each other.
- .7 Neatly group and arrange all exposed work.
- .8 Locate all work to permit easy access for service or maintenance as required and/or applicable. Locate all valves, dampers and any other equipment which will or may need maintenance or repairs and which are 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 the accessories at the floor level.
- .9 Make all connections between pipes of different materials using proper approved adapters. Provide cast brass dielectric type adapters/unions at connections between ferrous and copper pipe.
- .10 Ensure that equipment and material manufacturer's installation instructions are followed unless otherwise specified herein or on the drawings and unless such instructions contradict governing codes and regulations.
- .11 Carefully clean all ducts, pipe and fittings prior to installation. Temporarily cap or plug ends of pipe, ducts and equipment which are open and exposed during construction.
- .12 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 the pipe or duct, except for ductwork at fire barriers, in which case the insulation will be terminated at each side of the duct fire damper.
- .13 Inspect surfaces and structure prepared by other trades before performing your work. Verify that surfaces or the structure to receive your work have no defects or discrepancies which could result in poor application or cause latent defects in installation and workmanship. Report defects in writing. Installation of your work will constitute acceptance of such surfaces as being satisfactory.
- .14 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 the piping prior to being concealed.

- .15 For factory applied finishes, repaint or refinish all surfaces damaged during shipment and installation. The quality of the repair work is to match the original finish. This requirement also applies to galvanized finishes.
- .16 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 the products to protect against corrosion or provide products which will not corrode in the environment, i.e. aluminum ductwork, copper or stainless steel pipe, etc.
- .17 Whether shown or specified on the drawings or not, provide screwed unions or flanges in all piping connections to equipment, and in regular intervals in long (in excess of 12 m) piping runs to permit removal of sections of piping.

3.14. PIPE JOINT REQUIREMENTS

- .1 Do not make pipe joints in walls or slabs.
- .2 Ream all 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 the pipe has been screwed into the fitting, valve, union, or piping accessory, not more than two pipe threads are to remain exposed.
- .4 Site bevel steel pipe to be welded or supply mill beveled pipe. Remove all scale and oxide from the bevels and leave smooth and clean. Use factory made welding tees or welding outlet fittings for piping branches off mains. Do not use shop or site fabricated fittings unless written approval has been obtained.
- .5 Welded joints are to be made by CWB certified, licensed journeyman welders qualified in accordance with CSA B51, Boiler Pressure Vessel and Pressure Piping Code, and who are in possession of a proper certificate of qualification for each procedure to be performed. Each weld is to be identified with the welder's identification symbol, and welds are not to be concealed until they have been inspected and approved. Electrodes are to be in accordance with CSA W48 Series, Electrodes, and requirements of CAN/CSA W117.2, Safety in Welding, Cutting and Allied Processes are to be followed.
- .6 Unless otherwise specified, make all flanged joints with Cranite Ltd. or equivalent gasket materials to suit the application, and bolts and nuts. Bolts are not to be longer than the length necessary to screw the nut up flush to the end of the bolt. Bolts used for flanged connections in all piping with a working pressure of 690 kPa 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 the flange and between each nut and the flange.
- .7 A random check of bolted flanged connections will be made to verify that flanged connections are properly mated with no shear force acting on bolts. Supply all labour to disconnect and reconnect the selected flanged joints. If improperly mated joints are found, remove and reinstall the affected piping so that the flanges mate properly. If improperly mated joints are found, additional joints will be checked, and you will be responsible for the repair of any other improper joints discovered.

- .8 Unless otherwise specified, make all soldered joints in copper piping using flux suitable for and compatible with the type of solder being used. Clean the outside of the pipe end and the inside of the fitting, valve, or similar accessory prior to soldering.
- .9 Install mechanical joint fittings and couplings in accordance with the manufacturer's instructions.
- .10 Grooves for mechanical grooved coupling systems are to be rolled. Make arrangements with the coupling and fitting manufacturer for shop and/or site instructions and demonstrations as required and adhere to the manufacturer's instructions with respect to pipe grooving, support, type of gasket requirement, anchoring and guiding the grooved piping system. Coupling and fitting manufacturer shall periodically visit job site and review installation.
- .11 Solvent weld PVC piping in two parts, primer stage and cementing stage, in accordance with the manufacturer's recommendations, ASTM D2855, and CSA requirements.

3.15. PIPE LEAKAGE TESTING

- .1 Before new piping has been insulated or concealed, and before equipment, fixtures and fittings have been connected, test all piping for leakage.
- .2 Tests are to be witnessed by the 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 For gravity drainage and vent piping, securely close all openings and pipe ends and fill piping with water up to the highest level and ensure that the water stands at the same level for a minimum of two hours. After the fixtures and fittings are set and the pipes connected to the building drain or drains, turn on water into all pipe, fixtures, fittings and traps in order to detect any imperfect material or workmanship. Make a smoke test if required by the Municipality. At your option, drain and vent piping may be pressure tested with cold water at 345 kPa for two hours with zero leakage.
- .5 Test domestic water piping with cold water at a pressure of 1½ times normal working pressure and maintain the pressure for a minimum of two hours.
- .6 Test all CO2 fire extinguishing 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.
- .7 Test heat transfer (HVAC) system piping with cold water at a pressure of 1035 kPa for a minimum of two hours.
- .8 Test refrigerant piping for leakage and dehydrate in accordance with requirements of Chapter 18 of the ASHRAE HANDBOOK - FUNDAMENTALS.

- .9 The following requirements apply to all testing:
 - .1 ensure that all piping has been properly flushed, cleaned and is clear of foreign matter prior to pressure testing;
 - .2 temporarily remove or valve off all piping system specialties or equipment which may be damaged by test pressures prior to pressure testing the systems, and flush piping to remove foreign matter;
 - .3 when testing is carried out below the highest level of the particular system, increase the test pressure by the hydrostatic head of 7 kPa for every 600 mm below the high point;
 - .4 include for temporary piping connections required to properly complete the tests;
 - .5 piping under test pressure is to have zero pressure drop for the length of the test period;
 - .6 make tight leaks found during tests while the piping is under pressure, and if this is impossible, remove and refit the piping and reapply the 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 the number of tests required;
- .10 In addition to the leakage tests specified above, demonstrate proper flow throughout the systems including mains, connections and equipment, as well as proper venting and drainage, and include for any necessary system adjustments to achieve the proper conditions.

3.16. EQUIPMENT BASES AND SUPPORTS

- .1 Unless otherwise specified or required, set all floor mounted equipment on minimum 100 mm high reinforced concrete housekeeping pads 200 mm clear of the equipment on each side and end, or a minimum of 200 mm from the centre line of equipment anchor bolts to the edge of the base, whichever is larger. Provide all curbs for all equipment everywhere on this project. Conform to the 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 the concrete pour and be responsible for all required levelling, alignment, and grouting of the 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 the following requirements:

- .1 all stands and supports, except those for small equipment, are to be designed by a structural engineer registered in the jurisdiction of the work, and stamped and signed design drawings with calculations are to be submitted as shop drawings for review;
 - .2 all steel stands are to be flange bolted to concrete housekeeping pads;
 - .3 all stands and supports are to be seismically restrained in accordance with applicable requirements.
- .3 Provide welded, cleaned and prime coat painted structural steel platforms where shown for service access to equipment. Access platforms are to be designed by a structural engineer registered in the jurisdiction of the work and stamped and signed shop drawings with calculations are to be submitted as shop drawings for review. Service access platforms are to conform to the following requirements:
- .1 platforms are to be in accordance with OSHA requirements and are to be adequately sized, braced, anchored, and as required, seismically restrained;
 - .2 flooring is to be Fisher & Ludlow "Tru-Weld" Type 19-4, Borden type W/B (19-W-4), or equal, welded steel bar type grating;
 - .3 support legs are to be 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 dia. Schedule 40 black steel pipe are to be provided for all platforms and are to be complete with vertical stanchions at maximum 1.2 m centres, top and intermediate horizontal railing, and toe plates at the floor;
 - .5 vertical ladders are to be constructed of Schedule 40 black steel pipe, 25 mm dia. for equal height rungs, 40 mm for stringers, anchored to floors and walls and sway braced as required;
 - .6 ships ladders, which are to be used wherever space conditions permit, are to be of welded steel construction, are to climb at an approximate 60° angle, and are to be complete with channel iron stringers, open grate equal height risers approximately 165 mm wide and factory made by the grating manufacturer, handrails, and suitable anchoring and support.

3.17. USE OF MECHANICAL SYSTEMS FOR TEMPORARY HEATING

- .1 Permanent building mechanical systems are not to be used for temporary heating purposes during construction.

3.18. MAINTAINING EQUIPMENT PRIOR TO ACCEPTANCE

- .1 Maintain all 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 aluminum tubing.
- .4 All filters are to be new upon Substantial Performance of the work. This is in addition to any spare filters specified.

END OF SECTION

PART 1 - GENERAL1

1.1. WORK INCLUDED1

1.2. SUBMITTALS1

1.3. ENVIRONMENTAL REQUIREMENTS1

1.4. QUALITY ASSURANCE1

PART 2 - PRODUCTS.....1

2.1. MATERIALS - GENERAL1

2.2. PIPE INSULATION2

2.3. SHEET METAL INSULATION.....5

PART 3 - EXECUTION6

3.1. PROTECTION6

3.2. INSTALLATION6

PART 1 - GENERAL

1.1. WORK INCLUDED

- .1 Comply with Division 01 00 00, General Requirements.
- .2 Provide all labour, materials, products, equipment and services to supply and install thermal insulation, vapour barriers and finishes for mechanical work as indicated on the Drawings and in these Specifications.
- .3 Insulation thermal performance values and thicknesses shall meet the most stringent requirements of both The National Energy Code of Canada for Buildings 1997 and ASHRAE 90.1-2013.

1.2. SUBMITTALS

- .1 Submit samples and specification sheets of insulation materials. Include manufacturer's installation instructions.

1.3. ENVIRONMENTAL REQUIREMENTS

- .1 Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics and insulating cements.
- .2 Ensure items to be insulated are dry and clean to not promote the growth of moulds.

1.4. QUALITY ASSURANCE

- .1 Insulation materials shall be manufactured to meet ISO 9000 quality standards.

PART 2 - PRODUCTS

2.1. MATERIALS - GENERAL

- .1 All insulation pertaining to Division 23 00 00 shall be carried out by one firm specializing in insulation work. Do not mix similar products of multiple manufacturers.
- .2 Provide non-combustible insulation, jackets and finishes having a Flame Spread/Smoke Developed rating of 25/50 or less, meeting CAN/ULC S-102-M88 requirements or NFPA 90a, 101 and 255.
- .3 In high humidity environments (greater than 60% RH average ambient condition) all insulation materials shall be of the closed cell type which shall not permit the growth of molds if the insulation or insulation cover is cut, punctured or damaged.
- .4 Attain a complete and continuous vapour barrier over insulation applied to cold and dual temperature piping, sheet metal and equipment. Use Owens Corning Fiberglas "Evolution" paper free All Service Jacket and SSL II adhesive. Apply to piping, fittings, valves and inline components, sheet metal, fittings and equipment. Seal longitudinal and circumferential laps with manufacturers recommended adhesive.
- .5 Re-cover all exposed insulation and insulation finishes with minimum 0.20kg/square metre canvas, and two applications of Childers CP50 or Bakor

120-09 white fire resistant coating. In mechanical rooms where insulation is exposed cover with PVC jacket and fitting covers installed as per manufacturer's instructions and conforming to the specified Flame Spread/Smoke Developed Rating.

- .6 Re-cover insulation and insulation finishes outside the building or exposed to the weather with one 1.5mm thick layer of Childers Encacel X or Bakor 110-26 fire retardant black mastic vapour barrier coating. Embed a layer of woven glass reinforcing fabric into the wet coating, lapping ends and edges at least 75mm. Apply a top coating of 1.5mm thick Encacel X or Bakor 110-26 over the entire surface of the fabric. Seal the entire covering to achieve a watertight assembly.

2.2. PIPE INSULATION

- .1 Provide insulation materials with a maximum thermal conductivity of 0.036 W/m.°C at 38°C mean temperature.
- .2 On hot piping applications, hold insulation in place with flare type staples (outward clinch).
- .3 On cold and dual temperature piping applications, apply vapour barrier jacket over insulation and seal longitudinal and circumferential laps with Childers CP82 or Bakelite 230-39 adhesive. Seal all pipe terminations, including fittings, wall penetrations and pipe supports with vapour barrier mastic. For chilled water and brine systems provide vapour seal pipe terminations every four (4) pipe sections.
- .4 Apply pipe insulation over 40mm in thickness in two layers with joints staggered.
- .5 Insulate fittings with fabricated mitered or preformed sections of specified insulation.
- .6 Insulate over flanges and mechanical couplings with specified insulation and thickness, sized to suit flange diameters. Fill spaces between insulation and adjoining pipe insulation with similar material.
- .7 Insulate valves and inline components with flexible insulation density 12kg/cubic metre compressed not more than 50% of original thickness. Build up to specified thickness with approved asbestos free finishing cement.
- .8 Do not insulate terminal unit automatic control valves installed in hot piping. Do not insulate terminal unit automatic control valves which are installed in cold and dual temperature piping and which are located over condensate drain pans.
- .9 Provide removable 1.31mm galvanized sheet metal enclosures lined with Armaflex FS sheet insulation 25mm thickness on pipeline strainers to facilitate screen access.
- .10 Under all hangers used on chilled water and domestic cold water, provide an insert between support shield and piping for piping 38 mm or larger. Fabricate using T-12 calcium silicate or other high density insulating material suitable for temperature application. Ensure that the vapour barrier remains intact and continuous. Insulation inserts shall not be less than the following lengths:

<u>Pipe Size</u>	<u>Length</u>
40 mm - 60 mm	250 mm
75 mm - 150 mm	300 mm
200 mm - 250 mm	400 mm
300 mm and over	550 mm

.11 Provide one of the following pipe insulation types, and as scheduled in the Pipe Insulation Table.

- .1 Type P1: Owens Corning 850 Pipe Insulation, Johns Manville Micro-Lok AP-T PLUS Fiberglas Pipe Insulation, Manson Fiberglas Pipe Insulation or Knauf Pipe Insulation with factory applied paper free ASJ vapour barrier jacket where scheduled.
- .2 Type P2: Johns Manville Thermo 12 Gold throughout molded hydrous calcium silicate, or Roxul Enerwrap 80 mineral fibre blanket, asbestos free pipe insulation. Insulation shall be banded securely in place with 20mmx0.5mm stainless steel bands on maximum 300mm centres.
- .3 Type P3: Owens Corning Flex-Wrap Pipe Insulation, Johns Manville Pipe & Tank, Manson Multi-Flex or Knauf Flex-Wrap with protective reinforced foil scrim, 48 kg /cubic metre density.
- .4 Type P4: Direct bury or underground piping: Pittsburg Corning Foamglas cellular glass insulation, meeting ASTM C 552-00 and CGSB 51-GP-38 Insulation shall be banded securely in place with 20mmx0.5mm stainless steel bands on maximum 300mm centres. Wrap insulation finish with Pittwrap 125 mil heat sealable multiply laminate.
- .5 Type P5: High Humidity. Kingspan (Kooltherm) www.insulation.kingspan.com or Resolco Insulphen phenolic CFC free preformed pipe insulation, with factory applied reinforced aluminum foil jacket and which meets or exceeds BS 3927:1989, Table 1, Type A. For grooved coupling piping systems use Kooltherm high density phenolic foam preformed covers and jointing systems. Or Resolco International BV Insul-Phen phenolic foam insulation listed by CAN/ULC S-102-M88 for smoke and S-127- 1988 for flame spread.

.12 Pipe Insulation Table:

No	Duty	Insulation Type	Thickness	Vapour Barrier
1	Domestic cold water and non-potable water			
	100mm and less	P-1	12mm	Yes
	125mm and larger	P-1	25mm	Yes

No	Duty	Insulation Type	Thickness	Vapour Barrier
2	Domestic hot and domestic tempered water, and domestic hot water and tempered water recirculation 32mm and less 40mm and larger	P-1 P-1	25mm 40mm	No No
3	Primary heated water supply and return, and secondary heated water supply and return (Below 94°C) 32mm and less 40mm and larger	P-1 P-1	40mm 50mm	No No
4	Horizontal storm drain and horizontal sanitary drainage all pipe sizes	P-1	25mm	Yes
5	Horizontal condensate drains except with fan coil unit enclosure all pipe sizes	P-1	12mm	Yes
6	Refrigerant piping suction lines 4.4°C and above Refrigerant piping suction lines below 4.4°C 25 mm and smaller 32 mm and larger	P-1 P-1 P-1	25mm 25mm 40mm	Yes Yes Yes

.13 In lieu of specified pipe insulation, where permitted by governing authorities, and in concealed locations, Imcoa Polyolefin or Armstrong AP Armaflex FS pipe insulation in nominal 12mm thickness may be substituted for the following applications, on piping not exceeding 100mm diameter, and shall be applied in strict accordance with manufacturer's recommendations.

- .1 domestic cold water
- .2 domestic hot and tempered water
- .3 domestic hot and tempered water recirculation

- .4 heated water, chilled water and dual temperature water runouts concealed behind perimeter enclosure
- .5 condensate drains

2.3. SHEET METAL INSULATION

- .1 Provide insulation with a maximum thermal conductivity of 0.036 W/m.°C at 24°C mean temperature.
- .2 Prior to finishing of insulation of hot and cold exposed rectangular ductwork, provide corner beads similar to Roll-on Type.
- .3 Apply vapour barrier over insulation on cold and dual temperature ducts.
- .4 Circular silencers and acoustic plenums need not be externally insulated.
- .5 Ductwork and casings lined with acoustic insulation 25mm or more in thickness need not be externally insulated. Refer to Section 23 31 00 for Acoustic Insulation.
- .6 Distribution ductwork below access floors in under floor air distribution systems (UFAD) need not be insulated.
- .7 Insulation of ducts in unconditioned spaces is required where there is a possibility of condensation forming on the either surface of a duct. That is a warm duct in a cool space or a cold duct in a warm space.
- .8 Provide one of the following external sheet metal insulation types, and as scheduled in the Sheet Metal Insulation Table.
 - .1 Type D1: Owens Corning Rigid Duct Insulation, Johns Manville 814 Spin-Glas, Manson 800 Series Spin-Glas Rigid Insulation Board or Knauf Rigid Insulation Board, not less than 48kg/cubic metre density. Impale insulation on mechanically fastened pins located at not greater than 300mm centres. Secure insulation with speed washers.
 - .2 Type D2: Owens Corning Flexible Duct Insulation, Johns Manville Microlite type 75 Duct Wrap, Manson Microlite Duct Wrap or Knauf Duct Wrap, 12kg/cubic metre density. Adhere insulation to duct surface with Childers CP82 or Bakelite 230-39 adhesive, which shall be applied in strips 150mm wide at not greater than 300mm centres. Lap all edges at least 50mm and secure insulation with fire resistant tying cord, similar to Fiberglas EC9-4-T. Take care that insulation is not compressed to less than specified thickness. It is recognized that some compression of insulation will take place immediately under tying cord, but in no case shall the thickness of the compressed material be less than 75% of original specified thickness.
 - .3 Type D3: Owens Corning Rigid Vapour Seal Duct Insulation, Johns Manville 814 Spin-Glas with FSK Facing, Manson Spin-Glas Rigid Insulating Board with reinforced foil facing, or Knauf Rigid Insulation Board with FSK facing. Density shall be not less than 48kg/cubic metre. Impale on mechanically fastened pins located at not greater than 300mm centres. Secure with speed washers. Butt joints tightly together and seal washers, breaks and joints with self-adhering 100mm wide plain

aluminum tape, or adhere foil with Childers CP82 or Bakelite 230-39 adhesive.

.9 Sheet Metal Insulation Table

No	Duty	Insulation Type	Thickness	Vapour Barrier
1	Exhaust ducts between motorized dampers and building exterior or final 3m of exhaust air ducts whichever is greater. Ducts in unconditioned spaces.	D3	25mm	Yes
2	Rectangular hot supply ducts	D1	25mm	No
3	Round hot supply ducts	D2	40mm	No
4	Cold and dual temperature supply ducts – exposed or concealed	D3	25mm	Yes

PART 3 - EXECUTION

3.1. PROTECTION

- .1 Protect the work of other trades with tarpaulins.
- .2 Protect the work of this trade from being defaced by other trades. Make good any damage and leave in perfect condition, ready for final painting.

3.2. INSTALLATION

- .1 Apply insulation over clean dry surfaces, firmly butting all sections together.
- .2 Apply insulation, vapour barriers and insulation finishes in strict accordance with manufacturer's recommendations.
- .3 Do not cover equipment nameplates with insulation.
- .4 Coordinate related work with other Divisions.

END OF SECTION

PART 1 - GENERAL	1
1.1. WORK INCLUDED	1
1.2. REFERENCE STANDARDS	1
1.3. QUALITY ASSURANCE	2
1.4. SUBMITTALS	2
PART 2 - PRODUCTS	2
2.1. DISPOSAL OF MATERIALS	2
2.2. SALVAGEABLE ITEMS	2
PART 3 - EXECUTION	2
3.1. GENERAL INSTRUCTIONS	2
3.2. STORAGE OF MATERIALS	3
3.3. PROTECTION OF OWNERS PREMISES	3
3.4. RESTRICTIONS ON USE OF PREMISES	4
3.5. PRE-DEMOLITION AUDIT	4
3.6. PREPARATION	4
3.7. INTERRUPTION OF EXISTING SERVICES	4

PART 1 - GENERAL

1.1. WORK INCLUDED

- .1 These Specifications are an integral part of the Contract Documents. Tendering and Contract Requirements and Division 01 00 00, General Requirements apply to all Division 20 00 00 Specification Sections.
- .2 Provide labour, materials, products, equipment and services required to complete the demolition work specified herein.
- .3 Refer to Drawings for extent of demolition work. The drawings indicate the approximate locations of services as far as these are known.
- .4 Dispose, off site, of all debris in accordance with the jurisdictional authorities.
- .5 Removal and storage of salvageable items will be as directed by this specification section and the Owner or their representative.
- .6 During the course of this work, suspected hazardous or contaminated materials will probably be encountered. The Owner has engaged the services of **Pinchin Ltd.** to carry out a contaminated materials survey. The results of this survey are available by request.
- .7 Obtain the services of analysts of Pneumatic Systems Ltd, Contact info: Dave Strain, Ph: 905-640-23333, for all pneumatic demolition work.
- .8 Mechanical demolition work associated with this building is indicated on the demolition drawings and generally and consists of the following:
 - .1 Plumbing and Drainage
 - .2 HVAC systems and equipment
 - .3 Building Control Systems

1.2. REFERENCE STANDARDS

- .1 Meet the requirements and recommendations of all Municipal, Provincial and Federal Bylaws and Ordinances.
- .2 Execute this work in accordance with the latest edition of the following codes and standards.
 - .1 CAN/CSA-S350-M1980 - Code of Practice for Safety in Demolition of Structures.
 - .2 Ontario Building Code.
 - .3 Occupational Health and Safety Act.
 - .4 Regulations for Construction Projects.
 - .5 Ontario Fire Code.
 - .6 Regulations under Fire Marshals Act.

1.3. QUALITY ASSURANCE

- .1 All work shall be performed by a firm having adequate equipment and skilled labour and being able to provide written evidence of satisfactorily completed work, similar to that specified during the past immediate five (5) years.
- .2 Removal from site and disposal of debris shall be carried out in accordance with the requirements of the local jurisdictional authorities.
- .3 Arrange and pay for all permits, notices and inspections necessary for the proper execution and completion of the demolition work.

1.4. SUBMITTALS

- .1 Submit shop drawings as requested by the consultant, indicating demolition sequence, cutting and patching, bracing and protection of existing services designated to remain.

PART 2 - PRODUCTS

2.1. DISPOSAL OF MATERIALS

- .1 All materials which have not been designated for salvage from the demolition shall become the property of the Contractor. Remove all material and debris from the site as quickly as possible and dispose of legally. Burning of debris or selling of materials on the site will not be permitted.
- .2 Present to the Owner existing equipment removed but not identified for salvage on site. Acceptance of removed equipment is at the discretion of the Owner. Remove such items from site when deemed unsuitable.
- .3 Conform to requirements of municipality's Works Department regarding disposal of waste materials.
- .4 Materials prohibited from municipality waste management facilities shall be removed from site and disposed to recycling companies specializing in recyclable materials.

2.2. SALVAGEABLE ITEMS

- .1 The following is a list of salvageable items to be carefully disconnected, removed and turned over to the Owner:
 - .1 Plumbing fixtures and trim.
 - .2 Fire extinguishers
 - .3 Controls such as control valves, actuators, thermostats and EMCS network hardware.

PART 3 - EXECUTION

3.1. GENERAL INSTRUCTIONS

- .1 At the end of each work shift, leave work in a safe condition.

- .2 Patch fire rated partitions and floors to maintain rating upon removal of mechanical services originally spanning fire rated assembly.
- .3 Demolish work into sections of practical size for removal without alteration or damage to existing building.

3.2. STORAGE OF MATERIALS

- .1 Store materials only in areas designated by the Owner and as permitted by the local jurisdictional authorities.
- .2 Materials and debris shall not be stacked in building to the extent that overloading of any part of the structure will occur.

3.3. PROTECTION OF OWNERS PREMISES

- .1 Adhere strictly to the Owner's requirements.
- .2 Confer with the Owner concerning schedule, dust and noise control prior to commencing work in or adjacent to existing facilities where such work might affect either those facilities or their occupants.
- .3 Execute work with least possible interference or disturbance to occupants, public and normal use of premises.
- .4 Provide temporary means to maintain security when security has been reduced by Division 20 00 00.
- .5 Only elevators, dumbwaiters, conveyors or escalators assigned for Contractor's use may be used for moving men and material within building. Protect walls of passenger elevators, to approval of Owner prior to use. Accept liability for damage, safety of equipment and overloading of existing equipment.
- .6 Provide temporary dust screens, barriers, and warning signs in locations where renovations and alteration work is adjacent to areas which will be operative during work.
- .7 Protect all mechanical systems, indicated to remain, from damage.
- .8 Provide and maintain ready access to firefighting equipment at all times.
- .9 Provide and maintain proper and suitable fire extinguishers throughout the duration of the work.
- .10 The drawings indicate the approximate locations of services as far as these are known. Should any mechanical or electrical service line be broken, or disrupted by operations specified under this contract, repair service lines, and make good all damage due to the disruption or break, at no expense to the Owner. Notify the Owner immediately whenever any service line is broken or damaged.
- .11 The drawings indicate the approximate locations of services as far as these are known. Immediately advise Consultant in writing when unknown services are encountered.
- .12 Accept liability for costs incurred by the Owner in repairing and cleaning equipment, etc., resulting from failure to comply with the above requirements.

3.4. RESTRICTIONS ON USE OF PREMISES

- .1 Use only those existing entrances and stairs designated by the Owner for access to and egress from the existing buildings and various floors where work of this contract is to be carried out. No traffic through other areas of the building will be permitted without the prior consent of the Owner.
- .2 Keep stairs and corridors clear and open as required by Fire Marshall for exit purposes in case of fire, and as required for use by the Owner's personnel.
- .3 Owner will designate which toilet facilities may be used.

3.5. PRE-DEMOLITION AUDIT

- .1 The Division 20 00 00 contractor shall, in the presence of the Owner and the Consultant, conduct a pre-demolition audit to determine exactly which materials in the existing building are to be included in the demolition work and which materials can be either reused by the Owner or resold by the Contractor. Submit, in writing, to the Owner, findings from the audit.
- .2 Items from demolition which will be disposed of shall be so done in accordance with the applicable requirements of the "Build Green Project" in force at the place of work, at the time of this work.

3.6. PREPARATION

- .1 Notify the consultant a minimum of **48 hours** prior to commencing this work.
- .2 Prior to commencing this work arrange to have the appropriate trades concerned present for the disconnection of all utility services.
- .3 Ensure that all existing services designated to remain are adequately protected.

3.7. INTERRUPTION OF EXISTING SERVICES

- .1 Arrange, schedule and perform work with minimum disturbance to existing facilities and services.
- .2 Submit a complete schedule of service interruptions and changeovers with approximate dates required, durations and times of day, for approval before proceeding.
- .3 Notify Owner in writing at least 72 hours in advance of planned interruption to existing services.
- .4 Interruption of service must occur at the times and for the duration stipulated by the Owner.
- .5 Keep service interruption duration to an absolute minimum. Carry out all preparatory work, measurements, etc., without interruption of existing services.
- .6 If service interruptions are required by the Owner during the night or on weekends, etc., premium time shall be included at the Contract Price. No extra charges will be allowed at a later date for failure to include same.

END OF SECTION

PART 1 - GENERAL	1
1.1. WORK INCLUDED	1
PART 2 - PRODUCTS	1
2.1. PIPE AND FITTINGS	1
2.2. VALVES	2
PART 3 - EXECUTION	3
3.1. VERIFICATION OF INVERTS.....	3
3.2. BRACED SEWER PIPE JOINTS	3
3.3. PIPE EXPANSION	3
3.4. TESTING.....	4
3.5. CLEANING AND FLUSHING SEWERS	4
3.6. CLEANING, FLUSHING AND DISINFECTING WATER PIPING.....	4
3.7. CONNECTIONS TO OWNER'S EQUIPMENT.....	5
3.8. CONNECTIONS TO LABORATORY EQUIPMENT	5

PART 1 - GENERAL

1.1. WORK INCLUDED

- .1 Comply with Division 01 00 00, General Requirements and all documents referred to therein.
- .2 Provide all labour, materials, products, equipment and services to supply and install the plumbing and drainage inside the building to point of connection outside the exterior building wall as indicated on the Drawings and specified in this Section.

PART 2 - PRODUCTS

2.1. PIPE AND FITTINGS

- .1 Provide chrome plating on all exposed piping within washrooms.
- .2 Drainage and Vent Piping:

	Pipe Size 65 mm and Smaller	Pipe Size 75 mm and Larger
Sanitary - Above Ground and Condensate	DWV copper pipe with drainage fittings and 95/5 tin/antimony solder joints.	CSA Series 4000 cast iron hubless soil pipe and fittings, with SD 4000 heavy duty mechanical joint couplings.
Sanitary - Below Ground	ABS (DWV) pipe or Profile PVC sewer pipe with solvent welded fittings.	CSA Series 4000 cast iron hubless soil pipe and fittings, with mechanical joints or IPEX Ring-Tite SDR35, CSA certified to B182.2 PVC gasketed or solvent welded sewer pipe and fittings.
Acid Waste	IPEX Plenumline Acid Resistant Piping	IPEX Plenumline Acid Resistant Piping
Vent Piping - Above Ground	DWV copper pipe with drainage fittings, 95/5 tin /antimony solder joints.	CSA Series 4000 cast iron soil pipe and fittings with SD 4000 heavy duty mechanical joint couplings.
Vent Piping - Below Ground	ABS (DWV) pipe or Profile PVC sewer pipe with solvent welded fittings.	CSA Series 4000 cast iron soil pipe and fittings, with SD 4000 heavy duty mechanical joint couplings, or IPEX Ring- Tite SDR35, CSA certified to B182.2 PVC gasketed or solvent welded sewer pipe and fittings.

	Pipe Size 65 mm and Smaller	Pipe Size 75 mm and Larger
Acid Vent Piping	IPEX Plenumline Acid Resistant Piping	IPEX Plenumline Acid Resistant Piping

- .1 Where mechanical joints are used, provide bracing across all joints on piping larger than 150 mm diameter, refer to details on drawings.
- .2 Sewers may surcharge, causing the build up of internal pressure in gravity sewers. Ensure that piping is properly braced and rigidly supported to withstand such pressure.
- .3 Domestic Water
 - .1 Domestic hot water and recirculation - all sizes up to 100 mm diameter:
 - .1 Type L hard copper pipe, wrought copper fittings with 95/5 tin/antimony solder joints.
 - .2 Domestic cold water and domestic chilled water all sizes up to 100 mm diameter.
 - .1 Type L hard copper pipe, wrought copper fittings with 95/5 tin/antimony solder joints.
 - .3 Domestic cold water sizes over 100 mm diameter
 - .1 Type L hard copper pipe, wrought copper fittings with 95/5 tin/antimony solder joints.
 - .2 304/304L Stainless Steel pipe with stainless steel fittings.
 - .1 Piping shall be schedule 10 for 150 mm and smaller.
 - .2 Piping shall be schedule 40 for pipes larger than 150 mm.
 - .4 Provide Type K soft copper pipe without joints below ground.
 - .5 For working pressures up to 2100 kPa, Victaulic style 607 (copper piping systems) or 807 (stainless steel systems) couplings with Grade P Fluoroelastomer blend gasket for water systems with operating temperatures to 82°C, and grooved copper or stainless steel piping systems may be used in accessible areas for domestic water.

2.2. VALVES

- .1 Provide ASTM domestic water valves to the following Kitz figure numbers:
 - .1 Gate Valves:
 - .1 50 mm and smaller - soldered 1400 kPa w.o.g. Fig. 44.
 - .2 65 mm and larger - flanged 1400 kPa w.o.g. Fig. 75.

- .2 Globe Valves:
 - .1 50 mm and smaller - soldered 2070 kPa w.o.g. Fig. 10 with suitable composition disc.
 - .2 65 mm and larger - flanged 1400 kPa w.o.g. Fig. 76.
- .3 Standard Check Valves:
 - .1 50 mm and smaller - soldered 2070 kPa w.o.g. Fig. 23.
 - .2 65 mm and larger - flanged 1400 kPa w.o.g. Fig. 78.
- .2 For 50 mm and smaller, ball valves may be provided as substitute for gate and globe valves. Provide ball valves with brass or bronze body, chrome plated solid ball, PTFE seats and seals and full port.
 - .1 up to 50 mm - 4140 kPa w.o.g. - soldered Fig 69.
- .3 Provide Check-Rite or Centre Line non-slam check valves on discharge side of pumps and where shown or specified.
- .4 For Victaulic grooved piping systems, provide Victaulic Series 608 lever handle, butterfly valves complete with Grape P Fluoroelastomer gasket and drive hub extension insulation block.

PART 3 - EXECUTION

3.1. VERIFICATION OF INVERTS

- .1 Verify all field service conditions immediately after award of Contract to ensure that drainage runs can meet the inverts of the site services.
- .2 Give notification immediately of any apparent difficulties or discrepancies.
- .3 No extra will be paid at a later date for rerouting of drains because site inverts cannot be met.

3.2. BRACED SEWER PIPE JOINTS

- .1 Provide bracing across mechanical joint couplings for all sanitary and storm piping 150 mm and larger. Follow manufacturers recommended practices or consult with factory prior to testing of piping.
- .2 Provide sway braces for all suspended sewer piping to prevent movement under hydraulic forces.
- .3 Refer to details on drawings for sample recommended bracing.

3.3. PIPE EXPANSION

- .1 Provide expansion compensators for all piping systems. Design with sufficient flexibility to prevent end thrust and movement caused by thermal expansion. For plastic piping systems refer to manufacturers recommended compensators and install in accordance with written directions.
- .2 Provide expansion compensators at building expansion joints.

3.4. TESTING

- .1 Carry out not less than the following tests:
 - .1 Ball test drains.
 - .2 Perform water tests on all soil, waste, vent and rainwater systems when rough-in of the system, or section thereof including fittings, branches, cleanouts and traps except fixture traps. When the system or section is filled, shut off the water, and allow to stand for one hour. There shall be no loss by leakage during this time.
 - .3 Pressure test domestic cold water, domestic hot water, and recirculation lines with water at 150% of maximum operating pressure, for 6 hours without loss of pressure.
 - .4 Pressure test pumped sewage lines including fittings, joints and piping with water at 150% operating pressure for 6 hours without loss of pressure.
- .2 Conduct additional tests required by the authorities having jurisdiction.
- .3 If tests are required by an authority having jurisdiction, perform tests in the presence of each governing authority's authorized inspector, and obtain certification.
- .4 Certify tests not required by the authorities having jurisdiction.
- .5 Perform tests before piping, drains or vents are covered or concealed.
- .6 Remove all components which will not withstand test pressure and replace after tests.
- .7 Eliminate leaks or remove and refit defective parts. Caulking of threaded or welded joints will not be permitted.
- .8 Repeat tests as often as necessary to obtain certification.
- .9 Set all fixtures and fill all traps with water after tests have been completed.

3.5. CLEANING AND FLUSHING SEWERS

- .1 On completion of construction of drains, flush all drains until the deposits of earth and other foreign material have been removed.

3.6. CLEANING, FLUSHING AND DISINFECTING WATER PIPING

- .1 Be responsible for care and cleaning of the piping system during and after construction. Plug all open ends during construction to prevent the entrance of foreign materials.
- .2 Flush all systems with clean, potable water to remove scale and sediment immediately upon filling.
- .3 Sterilize all potable water lines to meet local municipal requirements.

- .4 After completing satisfactory hydrostatic tests of the complete system, and flushing mains as outlined above, disinfect the mains in accordance with AWWA Standard C651-86. Repeat the flushing and disinfecting operation until the test results are satisfactory.
- .5 Ensure by operation of isolating valves or the installation of check valves, that the disinfecting solution does not flow back into street mains or other sections of piping in use.
- .6 Arrange and pay for water quality tests to be performed by a recognized independent testing laboratory. Obtain certificates confirming safety of potable water supply.

3.7. CONNECTIONS TO OWNER'S EQUIPMENT

- .1 Rough in and connect to Owner's equipment. Do not rough in prior to receipt of final approved layout of Owner's equipment.

3.8. CONNECTIONS TO LABORATORY EQUIPMENT

- .1 Provide rough-in and make final connections to laboratory equipment as shown on Drawings. Otherwise, valve and cap services in ceiling or walls as shown.
- .2 Do not begin rough-in work until supplied with a final set of dimensioned rough-in drawings from the laboratory equipment supplier.
- .3 All final connections shall include shut off valves on hot and cold water supplies and the installation of all vacuum breakers, check valves, backflow preventors, and other plumbing specialties as shown on Drawings and as required to meet authorities having jurisdiction.

END OF SECTION

PART 1 - GENERAL	1
1.1. WORK INCLUDED	1
PART 2 - PRODUCTS	1
2.1. GENERAL	1
2.2. CLEANOUTS	1
2.3. BACKFLOW PREVENTERS	1
2.4. TRAP PRIMING	1
2.5. WATER HAMMER ARRESTORS	2
2.6. WATER MIX REGULATING VALVES	2
2.7. ACCEPTABLE EQUIPMENT SUPPLIERS	3
PART 3 - EXECUTION	3
3.1. PROTECTION	3
3.2. COORDINATION	3
3.3. TRAP PRIMING	3

PART 1 - GENERAL

1.1. WORK INCLUDED

- .1 Comply with Division 01 00 00, General Requirements.
- .2 Provide all labour, materials, products, equipment and services to supply, install and test complete plumbing specialties indicated on the drawings and specified in this section of the Specifications.

PART 2 - PRODUCTS

2.1. GENERAL

- .1 Meet requirements of the accompanying product cutsheets.
- .2 All cast iron parts for floor drains, area drains, and cleanouts shall be duco or fusion bonded powdered epoxy coated.
- .3 All fixture carriers must be compatible with acceptable fixtures listed in Specification Section 22 40 00.
- .4 Provide reduced pressure principal backflow preventers where shown and where closed domestic water piping connections are made to heating and cooling process systems and makeup water systems.

2.2. CLEANOUTS

- .1 Stack cleanouts shall be cast iron tee type with gas-tight plug.
- .2 Line cleanouts shall be cast iron ferrule with threaded or bolted plug.
- .3 Access doors shall be stainless steel with friction fit door and recessed top to accept tile size. Acudor Series UF5000SS, CAN-AQUA CA-HD Series.
- .4 Floor cleanouts shall be cast iron construction with gas tight seal. Tops shall be round, heavy duty, scoriated nickel bronze, adjustable to finished floor. Provide nickel bronze recessed tops where required to suit floor finishes. In unfinished and heavy traffic areas, use heavy duty scoriated ductile iron tops.

2.3. BACKFLOW PREVENTERS

- .1 Provide CSA approved, reduced pressure principal bronze backflow preventers. Size preventer for required flow with a maximum pressure drop of 77 kPa.
- .2 Install preventers where shown on the drawings.
- .3 Pipe relief lines to drain.

2.4. TRAP PRIMING

- .1 Prime floor drain traps with cold water.
- .2 For individual traps provide bronze trap seal primers with integral vacuum breakers.

- .3 For installations with large numbers of traps in close proximity, provide electronic trap priming systems equivalent to Precision Plumbing Products Inc. Electronic Trap Priming Manifold PT-4 through PT-30. Select model to suit the number of traps to be primed (4 through 30). Provide for each assembly:
- .1 24 hour timer - 120/1/60
 - .2 circuit breaker
 - .3 manual override switch
 - .4 manual isolation valve 20 mm for supply
 - .5 solenoid valve - 120/1/60
 - .6 vacuum breaker
 - .7 calibrated distribution manifold
 - .8 internal power and control wiring
 - .9 internal piping
 - .10 NEMA 1 flush mount or surface mount cabinet constructed of 16 ga. steel

2.5. WATER HAMMER ARRESTORS

- .1 Provide shock arrestors on hot and cold water supplies to all faucets, valves, solenoids, fixture and group of fixtures.
- .2 Size units according to the following table:

Size Reference	Fixture Units	Size
A	1 - 11	12 mm
B	12 - 32	20 mm
C	33 - 60	25 mm
D	61 - 113	32 mm
E	114 - 154	40 mm
F	155 - 330	50 mm

- .3 Provide line size shock arrestors on top of domestic water risers.
- .4 Provide 10 mm size arrestors on supply to one service sink or maximum 3 lavatories.

2.6. WATER MIX REGULATING VALVES

- .1 Provide thermostatic water mixing valve as scheduled on drawings.
- .2 Provide high and low thermostatic controllers, stainless steel pistons, check stops, pressure reducing valve and two pressure gauges, volume control, dial thermometer on mixed water and isolation ball valves.

- .3 Provide recessed/semi-recessed/surface mounted cabinets as shown on the drawings.

2.7. ACCEPTABLE EQUIPMENT SUPPLIERS

- .1 Where Nickel bronze or stainless steel drain tops are specified, the shank shall be of the same material.
- .2 Acceptable equipment suppliers are as follows:

Drainage Products	- J.R. Smith - Watts - Zurn
Backflow Preventers	- Conbraco - Watts - Zurn
Trap Primers and Water Hammer Arrestors	- P.P.P. - Zurn - J.R. Smith - Watts
Water Mix Regulating Valves	- Powers - Leonard - Haws - Encon - Symmons
Eyewash Station	- Bradley - Haws - Guardian - Encon

PART 3 - EXECUTION

3.1. PROTECTION

- .1 Provide 0.15 mm polyethylene under each strainer to prevent dirt from entering the system during construction. Remove polyethylene prior to Substantial Performance.

3.2. COORDINATION

- .1 Coordinate all drain and clean out provisions with other Trades and Architect.
- .2 Coordinate installation of floor drains with General Contractor to ensure proper integration of membrane topping.
- .3 Refer to the dimensioned architectural elevations and project shop drawings. Install all sensors such that their operations are not impeded.

3.3. TRAP PRIMING

- .1 Prime all traps as required by code.

- .2 When using electronic trap priming systems:
 - .1 Locate trap primer in easily accessible location.
 - .2 Division 20 00 00 shall provide all power wiring to trap primer. Coordinate with Division 26 00 00 for suitable power source to provide power to trap primer.

END OF SECTION

PART 1 - GENERAL1

1.1. WORK INCLUDED1

1.2. REFERENCE STANDARDS1

1.3. COORDINATION1

1.4. MATERIALS.....1

PART 2 - PRODUCTS1

2.1. PRODUCTS1

PART 3 - EXECUTION2

3.1. PROTECTION2

3.2. INSTALLATION2

3.3. CLEAN UP2

PART 1 - GENERAL

1.1. WORK INCLUDED

- .1 Comply with Division 01 00 00, General Requirements and all documents referred to therein.
- .2 Provide all labour, materials, products, equipment, and services to supply and install the plumbing fixtures and trim indicated on the Drawings and specified in this Section of the Specifications.

1.2. REFERENCE STANDARDS

- .1 Provide fixtures and accessories which are CSA labelled and are new, free from cracks, flaws, and imperfections.
- .2 Provide vitreous china or vitreous glazed earthenware meeting CSA Standard CAN3-B45 Series.
- .3 Provide stainless steel fixtures meeting CSA B45.4.
- .4 Provide plumbing trim meeting CSA B125.
- .5 All fixtures and accessories shall meet the City of Bridgenorth guidelines.

1.3. COORDINATION

- .1 Make fixture count from Architectural and Mechanical Drawings. Provide the higher fixture quantity including all services.
- .2 Contractor is to verify the handle placement (handing) on the tank to suit AODA standards in accordance with the washroom layout, prior to order.

1.4. MATERIALS

- .1 Provide white fixtures, except where noted.
- .2 Provide chrome plated piping, valves, fittings and accessories where exposed to view in washrooms.
- .3 Equip hot and cold-water supplies to each fixture with compression stops.

PART 2 - PRODUCTS

2.1. PRODUCTS

- .1 Refer to PDF formatted fixture cuts included in this section or on drawings.
- .2 Similar products are to be provided from the same manufacturer.
- .3 Electronic fixtures shall have a CSA listed transformer.
- .4 Provide local point of use lead free thermostatic mixing valves for each faucet supply unless indicated otherwise on the plumbing fixture cut sheets or plans.

- .5 Acceptable equipment suppliers are as follows:
 - .1 Valves
 - Sloan
 - Emco
 - Zurn
 - .2 Plumbing Brass
 - American Standard
 - Kohler
 - Sloan
 - Zurn
 - .3 Plumbing Fixtures (Stainless Steel)
 - Franke
 - Aristaline
 - Kohler
 - Kindred
 - .4 Emergency Shower/Eye Wash
 - Bradley
 - Haws
 - Encon
 - Guardian

PART 3 - EXECUTION

3.1. PROTECTION

- .1 Protect all fixtures and trim during construction period. Replace any fixtures that contain cracks, flaws or imperfections.

3.2. INSTALLATION

- .1 Connect fixtures complete with supplies and drains, separately trapped, supported level and square. Hot water faucets shall be on left side. Thermostatic controlled mixing valves shall include check stops on supplies.
- .2 Refer to Architectural Drawings for special mounting heights and spacing of fixtures.
- .3 Insulate exposed fixture piping in accordance with local plumbing and building codes.

3.3. CLEAN UP

- .1 After final installation of plumbing fixtures and trim, clean fixtures and trim, adjust trim and ensure that fixtures and trim are operational. Replace trim that does not perform satisfactorily.

END OF SECTION

PART 1 - GENERAL1

1.1. WORK INCLUDED1

PART 2 - PRODUCTS1

2.1. PIPING1

2.2. ACID NEUTRALIZERS.....1

PART 3 - EXECUTION2

3.1. INSTALLATION2

3.2. LABORATORY EQUIPMENT CONNECTIONS2

3.3. TESTING2

PART 1 - GENERAL

1.1. WORK INCLUDED

- .1 Comply with Division 01 00 00, General Requirements and all documents referred to therein.
- .2 Provide all labour, materials, products, equipment and services to supply, install and test the laboratory drainage services indicated on the Drawings and specified in this Section of the Specifications.

PART 2 - PRODUCTS

2.1. PIPING

- .1 Pipes and fittings for drains and vents within individual fire separations of Laboratories and Prep Rooms shall be IAPMO listed, Schedule 40, FR-PVDF as manufactured by IPEX to include pipe supplied in 10 ft. lengths and matched fitting, and traps from the same manufacturer.
- .2 Buried piping from Laboratories and Prep Rooms (not including pipes carrying radio isotopes) shall be IAPMO listed, Schedule 40, FR-PVDF as manufactured by IPEX to include pipe supplied in 10 ft. lengths and matched fitting, and traps from the same manufacturer.
- .3 Pipe and fittings shall be made from Kynar 740-02, flame retardant PVDF conforming to ASTM F 1673, with a limiting oxygen index (LOI) of 60, Resin must have a vertical burn rating of 94 V-0. Kynar 740-02 resin based on testing to ASTM E84 (UL 723) must have surface burning characteristics greater than or equal to a flame spread 5 and smoke development 35.
- .4 Fittings shall be third party certified to ASTM F 1673 and ASTM E84, and IAPMO approved, be of all plastic construction and a tapered elastic retaining ring shall be designed to lock into a machined groove on the mating piping. All fittings shall have integrally molded union connections. No metallic grab rings or clamps shall be allowed. Fittings shall be Plenumline™ or approved equal.

2.2. ACID NEUTRALIZERS

- .1 Provide complete acid neutralizing systems as specified below and provided by SMS Limited, Toronto.
- .2 Each system shall consist of an S.M.S. AN-4-MSI series polyethylene tank with inlet, outlet and vent connections as required to suit pipe sizes shown on drawings. Tank shall be provided with a 200 mm dia. X 300 mm height internal sediment interceptor. Provide an 18 mm thick polyethylene cover with 305 mm dia. inspection port and 300 mm dia. port for internal interceptor. Furnish each tank with sufficient neutralizing chips for initial charge and a maintenance instruction sign. Refer to Drawings for locations and Schedule for tank capacities.
- .3 Include with each system a Model 47-R, 110V AC, pH monitoring, recording, alarm system, with a 150 mm mirror backed 0-14 pH meter, built-in 30 day chart recorder (with a 12 month supply of chart paper), high/low limit set points for visual and audible alarm, and 400 Watt AC power outlet for remote alarm. Install a Model PHE-1 submersion style pH electrode in tank at site and connect to panel with 6 m of electrode cable. Mount panel on wall in suitable

location to allow for connection of electrode cable. Division 26 will provide 100 volt AC duplex receptacle adjacent to panel location. Connect pH monitoring panel to the building automation system.

PART 3 - EXECUTION

3.1. INSTALLATION

- .1 Install pipe to meet manufacturer's recommendations. On completion of installation, obtain manufacturer's certification that work meets requirements.

3.2. LABORATORY EQUIPMENT CONNECTIONS

- .1 Provide all rough in and make all final connections to the laboratory equipment shown on the Drawings. Otherwise, valve and cap services in ceiling or walls as shown.
- .2 Do not begin any rough in work until supplied with a final set of dimensioned rough in drawings from the laboratory equipment supplier.
- .3 Meet requirements of all authorities having jurisdiction.

3.3. TESTING

- .1 If tests are required by an authority having jurisdiction, perform tests in the presence of each governing authority and obtain certification. Repeat tests as often as necessary to obtain certification.
- .2 Perform tests before piping is covered or concealed.
- .3 Remove all fittings which will not withstand test pressure and replace after tests.
- .4 Eliminate leaks or remove and refit defective parts.
- .5 Testing with compressed air including air booster over water is prohibited. The entire system shall be installed free of stress and in proper alignment. Horizontal supports shall provide a wide bearing area and be free of burrs or sharp edges. Support spacings shall be in accordance with the manufacturer's recommendations and local plumbing codes. Vertical piping shall have riser clamps at each floor. Pipe supports shall be installed so that horizontal piping is in uniform alignment and with a uniform slope of at least 1/8" per foot, or in accordance with the local plumbing code requirements.

END OF SECTION

PART 1 - GENERAL	1
1.1. QUALIFICATIONS	1
1.2. SUBMITTAL REQUIREMENTS	1
1.3. WORK INCLUDED	1
1.4. REFERENCE STANDARDS	2
1.5. REFERENCE DOCUMENTS	2
PART 2 - PRODUCTS	2
2.1. TEST EQUIPMENT	2
PART 3 - EXECUTION	2
3.1. GENERAL	2
3.2. JOB SITE INSPECTION	2
3.3. FANS AND AIR HANDLING SYSTEMS	2
3.4. AIR DISTRIBUTION AND TERMINALS	3
3.5. HYDRONIC EQUIPMENT	3
3.6. HYDRONIC PIPING AND DISTRIBUTION	3
3.7. PRELIMINARY TESTING	4
3.8. REPORTS	4
3.9. REPORT VERIFICATION	4
3.10. GUARANTEE	4

PART 1 - GENERAL

1.1. QUALIFICATIONS

- .1 The TAB Agency shall be a current member in good standing with either the Associated Air Balance Council or National Environmental Balancing Bureau.

1.2. SUBMITTAL REQUIREMENTS

- .1 Submit the following information with shop drawings:
 - .1 List of proposed equipment to be used for this project.
 - .2 Proof of membership in the Associated Air Balance Council (AABC) or National Environmental Balancing Bureau (NEBB).
 - .3 The names and qualifications of all personnel who will be assigned to this project. Use of other personnel will be grounds for contract termination.
 - .4 A listing of references including project names, Consultant, Contractor and Owner references with telephone numbers.

1.3. WORK INCLUDED

- .1 Comply with Division 01 00 00, General Requirements and all documents referred to therein.
- .2 Provide all labour, materials, products, equipment and services to test, adjust and balance all air and hydronic systems to verify conformance to specified quantities and to the design intent of the mechanical system.
- .3 Refer to Specification 01 91 00 for commissioning activities to be performed by others. Cooperate with the Commissioning Authority.
- .4 The following systems and/or equipment are included in the Scope of Work:
 - .1 Air Systems:
 - .1 Supply Fan AHU
 - .2 Return Fans
 - .3 Exhaust Fans
 - .4 Zone Branch and Main Ducts
 - .2 Hydronic Systems:
 - .1 System Mains and Branches
 - .2 Terminal Units
- .5 Refer to Specification Section 23 31 00 for test openings in duct system. Provide additional openings to fulfill the work of this section.

1.4. REFERENCE STANDARDS

- .1 All work shall be in accordance with the latest edition of the AABC or NEBB National Standards. If these contract documents set forth more stringent requirements than the Reference Standards, these contract documents shall prevail.

1.5. REFERENCE DOCUMENTS

- .1 Obtain and pay for, a complete set of reviewed Shop Drawings of pumps, fans and control systems.
- .2 Obtain and pay for, a complete set of Mechanical Drawings and Specifications.

PART 2 - PRODUCTS

2.1. TEST EQUIPMENT

- .1 When requested by the Consultant, provide current calibration certificates for test equipment.

PART 3 - EXECUTION

3.1. GENERAL

- .1 The specified systems shall be reviewed and inspected for conformance to design documents. Testing, adjusting and balancing on each identified system shall be performed. The accuracy of measurements shall be in accordance with AABC or NEBB Standards or 5%, whichever is more stringent.
- .2 Any deficiencies in the installation or performance of a system or component shall be reported in writing to the Contractor and Consultant.
- .3 Equipment settings, including manual damper quadrant positions, manual valve indicators, fan speed control levers, and similar controls and devices shall be physically marked to show final settings.

3.2. JOB SITE INSPECTION

- .1 Inspect the installation of the systems to be tested at least twice during the construction period. Ensure specified devices and components required for testing and balancing functions have been installed according to the manufacturer's recommendations.
- .2 Ensure all required balancing dampers are installed, functional, and accessible for use in testing and balancing procedures.
- .3 Provide a written report of inspection to the Contractor and Consultant identifying specific concerns and deficiencies affecting the testing and balancing procedures.

3.3. FANS AND AIR HANDLING SYSTEMS

- .1 Verify that all ductwork, dampers, grilles, registers, and diffusers have been installed per design.

- .2 Balance air handling systems at minimum outdoor air quantities. On completion of TAB procedures, retest at maximum outdoor air quantities.
- .3 Test and adjust fan RPM to achieve design flow. Provide sheave and belt change if required to achieve the required CFM and performance.
- .4 Test and record motor voltage and amperage. Compare data with nameplate limits.
- .5 Perform pitot tube traverse at all main and branch ducts. Compare traverse total with measured outlet total to determine actual duct leakage.
- .6 Test and adjust minimum outdoor and relief air volumes.
- .7 Test and record system static pressure profile of each air handling system at minimum outdoor air volume. Note coil (i.e. wet/dry) and filter condition of time of testing.
- .8 Test and record entering and leaving air conditions for each heat transfer coil and device. Simulate conditions to achieve winter or summer design parameters.
- .9 Test and record settings of motor thermal overload devices. Adjust settings where required.

3.4. AIR DISTRIBUTION AND TERMINALS

- .1 Adjust duct distribution to obtain specified air quantities. At least one zone balancing damper shall be completely open. Multi diffuser/grille branch ducts shall have at least one volume damper completely open.
- .2 Test and adjust each air terminal to obtain specified flow. Adjust deflectors and pattern controllers to eliminate drafts.

3.5. HYDRONIC EQUIPMENT

- .1 Test and adjust water flow to devices such as coils, chillers, heat exchangers and cooling towers to obtain the specified flow. Compare actual equipment water side pressure drops with manufacturer's published data.
- .2 Where equipment is used in heat transfer (i.e. Air/Water Coils), measure entering and leaving liquid/gas conditions and compare to manufacturer's published data.
- .3 Where possible, simulate design conditions for testing. If simulation is not practical, perform seasonal testing when design conditions can be achieved.

3.6. HYDRONIC PIPING AND DISTRIBUTION

- .1 Adjust water flow in distribution system to obtain specified flows.
- .2 Test and record flow and differential pressure systems to establish references for satisfactory operation.
- .3 Test and adjust system feeders to ensure adequate system static pressure is available under all operating conditions.

- .4 Test and adjust hydronic terminals to obtain specified flow.

3.7. PRELIMINARY TESTING

- .1 In the event preliminary testing reveals a deficiency in the system which cannot be corrected through the balancing process, advise the Contractor and Consultant in writing describing the conditions and suggested corrective action.

3.8. REPORTS

- .1 Provide PDF copy of the TAB report for Consultant review.
- .2 Summarize all testing into logical sections, tabulated and summarized.
- .3 Identify system terminals and distribution on legible plan or schematic drawings depicting actual system arrangement. Label pitot tube traverse locations, terminal identification, and equipment identification in a manner consistent with the contract documents.

3.9. REPORT VERIFICATION

- .1 Cooperate with the Consultant in field verification of the final reported valves.
- .2 Specific and random verifications will be performed using the same procedures used in preparation of the reports.
- .3 Sufficient verifications will be performed to satisfy the Consultant that the reports accurately represent the actual system conditions.

3.10. GUARANTEE

- .1 Provide AABC National Project Performance Guaranty or NEBB Performance Bond for the work.
- .2 Include a copy of the guarantee in each copy of the Testing and Balancing Report.

END OF SECTION

PART 1 - GENERAL	1
1.1. WORK INCLUDED	1
PART 2 - PRODUCTS	1
2.1. PIPING, JOINTS AND FITTINGS	1
2.2. VALVES	2
2.3. CIRCUIT BALANCING VALVES	3
2.4. SAFETY AND RELIEF VALVES	4
2.5. HYDRONIC TERMINAL UNIT VALVES	4
2.6. AIR VENTS	4
PART 3 - EXECUTION	4
3.1. INSTALLATION	4
3.2. TESTING	5
3.3. INSTALLATION OF CONTROL DEVICES AND INSTRUMENTATION	5

PART 1 - GENERAL

1.1. WORK INCLUDED

- .1 Comply with Division 01 00 00, General Requirements and all documents referred to therein.
- .2 Provide all labour, materials, products, equipment, and services to supply, install and test the heated water piping systems indicated on the Drawings and specified in this Section of the Specifications.
- .3 Install all piping in accordance with CSA B214.07, Installation Code for Hydronic Heating systems.
- .4 Install sensor wells and other items required by Controls Section 25 30 00

PART 2 - PRODUCTS

2.1. PIPING, JOINTS AND FITTINGS

- .1 Meet the following pipe requirements:
 - .1 Pipe: 12 mm to 50 mm
 - .1 ASTM A53, Standard wall steel electric resistance weld for internal pressure up to 4100 kPa and ASTM A106 where pressure exceeds 4100 kPa. Fittings and couplings shall be threaded malleable iron meeting ASA B16.3 for pressure classes 1035 kPa and 2068kPa. Use cast iron meeting ASA B16.4 for pressures classes of 1206 kPa or 2758 kPa.
 - .2 Pipe: 65 mm and larger
 - .1 Pipe as above, ends bevelled for welding. Fittings and line joints, wrought steel meeting ASA B16.9 for welding, or flanged fittings and slip on flanges meeting ASA B16.5. Select pressure classification to meet system working pressures.
- .2 Meet Section 20 05 00 requirements for pipe installation and equipment connection including union and flange provision.
- .3 Provide 1-1/2 mm thick Cranite ring gaskets. Provide line joints, valves, fittings, flanges and in-line components below floor level for 2100 kPa system operating pressure. Select line joints, fittings and flanges used at and above floor level for actual system operating pressures.
- .4 Provide ASA B16.18, Type L copper takeoffs from risers, runouts and horizontal distribution systems.
- .5 Victaulic pipe joints may be used except for pipe enclosed in shafts. Meet the best practices described in current Victaulic literature. Victaulic pipe joints shall be rigid Victaulic Style 107 QuickVic couplings for sizes 50mm to 300mm, Style W07 AGS rigid couplings for sizes 350mm to 1525mm. For glycol systems use Style 107 Victaulic QuickVic couplings only. Victaulic fittings on glycol shall only be used on 2" to 8" piping.

2.2. VALVES

- .1 Gate and globe valves shall be Kitz to the following Kitz figure numbers:

To 1400 kPa working pressure:

	Figure Numbers	
	Gate	Globe
50 mm and smaller		
Soldered	44	10
Screwed	24	09
65 mm and larger		
Flanged	72	76

To 2100 kPa working pressure:

	Figure Numbers	
	Gate	Globe
50 mm and smaller		
Soldered	43	10
Screwed	42	09
65 mm and larger		
Flanged, rising stem	300SCL	300SCJ

- .2 For pipe sizes 50 mm and smaller, ball valves may be substituted for the above gate and globe valves. Provide ball valves with brass or bronze body, chrome plated solid ball, PTFE seats and seals and full port:
- .1 soldered - Kitz Figure 59
- .2 screwed - Kitz Figure 58
- .3 Check valves shall be non-slam type, selected for system operating pressures and temperatures.
- .4 Butterfly valves shall be DeZurik manufacture, full lug body style, with stainless steel shaft, supported by 3 bearings (top, bottom and actuator), replaceable EPDM seat to the following schedule. All flanges shall be ANSI rated, weld neck. Install spool pieces between valves and adjacent equipment. Equip valves to 100 mm with 10 position lever operator. Equip valves 150 mm and larger with gear box and handwheel operator. Each valve type shall hold line pressure with downstream flange removed to the full shutoff rating of the valve.
- .1 To 1225 kPa working pressure, use Fig. 660L.
- .2 To 1575 kPa working pressure, use Fig. 632-L648.
- .3 To 1750 kPa working pressure, use Fig. Bhp-L1 meeting ANSI B16.5 as follows:

- .1 1995 kPa to 38°C
- .2 1885 kPa to 100°C
- .3 1750 kPa to 121°C
- .4 To 2100 kPa working pressure, use Bhp-L2 meeting ANSI B16.5 as follows:
 - .1 5180 kPa to 38°C
 - .2 3500 kPa to 193°C
 - .3 2100 kPa to 440°C
- .5 Provide high performance butterfly valves (BHP) in the appropriate pressure class, for modulating control applications in either two or three way configuration and where electric actuators are used.
- .5 Provide DeZurik plug valves for balancing applications except where circuit balancing valves are specified.
 - .1 To 1225 kPa provide Series 425/118 eccentric plug valve. Equip sizes 12 mm to 100 mm with memory stop and drip cap. Equip valves over 100 mm with handwheel gear.
 - .2 To 1575 kPa provide Series 118SX or 118FX eccentric plug valves. Equip sizes 12 mm to 65 mm with lever and memory stop. Equip valves over 65 mm with handwheel gear.
 - .3 To 1995 kPa provide Series 128 eccentric plug valves. Equip sizes 12 mm to 65 mm with lever and memory stop. Equip valves over 65 mm with handwheel gear. Meet ANSI B16.5 temperature and pressure requirements.
 - .4 Provide ball drain valves with cap and chain at base of all hydronic risers. Valve rating- 1750 kPa at 121°C.

2.3. CIRCUIT BALANCING VALVES

- .1 Provide circuit balancing valves:
 - .1 on the common return pipe from each coil bank, heat exchanger, boiler and chiller
 - .2 where shown on the Drawings
 - .3 for all locations where balancing valves are shown in pipe less than 65 mm in size
- .2 For valves to 50 mm provide Y pattern style, all metal, with soldered or screwed connections, built-in drain connection with shut off valve and protective caps, and integral valve insulation.
- .3 For valves from 65 mm to 300 mm provide Y pattern style, cast iron body, flat face flanges, or grooved end connections for grooved piping systems.

- .4 Provide, for each valve:
 - .1 vernier type handwheel settings for precision flow balancing
 - .2 positive shut off valve with no drip seat and plug type stem with teflon disc
 - .3 tamper proof hidden memory feature
 - .4 positive shut off metering valves with connections for portable meter
- .5 Balancing valves to be sized according to design flow. Select circuit balancing valve size to give a pressure drop at 100% open between 3.0 kPa and 21 kPa. Select valves located remote from the pumps in the circuit near minimum pressure drop and those located near the pumps at higher pressure drops.

2.4. SAFETY AND RELIEF VALVES

- .1 Provide safety and relief valves for all closed water systems. Pipe relief to nearest floor drain.
- .2 Provide valves rated at 1035 kPa at 99°C ASTM rated, cast iron body bronze disc and seat, steel spindle assembly, carbon steel spring.

2.5. HYDRONIC TERMINAL UNIT VALVES

- .1 Provide bronze body, stainless steel ball isolation valves at inlet and outlet of each hydronic terminal unit. Valves shall be rated for the system pressure. Valves shall be line sized.

2.6. AIR VENTS

- .1 Select air vents to suit system operating pressures.
- .2 Provide automatic air vents, complete with isolating gate valves at all high points where mains are trapped, where shown in the Drawings and where shown on Typical Detail Sheets. Pipe outlet from each vent to a service sink, drip pan or floor drain.
- .3 Provide manual air vents, screwdriver or key type at each unit heater, cabinet unit heater, convactor, wallfin section and fan coil unit.

PART 3 - EXECUTION

3.1. INSTALLATION

- .1 Meet Section 20 05 00 requirements.
- .2 Use valves and strainers of the same size as pipe in which it is installed, unless otherwise indicated.
- .3 Provide globe, ball or plug valves for throttling or controlling flow in accordance with article 2.2.
- .4 Provide gate, ball or butterfly valves for shutoff in accordance with article 2.2.
- .5 Install reducing fittings so as not to trap air.

- .6 Provide long radius elbows.
- .7 Provide flanges or unions at connections to all equipment.
- .8 Provide screwed or flanged joints only in accessible locations. Provide access doors as required.
- .9 Do not use field fabricated fittings.
- .10 Equip low points with 20 mm drain valve piped to floor drain. Provide, at high points on lines and on equipment connections, collection chambers and high capacity float operated automatic air vents.
- .11 The first hanger on branch take off piping from a riser shall be spring hung to reduce stress on riser and branch.
- .12 Connect branch pipe runouts to top of main distribution pipe.

3.2. TESTING

- .1 Meet testing requirements of all authorities having jurisdiction. Obtain certification and certify tests not required by authorities. Perform not less than the following tests.
- .2 Prove hydronic piping tight under a hydrostatic test of 150% of design working pressure but not less than 700 kPa. Test without pressure drop for a period of not less than 4 hours.
- .3 Perform tests before piping is covered or concealed.
- .4 Remove all components which will not withstand test pressure and replace after tests.
- .5 Eliminate leaks or remove and refit defective parts. Do not caulk threaded or welded joints.
- .6 After work is completed, adjust and put all parts of the system into proper working order. Adjust all valves to achieve specified heating capacities. Leave the complete job ready for regular operation, all to the satisfaction of the Consultant.
- .7 After the testing period, drain the system, and before water treatment is introduced into the system, clean out all dirt pockets and strainers.
- .8 Provide lubricating oils, packing, and other accessories, for proper operation of the system.
- .9 The final test and acceptance shall not be made until the work is finally completed.

3.3. INSTALLATION OF CONTROL DEVICES AND INSTRUMENTATION

- .1 Install all control devices and instrumentation for the hydronic systems as shown on the drawings, specified in Section 25 30 00 for items supplied by the controls supplier.

END OF SECTION

PART 1 - GENERAL	1
1.1. WORK INCLUDED	1
1.2. SUBMITTAL DATA	1
1.3. REFERENCE STANDARDS	1
PART 2 - PRODUCTS	1
2.1. PIPING, JOINTS AND FITTINGS	1
PART 3 - EXECUTION	2
3.1. PIPING AND WIRING INSTALLATION	2
3.2. DEHYDRATION AND CHARGING	2
3.3. START UP AND ADJUSTMENT	2
3.4. GUARANTEE	2

PART 1 - GENERAL

1.1. WORK INCLUDED

- .1 Comply with Division 01 00 00, General Requirements and all documents referred to therein.
- .2 Provide all labour, materials, products, equipment, and services to supply and install refrigerant piping systems as indicated on the Drawings and specified in this Section of the Specifications.
- .3 Installation shall be designed and installed by refrigerant piping system specialists.

1.2. SUBMITTAL DATA

- .1 Submit Shop Drawings of refrigerant piping systems and control systems for review prior to commencement of installation.
- .2 Drawings shall include the following:
 - .1 An isometric layout of refrigerant piping showing all piping and components required for the satisfactory operation and maintenance of systems, including but not limited to charging valves, isolating valves, sight glasses, strainers, driers, thermostatic expansion valves, solenoid valves, receivers, relief valves, mufflers, traps, oil separators, and water regulating valves.
 - .2 Control wiring interconnecting air conditioning equipment and refrigerant piping system components.
 - .3 A description of the sequence of operation of the refrigerant piping system.

1.3. REFERENCE STANDARDS

- .1 Meet Division 26 00 00 requirements for wiring methods and materials.
- .2 Refrigerant piping design and installation shall conform to the recommendations and requirements of the following:
 - .1 CSA Standard B52 - Mechanical Refrigeration Code
 - .2 Ontario Building Code
 - .3 Air Conditioning and Refrigeration Institute
 - .4 Air Conditioning Equipment Manufacturer

PART 2 - PRODUCTS

2.1. PIPING, JOINTS AND FITTINGS

- .1 Select pipe, fittings and components to suit systems test and operating pressures.
- .2 Refrigerant piping shall be factory cleaned and sealed, type ACR seamless copper piping. Use only silver brazed joints.

- .3 Use only long radius elbows.
- .4 Size refrigerant piping to attain air conditioning equipment manufacturer's listed cooling capacities.

PART 3 - EXECUTION

3.1. PIPING AND WIRING INSTALLATION

- .1 Keep piping runs and number of elbows and fittings to a minimum.
- .2 Reduce the effect of piping vibration with the use of flexible metal hose.

3.2. DEHYDRATION AND CHARGING

- .1 After installation of piping, a minimum test pressure of 2100 kPa on the high pressure side and 1050 kPa on the low pressure side shall be placed on the piping system with nitrogen. Pressures shall be maintained without loss for not less than four (4) hours. Repair or replace defective joints.
- .2 After joints have been proven tight under test pressures, achieve a vacuum of not less than 95 kPa using a separate vacuum pump. Maintain vacuum without change in pressure for at least twelve (12) hours.
- .3 System shall then be charged with dry refrigerant.
- .4 After charging, recheck all joints with a halide leak detector. Replace any joints found to leak and repeat the above dehydration testing and charging procedures.

3.3. START UP AND ADJUSTMENT

- .1 Provide necessary instruments, gauges and testing equipment required.
- .2 Adjust thermostats, valves and controls and demonstrate that design requirements and equipment manufacturer's ratings have been met.
- .3 Test and record equipment voltage and amperes and compare with motor nameplate data.
- .4 Set and adjust controls to achieve required sequence of operation.

3.4. GUARANTEE

- .1 Replace any refrigerant and oil lost during the warranty period.

END OF SECTION

PART 1 - GENERAL	1
1.1. WORK INCLUDED	1
1.2. REFERENCE STANDARDS	1
PART 2 - PRODUCTS	1
2.1. DUCTWORK	1
2.2. ACCESS DOORS	3
2.3. ACOUSTIC DUCT LINING	4
2.4. BACKDRAFT DAMPERS	4
PART 3 - EXECUTION	4
3.1. SHEET METAL INSTALLATION	4
3.2. ACOUSTIC DUCT LINING INSTALLATION	5
3.3. TESTING	5
3.4. CLEAN UP	6

PART 1 - GENERAL

1.1. WORK INCLUDED

- .1 Comply with Division 01 00 00, General Requirements and all documents referred to therein.
- .2 Provide all labour, materials, products, equipment and services to supply and install the sheet metal and ductwork systems as indicated on the Drawings and specified in this Section of the Specifications.

1.2. REFERENCE STANDARDS

- .1 Meet Standards described in the latest Edition of HVAC Duct Construction Standards handbook from Sheet Metal and Air Conditioning Contractors National Association (SMACNA).
- .2 Duct dimensions shown on Drawings are net, inside insulation and acoustic duct lining.
- .3 Combination fire and smoke dampers and fire dampers shall be ULC listed and labelled as a unit and meet requirements of Ontario Fire Marshall and NFPA-90A.
- .4 Fire rated duct wrap material shall be ULC listed for the application which it is intended for.

PART 2 - PRODUCTS

2.1. DUCTWORK

- .1 Fabricate ductwork from galvanized sheet metal with a minimum coating of 1.83 grams/m² (G60 coating) unless other materials are specifically named. Duct installation shall conform to the following:
 - .1 Ductwork shall be smooth on the inside and free of obstructions, vibration and rattle.
 - .2 Fabricate ductwork, except as described in the next item, according to the following classifications:
 - .1 Class 1: All ducting subject to positive or negative static pressure of 250 Pa or less with maximum velocities of 13 m/s shall be constructed in accordance with SMACNA construction standards for 250 Pa duct.
 - .2 Class 2: All ducting subject to positive or negative static pressure of more than 250 Pa up to 500 Pa with maximum velocity of 13 m/s shall be constructed in accordance with SMACNA construction standards for 500 Pa duct.
 - .3 Class 3: All ducting subject to positive or negative static pressure of greater than 500 Pa up to 750 Pa with maximum velocity of 20 m/s shall be constructed in accordance with SMACNA construction standards for 750 Pa duct.

- .3 Provide duct transformation with expansion fittings having slopes not exceeding 1 to 7 and contraction fittings having slopes not exceeding 1 to 4.
- .4 Provide full radius tees, bends, and elbows for changes in direction except where square elbows are required due to space restrictions. Provide DuroDyne double thickness 0.8 mm turning vanes assembled in top and bottom rails in square elbows.
- .5 Provide balancing dampers free to move in either direction without binding or rattling. Construct dampers in ductwork from 1.2 mm galvanized sheet metal. Use manual quadrants on small ducts. On dampers longer than 375 mm use push rods with DuroDyne Model SRP ball joints. Use two push rods on ducts wider than 600 mm. Provide OBD balancing dampers where shown on the drawings or where required by the Balancing Sub Contractor.
- .6 Isolate equipment with DuroDyne neoprene 0.8 mm thick flexible connectors with finished fabric width not less than 150 mm.
- .7 Provide 50 mm insulated sheet metal blank off panels behind unused portions of exterior louvers.
- .8 Seal all joints in all ductwork with Transcontinental MP for low and medium pressure or DuroDyne S2 duct sealer for high pressure. Joints shall be sealed to conform to SMACNA standards.
- .9 Application of duct sealer to exposed duct shall result in visibly appealing finish. Where possible duct sealer shall be applied to inside of joints. Where duct sealer is applied to outside of duct, outside edge of seal shall be a straight line, perpendicular to duct edges.
- .2 Construct round ductwork to meet high pressure duct standards and as follows:
 - .1 Provide welded slip joint construction round duct fittings. Wipe pipe and fittings with DuroDyne S-2 duct sealer before assembly. Secure joints with self-tapping screws, and then brush again with thick coat of duct sealer.
 - .2 Provide dieformed round elbows through 200 mm dia. constructed from 1.1 mm galvanized steel. Provide 5 section construction for larger elbows.
 - .3 Provide conical round tees.
- .3 Flexible Ductwork:
 - .1 Provide insulated flexible ductwork upstream and downstream of air terminal control units and/or other locations indicated on the Drawings. All flexible ductwork must be factory insulated.
 - .2 Construct ductwork from a tape of soft annealed aluminum sheet, spiral wound into a tube and spiral corrugated to provide strength and flexibility. Provide a triple mechanical lock to form a continuous secure air joint without the use of adhesives for pressures up to 3000 Pa. Duct

shall be factory insulated with fiberglass insulation covered with polyethylene vapour barrier. Duct construction shall be plenum rated.

- .3 Conform to the requirements of NFPA 90 and Underwriters Laboratories classification for round duct to specification UL 181.
- .4 Provide flexible ductwork in minimum lengths of 1500 mm and maximum lengths of 3000 mm Class 1 pressure systems. For Class 2 and higher pressure systems restrict minimum and maximum lengths to 1200 mm.
- .5 Provide flexible acoustic ducting where shown. Duct shall be constructed of dead soft, perforated (20-25% open) aluminum tape, spirally wound and mechanically joined. Wrap duct with minimum 25 mm fiberglass insulation and cover with flame retardant non-toxic polyethylene sheet. Meet smoke and flame spread ratings of local building code. Duct shall meet ULC -S110 and U-181, Class 1.

2.2. ACCESS DOORS

- .1 Provide access doors for galvanized ductwork using 0.7 mm galvanized material with galvanized mounting frame and 25 mm rigid insulation between panels. Provide fastening devices to give tight closure.
- .2 Provide access doors for stainless steel ductwork using 0.61 mm stainless steel with stainless steel mounting frame and 25 mm rigid insulation between panels. Provide fastening devices to give tight closure.
- .3 Provide access doors for aluminum ductwork of 0.61 mm aluminum with aluminum mounting frame, and 25 mm rigid insulation between panels. Provide fastening devices to give tight closure.
- .4 Provide access doors and removable panels in plenums and casings of 1.31 mm galvanized material with 50 mm thickness fiberglass insulation. Equip doors with handles and hinges to open from either side (without risk of injury) as follows:
 - .1 for manddoors:
 - .1 handles - DuroDyne SP-20
 - .2 hinges - DuroDyne HB-3
 - .3 gaskets - DuroDyne GN-22
 - .2 for removable panels:
 - .1 sash locks - DuroDyne SL-1
 - .2 gaskets - DuroDyne GN-22
- .5 Construct all access doors with double panels.
- .6 Provide neoprene gaskets securely formed into door frames around the periphery of all duct access doors.
- .7 Equip door frames for plenums and casings with hollow tubular gaskets.

- .8 Provide access doors at all fire dampers.

2.3. ACOUSTIC DUCT LINING

- .1 Provide 25 mm thick acoustic duct liner where shown on drawings and as follows:
 - .1 Rectangular Duct Liner meeting ASTM C 1071 with air surface coated with acrylic coating treated with EPA registered anti-microbial agent proven to resist microbial growth as determined by ASTM G 21 and G 22.
 - .1 Noise Reduction Coefficient: .70 or higher based on "Type A mounting" and tested in accordance to ASTM C 423.
 - .2 Adhesive: meeting ASTM C 916.
 - .3 Fasteners: Duct liner galvanized steel pins, welded or mechanically fastened.
 - .2 Round Duct Liner: rigid preformed round liner, or with air surface coated with acrylic coating treated with EPA registered anti-microbial agent proven to resist microbial growth as determined by ASTM G 21 and G 22.
 - .1 Noise Reduction Coefficient of .70 as per ASTM C 423. (Type A mounting)

2.4. BACKDRAFT DAMPERS

- .1 Provide counter-balanced backdraft dampers suitable for use in temperatures from -40°C to 93°C.
- .2 Frames shall be 6063T5 extruded aluminum 2.3 mm wall thickness. Blades shall be formed aluminum, .63 mm wall thickness. Bearings shall be molded synthetic and linkage 12 mm tie bars. Blade edge seals shall be extruded vinyl. Dampers shall be equipped with adjustable counter-balance weights attached to rear of blades.
- .3 Maximum system velocity of 12.5 l/s and start open pressure of 7.5 Pa.
- .4 Refer to Drawings for locations, mounting direction and air flow direction.

PART 3 - EXECUTION

3.1. SHEET METAL INSTALLATION

- .1 Provide acoustic insulation on supply air ductwork from discharge side of mechanical air volume control boxes and attenuators as follows:
 - .1 3000 mm for straight duct run box or
 - .2 1500 mm downstream of 1st elbow or
 - .3 1500 mm for each branch downstream of 1st tee.
- .2 Provide final duct connections to all fume hoods and other individual canopies or hoods provided by Division 11 00 00, as designated on the drawings.

- .3 Frame and install motorized dampers. Unless shown otherwise, attach each motorized damper module to the channel framing.
- .4 Provide frames in ductwork for airflow stations.
- .5 Provide test openings in all ducts entering and leaving air handling equipment. Install test openings at 150 mm intervals across the long dimension of rectangular ducts, and at 90 degree intervals around circular ducts. In insulated surfaces, provide extension to suit insulation thickness. Provide additional test ports in ductwork where required for air balancing. Submit drawings to indicate proposed locations.
- .6 Make provisions in ductwork and plenums for installation of duct type smoke detectors and other control devices.
- .7 Slope ductwork down to exhaust hoods and other equipment connections. Provide drains at low points and pipe to nearest floor or funnel drain.
- .8 Extend fume hood exhaust ducts a minimum of 10'-0" above the roof which it penetrates and 10'-0" above any adjacent roof/air intake within 30'-0" in plain view of fume hood exhaust.
- .9 Provide neoprene isolation gaskets and nylon bolts at connections required for dissimilar metals.
- .10 Seal watertight all longitudinal and transverse joints in aluminum ductwork.

3.2. ACOUSTIC DUCT LINING INSTALLATION

- .1 Seal all leading and trailing edges and repair all rips or tears of acoustic duct liner with a suitable sealing compound similar to Johns-Manville Superseal.
- .2 Provide a tapered sheet metal nose piece to hold the leading edge of acoustic duct liner and direct the air over the edge.

3.3. TESTING

- .1 Pressure test all ductwork in accordance with the outlines and classification described in the SMACNA, HVAC Duct Leakage Test manual.
- .2 The leakage amount shall not exceed the allotted amount for the pressure class. The test pressures shall be based on the static pressure for each fan.

DUCT CONSTRUCTION CLASS	LEAKAGE CLASS Rectangular	LEAKAGE CLASS Round
2500 Pa	6	3
1500 Pa	6	3
1000 Pa	6	3
750 Pa	12	6
up to 500 Pa	24	12

- .3 Repair duct and retest where air leakage exceeds the specified limits.
- .4 Make good all audible leakage, whether test is within limit specified or not.
- .5 Provide calibrated tester, connection hoses, temporary plugs, etc., as required.

3.4. CLEAN UP

- .1 Vacuum clean the inside of all air handling systems, including fans, plenums, ducts, coils and terminal units to ensure that they are free from debris and dust.

END OF SECTION

PART 1 - GENERAL1

1.1. WORK INCLUDED1

1.2. REFERENCE STANDARDS1

1.3. SUBMITTAL DATA1

1.4. PERFORMANCE REQUIREMENTS1

1.5. GENERAL REQUIREMENTS1

PART 2 - PRODUCTS1

2.1. CENTRIFUGAL FANS1

2.2. POWER ROOF VENTILATORS (EXHAUST)2

PART 3 - EXECUTION2

3.1. INSTALLATION2

3.2. STARTUP AND TESTING3

PART 1 - GENERAL

1.1. WORK INCLUDED

- .1 Comply with Division 01 00 00, General Requirements and all documents referred to therein.
- .2 Provide all labour, materials, products, equipment and services to supply and install all fans indicated on the Drawings and specified herein.

1.2. REFERENCE STANDARDS

- .1 Fans to be standard products, selected from published literature of manufacturer.
- .2 Ratings to AMCA for sound and air delivery performance. Provide AMCA seal on each fan.
- .3 Fans shall be factory balanced, statically and dynamically to AMCA Standards.

1.3. SUBMITTAL DATA

- .1 Provide sound and air delivery performance ratings for fans where inlet vanes are provided. Include sound and power data at 100%, 66% and 33% capacity.

1.4. PERFORMANCE REQUIREMENTS

- .1 Refer to Fan Schedule and Drawings for fan sizes, arrangements, and capacities.

1.5. GENERAL REQUIREMENTS

- .1 Provide V-belt drives, unless noted otherwise, selected for 200% service factor, based on motor nameplate data. Provide variable pitch motor pulley for motors up to 3.7 kW. For motors larger than 3.7 kW provide for at least one drive change to adjust fan speed for site conditions.
- .2 Equip exhaust fans with backdraft dampers unless motorized dampers are provided in Section 25 50 00 or 25 30 00.
- .3 Scheduled motor horsepower and fan efficiencies are minimum acceptable. Select motors for direct driven fans to ensure non-overloading on any part of the fan curve. Meet Section 20 09 00.

PART 2 - PRODUCTS

2.1. CENTRIFUGAL FANS

- .1 Provide centrifugal fans, complete with motors, drives, belt guards and accessories required for the specified fans or air handling equipment. Centrifugal fans shall be single or double inlet or where show in the schedule, plenum type fans.
- .2 Provide non-overloading characteristics. Provide completely stable pressure characteristics from free delivery to shutoff. Provide backward inclined airfoil fan blades, unless scheduled otherwise.

- .3 Provide belt guards with tachometer openings for all belt driven equipment.
- .4 Factory clean air handling apparatus and coat with red oxide primer prior to shipment.
- .5 Provide ball type fan bearings with tapered adapter sleeve mount, housed in horizontally split pillow blocks. Bearings shall be SKF Type SNA with V rings. Fill bearing housings at the factory with grease to prevent condensation of moisture inside bearing blocks prior to startup of equipment.
- .6 Equip fan housing with drain holes.
- .7 Deviations from overall dimensions of specified air handling apparatus will not be accepted without written permission. Confirm before ordering, that equipment can be accommodated within space provided, indicating allowance for required service clearances.
- .8 Submit certified performance curves for all air handling fans through complete operating ranges of equipment for review with Shop Drawings.
- .9 Provide an inlet flow ring for all centrifugal (including plenum type) fans. Flow ring shall consist of a metallic tube fastened around the inlet diffuser cone. Provide at minimum four velocity pressure tapings spaced evenly around the inlet and a single static pressure tap on the fan housing. The probes shall be capable of producing steady, non-pulsating signal of the velocity pressure, independent of the upstream static pressure without adversely affecting the performance of the fan. Sense the pressure drop in the inlet cone and calculate flow with an accuracy of $\pm 3\%$ of actual reading. Output signal from the transducer shall be 0-10 VDC.
- .10 Furnish adjustable motor bases.
- .11 Coordinate instrument air requirements with Section 25 50 00 or 25 30 00.

2.2. POWER ROOF VENTILATORS (EXHAUST)

- .1 Provide centrifugal fan ventilators constructed of aluminum with aluminum birdscreen over outlet.
- .2 Provide belt drives with adjustable pitch sheaves. Units shall be selected for quiet operation. Provide a factory installed disconnect switch.
- .3 Provide ventilators with factory fabricated self flashing sound curbs, suitable for the respective fan.

PART 3 - EXECUTION

3.1. INSTALLATION

- .1 Locate units to enable servicing to all sides in compliance with manufacturer's recommendations.
- .2 Meet OSHA and WHMIS standards for motor drives, bases and belt guards required for each fan.
- .3 Supply one extra set of matched V-belts for each fan, properly tagged with the equipment designation.

3.2. STARTUP AND TESTING

- .1 Manufacturer shall inspect installed equipment for proper alignment and lubrication at time of startup and shall verify on startup report if acceptable.

END OF SECTION

PART 1 - GENERAL1

1.1. WORK INCLUDED1

1.2. REFERENCE STANDARDS1

PART 2 - PRODUCTS1

2.1. AIR COOLED REFRIGERATION CONDENSING UNITS.....1

PART 3 - EXECUTION3

3.1. INSTALLATION3

PART 1 - GENERAL

1.1. WORK INCLUDED

- .1 Comply with Division 01 00 00 General Requirements and all documents referred to therein.
- .2 Provide all labour, materials, products, equipment and services to supply and install the air-cooled refrigeration condensing units indicated on the drawings and specified in this Section of the Specifications.

1.2. REFERENCE STANDARDS

- .1 Units shall meet CSA and UL requirements.
- .2 Units shall be ETL or CETL approved.
- .3 AHRI Standard.
- .4 ANSI/ASHRAE 15.
- .5 Meet or exceed ASHRAE 90.1-2013 recommendations.

PART 2 - PRODUCTS

2.1. AIR COOLED REFRIGERATION CONDENSING UNITS

- .1 Provide air cooled refrigeration condensing units as scheduled and shown on the drawings. Condensing unit shall operate down to 10°C as standard. Multiple compressor/condenser circuits shall be independent from each other. Extend suction and liquid lines to the outside of the cabinet. Connect service ports fitted with Schraeder fittings to the suction and discharge lines for charging or pressure readings. Provide manual shut off valves on liquid lines. Provide complete with a factory mounted, fused disconnect switch.
- .2 Construct cabinets of heavy gauge satin coated galvanized sheet metal. Surfaces shall be cleaned with a degreasing solvent to remove oil and metal oxides. Prime paint all exposed surfaces. Provide an electrostatically applied enamel coat finish over primer. Support cabinets on formed galvanized or structural steel channel supports, designed and welded for low deflections. Provide weatherproof hinged/lift out control and compressor access doors with cam-lock fasteners. Provide integral lifting lugs for hoisting.
- .3 Provide fully hermetic scroll type, set on resilient neoprene mounts. Reciprocating compressors shall include crankcase heaters. Provide internal line break motor protection and an internal pressure relief. Compressors shall be high efficiency type and shall be matched with condenser coils.
- .4 Provide high efficiency semi-hermetic compressors complete with manual shut off valves, vibrasorbers on suction and discharge lines, compressor spring isolators, reversible oil pump and immersion type crankcase heater. Condensing units shall be designed for a minimum of 8°C liquid sub-cooling.
- .5 Condenser fans shall be direct driven propeller type arranged for vertical draw through air flow. Motors shall be 208V/3 Phase/60 cycle, high efficiency weather resistant type with integral overload protection and designed specifically for vertical shaft, outdoor condenser fan duty. Mount fans and

- motor on a formed orifice plate for optimum efficiency with minimum noise level.
- .6 Provide Condenser coils with copper tubes mechanically expanded into aluminum fins. Factory test coils with air at 2050 kPa in an illuminated water tank.
- .7 Control package shall include the following:
- .1 compressor and condenser fan motor contactors
 - .2 control circuit transformer
 - .3 cooling relays
 - .4 recycling pump down relays for semi-hermetic compressors
 - .5 ambient compressor lockout
 - .6 fuses
 - .7 manual reset high pressure controls
 - .8 automatic reset low pressure
 - .9 head pressure actuated fan cycling controls for multiple condenser fan units
 - .10 contacts for connection to EMCS.
- .8 Provide the following optional items:
- .1 Five minute anti-cycle timer on lead compressor and interstage time delay relays on subsequent stages.
 - .2 Factory installed hot gas bypass.
 - .3 Low ambient controls for ____°C operation.
 - .4 Separate insulated compressor compartment with 25 mm, 24kg/cu.metre or 50 mm, 48kg/cu.metre density insulation.
 - .5 Liquid receivers, shipped loose, one per circuit, complete with liquid shut off valves and pressure relief device.
 - .6 Heresite corrosion protection on condenser coils and refrigeration piping.
 - .7 Epoxy paint finish on all exposed surfaces (except coils, compressors and motors)
 - .8 Separate/unit mounted, coaxial/shell and tube condensers for water/glycol heat rejection.
 - .9 Centrifugal forward curved/airfoil fans for indoor/extra quiet applications.
 - .10 Condenser coil protective screens.

PART 3 - EXECUTION

3.1. INSTALLATION

- .1 Mount unit on roof where indicated on drawings. Support unit on roof using two (2) full length 150mm x 150 mm creosoted wood sleepers.
- .2 Make all required connections. Provide for cost of extra wiring if required by an alternate unit manufacturer.

END OF SECTION

PART 1 - GENERAL	1
1.1. WORK INCLUDED	1
1.2. REFERENCE STANDARDS	1
1.3. SUBMITTALS	1
1.4. HANDLING AND DELIVERY	2
1.5. FACTORY LEAK TESTING	2
1.6. PERFORMANCE REQUIREMENTS	2
PART 2 - PRODUCTS	3
2.1. DESCRIPTION	3
2.2. ACOUSTICAL PERFORMANCE	3
2.3. CASING	3
2.4. INSULATION	4
2.5. STRUCTURAL BASE CONSTRUCTION	4
2.6. ACCESS DOORS	4
2.7. FANS	5
2.8. MOTORS	5
2.9. VIBRATION ISOLATION	6
2.10. COILS	6
2.11. FILTERS	7
2.12. DRAINS	7
2.13. LIGHTS	7
2.14. FILTER GAUGES	8
2.15. ALUMINUM AIRFOIL DAMPERS	8
2.16. TEST PORTS	9
2.17. ELECTRICAL	9
2.18. FINISH	9
2.19. AIR LEAKAGE TESTING	9
PART 3 - EXECUTION	9
3.1. INSTALLATION	9
3.2. STARTUP AND TESTING	10

PART 1 - GENERAL

1.1. WORK INCLUDED

- .1 Comply with Division 01 00 00, General Requirements.
- .2 Provide labour, materials, products, equipment, and services to supply and install packaged air handling units indicated on the Drawings and specified in this Section.

1.2. REFERENCE STANDARDS

- .1 Air handling units shall be standard products, selected from published literature of manufacturer.
- .2 Provide fan ratings based on tests meeting ASHRAE and AMCA procedures and provide only fans carrying the AMCA seals. No fan will be accepted which has a point of rating not listed in the published data or which is not rated for air and sound performance.
- .3 Fans shall be factory balanced, statically and dynamically to AMCA Standards.
- .4 Factory finish coat over primer on all parts. Spray paint before assembly and repaint after.
- .5 Units shall be designed and constructed to meet the following standards:
 - .1 ANSI/ASHRAE 51
 - .2 ANSI Standard 221.47
 - .3 CGA, ETLC, CSA or UL/ULC certified for prewired equipment
 - .4 NRCA Standard for Roof Curbs
 - .5 NFPA 90A for flame and smoke spread for adhesives
 - .6 ASHRAE 90.1-2013 - Standard for energy efficient design of new buildings.

1.3. SUBMITTALS

- .1 In addition to the requirements of Section 20 04 00, submittals shall meet the following standards:
 - .1 Product data shall include dimensions, weights, capacities, certifications, component performance, electrical characteristics, casing construction details, wiring interconnections, gauges and finishes of materials.
 - .2 Provide fan curves (not fan tables), with specified operating point clearly plotted.
 - .3 Provide coil selection worksheets, clearly showing proper consideration for altitude, and air density.
 - .4 Provide filter information, including initial air pressure drop (APD), final APD, dust spot efficiency, final dust holding capacity, filter media

description, filter frame details, and filter removal details and MERV ratings.

- .5 Submit sound power levels for both air handling unit inlet and outlet at rated capacity. Data shall be sound power levels re 10^{-12} watts through eight octave bands, complying with AMCA 301 and obtained from tests made in accordance with AMCA Standard 300.
- .6 Submit electrical requirements for power supply wiring including wiring diagrams for interlock and control wiring, clearly indicating factory-installed and field installed wiring and electrical devices.
- .7 Submit manufacturers recommended installation instructions.

1.4. HANDLING AND DELIVERY

- .1 All materials and components used in manufacturing of air conditioning units shall be new, protected and shall arrive free of rust.
- .2 Provide adequate protection for equipment during shipment. Repair any damage to satisfaction of consultant.
- .3 All equipment shall be FOB job site.
- .4 All equipment shall be broken down and brought in through mechanical room doors 750mm wide. (typical for all equipment shown on plans)

1.5. FACTORY LEAK TESTING

- .1 Unit manufacturer shall pressure test air handling unit to ensure the leakage rate of the casing does not exceed 1.5% of the unit air flow at 1.5 times the minimum calculated internal positive static pressure.
- .2 Two typical units for this project shall be selected for testing by the Consulting Engineer. Any modifications found necessary to meet the pressure requirements shall be incorporated in all other units.
- .3 Test shall be conducted in accordance with SMACNA duct construction manual. A calibrated orifice shall be used to measure leakage airflow.
- .4 An officer of the manufacturer shall certify test results. Forward copies of certified test results to the consultant.

1.6. PERFORMANCE REQUIREMENTS

- .1 Refer to the Schedules for equipment sizes, arrangements, acoustic performance, and capacities.
- .2 Air handling units shall be built to the level of quality as herein specified to ensure the performance of the air handling unit based on operating parameters outlined herein.

PART 2 - PRODUCTS

2.1. DESCRIPTION

- .1 Provide factory assembled air handling unit in configuration as indicated on drawings. Unit shall include all specified components installed at the factory. Field fabrication of units and their components will not be accepted.
- .2 **Optional:** All units shall be inspected by the customer prior to shipment. Inspection shall be of unit completely assembled.
- .3 The unit shall be designed to be supported by a house keeping pad.
- .4 Units too large to fit on a standard tractor trailer may be shipped to site in sections. Otherwise, units shall be shipped in one piece.

2.2. ACOUSTICAL PERFORMANCE

- .1 The casing shall have been tested for acoustical performance by an independent laboratory that is accredited. Manufacturers shall submit sound data in compliance with the following:
- .2 Test methods and facilities used to establish sound transmission loss values shall conform explicitly with the ASTM designation E90-85 and E413-73.
- .3 Sound Transmission Loss DB ASTM E-90 & E413-73

	1	2	3	4	5	6	7	8	
2" wall	18	19	27	33	43	52	52	52	STC=37

- .4 Test methods and facilities used to establish sound absorption values shall conform explicitly with the requirements of the ASTM Standard Test Method for Sound Absorption Coefficients by the Reverberation Method: ASTM C423-84A and E795-83.
- .5 Sound Absorption ASTM C423-84A & E795-83

	1	2	3	4	5	6	7	8	
2" wall	.10	.23	.75	1.08	1.05	.99	.97	.95	STC=37

2.3. CASING

- .1 Walls and roofs shall be constructed of 16 gauge galvanized steel 2" thick acoustic thermal panels. The inner liner shall be 22 gauge perforated galvanized steel on all compartment units. The inner liner shall be 22 gauge solid galvanized steel on all AHUs and OAU's. Insulation shall be 2" thick 4.5 lb. density fibreglass. Provide neoprene liner to seal insulation in sections with perforated panels. All permanently joined flanged panel surfaces shall be sealed with an individual strip of 1/8" X 3/8" tape sealer. Wall and roof seams shall be turned inward to provide a clean flush exterior finish. All panel seams shall be sealed during assembly to produce an airtight unit.

2.4. INSULATION

- .1 All insulation used in air handling unit walls, roof and base shall have a Flame spread rating of less than 25 and a Smoke Developed rating of less than 50 per ASTM E84 and UL 723 and Can/ULC S102-M88.
- .2 Insulation shall meet NFPA 90A and 90B.

2.5. STRUCTURAL BASE CONSTRUCTION

- .1 Units shall be constructed from a minimum C6x8.2 lb./sq.ft. channel structural steel perimeter base, with 2x2x1/4 intermediate structural steel channel and angle iron supports. Perimeter structural steel base shall be designed to directly support the weight of the walls. Intermediate structural steel and angle iron shall support the weight of all internal components (i.e. fans, coils, enthalpy wheels, etc.). Maximum base deflection shall be 1/4 inch on unsupported spans of 12 ft. Structural steel base shall be designed so that it can be point loaded or set on an unlevel surface and shimmed by the contractor within 12 foot spans without deflecting more than 1/4 inch. The structural steel base shall be either I-beam construction or C-channel (not box channel) so that the base will shed all water. Base shall be provided with lifting lugs, minimum four (4) per shipping split. Formed metal bases formed from sheet metal will not be acceptable. Base shall prevent wall panel joints from separating during lifting, transportation and rigging.
- .2 Lifting lugs shall be located and engineered to properly support the loads within. Manufacturers shall provide a load point calculation along with detailed lifting lug information as part of the shop drawing package.
- .3 A 0.12" thick aluminum checker plate floor shall be installed on the base. Floor seams shall be continuously welded providing a completely flat unit floor. Standing seams will not be accepted in any section. A 1-1/2" perimeter collar shall be provided to ensure the unit is internally watertight. The collar shall be alternately screwed down and tack welded to the unit base on one (1) foot centers. Caulk joint to be watertight.
- .4 The base shall be insulated with 3" thick, 1-1/2 lb. density fiberglass insulation and sheeted with a 22 gauge galvanized steel liner. The base liner shall be broken, tack welded and sealed for rigidity and vapour barrier integrity.

2.6. ACCESS DOORS

- .1 Access door construction and width shall match the rest of the unit casing. Corners shall be welded for rigidity. Spot welding of corner seams will not be accepted. 4.5 lb. density insulation shall be sandwiched between the outer and inner skins. A 10" round tempered glass window shall be provided in each door.
- .2 Provide two chrome plated "Ventlok" Model #310 high pressure latches operable from either side of the door. Hinges shall be continuous piano type stainless steel. Door openings shall be fully gasketed with continuous 1/2" closed cell hollow round black gasket with a metal encapsulated reinforced backing that mechanically fastens to the door opening perimeter. Door frames shall be framed from 16 gauge galvanized steel with the outside of the door flush to the unit. Minimum door width shall be as shown on the plans but in no

case shall an access door be less than 18". Door height shall be the maximum permitted by the height of the unit up to 72".

- .3 Doors shall open against positive pressure.

2.7. FANS

- .1 All fans shall be tested in accordance with AMCA Standards 210-70 and 310 Test Codes for Air Moving Devices. Backward inclined fans shall bear the AMCA sticker for both air and sound performance.
- .2 Fan Wheels and Shafts: Provide air foil blades on all fan wheels. Provide solid shafts keyed to the fan wheel. Coat fan shaft with rust inhibitor. Hollow shafts will not be acceptable.
- .3 Fan bearings shall be self aligning pillow block, grease lubricated, extra heavy duty anti-friction ball or spherical roller type selected for an L10 life of 200,000 hours at design operating conditions. Bearings are to be mounted on the integral fan scroll bracing.
- .4 Fan and motor shall be mounted on an all welded, structural steel, prime coated and internal isolation base. The outlet of the fan shall be separated from the unit casing by means of a factory installed flexible connection. The internally mounted motor shall be provided on a slide rail base to allow proper adjustment of belt tension.
- .5 Provide an OSHA approved fully enclosed metal belt guard having side of galvanized steel and expanded metal face. Belt guard shall be sized to allow either sheave to be increased by two sizes.
- .6 Provide fixed pitch sheaves rated at 150% of motor nameplate H.P. Allow for one (1) drive change for air balancing purposes (parts only, labour by air balancer).
- .7 Provide plenum fan inlets on the fan wall and air outlets from the casing with a smooth bellmouth fitting with radius to match casing thickness, and free of protruding structural members and flanges.
- .8 Plenum fan assembly must have an enclosed safety screen as per OSHA Standards.

2.8. MOTORS

- .1 Motors shall be designed for severe duty in accordance with IEEE 841 standards and shall meet NEMA MG1 Part 31. Motors shall be operable at 208 Volts, 60 Hz, 3-phase.
- .2 Motor enclosure shall be totally enclosed fan cooled and rated to IP55. A non-metallic cooling fan shall be provided. Frame, end bells and fan cowl shall be manufactured of heavy duty cast iron. The end plates shall be sealed to the frame joints. Enclosure shall be epoxy coated and rated for ASTM B117-90 96 hour salt spray test.
- .3 Motor windings shall have class F insulation with class B temperature rise ratings. Windings shall be 200C inverter spike resistant wire. Motor windings shall withstand 2000V transients. Motor service factor shall be 1.15 on sine wave power and 1.0 on VFD power.

- .4 Bearings shall be regreasable without disassembly and provide for the elimination of purged grease. Bearing life shall be a minimum of L10 at 50000 hours. Bearing seals shall be Inpro or equivalent.
- .5 Motors shall be balanced to less than 0.08 inches per second (filter out) and the vibration test data shall be shipped with the motor.
- .6 Nameplates shall be stainless steel and contain both NEMA data and bearing data.
- .7 Motors used with variable frequency drives shall be provided with a brush system to electrically ground the shaft and discharge any induced voltage on the motor shaft, with a direct path to ground.
- .8 Motor shall be provided with a 3 year warranty.
- .9 Acceptable motor manufacturers are Reliance-Baldor, US Motors, and TECO-Westinghouse.

2.9. VIBRATION ISOLATION

- .1 An integral all weld steel vibration isolation base shall be provided for the fan and motor.
- .2 Provide open spring mounts with iso stiff springs, sound deadening pads and leveling bolts.
- .3 Horizontal stiffness shall be equal to vertical stiffness.
- .4 Spring deflection shall be 2".
- .5 Isolators shall have earthquake restraints. Upon request, the unit manufacturer shall submit a restraint detail certified by a professional engineer.

2.10. COILS

- .1 Coils shall be fully enclosed within casing and mounted on angle frames manufactured to allow coils to be individually removed. Cooling coil racks shall be 12 Ga. 304 stainless steel. Heating coils shall be mounted on galvanized angle racks.
- .2 Removable coil access panels shall be provided to remove coils through casing wall. Coil covers shall be double wall construction with all exposed edges of insulation covered with sheet metal including holes through the cover for coil header stub outs. Coils shall be individually removable towards the access side.
- .3 All drain pans shall be double wall continuously welded 304 stainless steel. Intermediate drain pans shall be interconnected with stainless steel 1" down pipes. Condensate drain shall be a minimum 1-1/4" diameter stainless steel tube extending 1" out from unit for solder connection to trap. Drain pans shall be sloped within unit and fully drainable.
- .4 Coils shall be certified in accordance with ARI Standard 410.
- .5 Construction:

- .1 Tubes
 - .1 Horizontal, copper.
- .2 Fins
 - .1 Aluminum mechanically bonded to tubes.
- .3 Headers
 - .1 Seamless copper with vent and drain connections.
- .4 Casing
 - .1 16 gauge, galvanized steel on heating coils and stainless steel on cooling coils, channels with 16 gauge center and end supports.
- .5 Connections
 - .1 Same end, counterflow, with vent, drain, supply and return stubs extended to outside of unit casing with grommets for airtight casing. Roof mounted units shall have the centre of the bottom coil connections located 10" off the unit floor.

2.11. FILTERS

- .1 Filters shall be high performance, AAF deep pleated 12" long cartridge disposable type. Each filter shall consist of glass fibre media, media support grid, contour stabilizer and enclosing frame.
- .2 Filter media shall be of high density microfine glass fibers laminated to a non-woven synthetic backing to form a lofted filter blanket. The filter media shall have an average efficiency of Merv 13 on the ASHRAE Test Standard 52. The filter shall be listed by Underwriters Laboratories as Class 2.
- .3 Holding frames shall be factory fabricated of 16 gauge galvanized steel and shall be equipped with gaskets and 2 heavy duty positive sealing fasteners. Each fastener shall be capable of withstanding 25 lb. pressure without deflection. They will be capable of being attached or removed without the use of tools.
- .4 Filters shall be lift out from upstream access section.

2.12. DRAINS

- .1 Provide 1 1/4" capped floor drain connections on the side of the unit for complete drainability of the base pan for the following sections:
 - .1 Fresh Air Plenums

2.13. LIGHTS

- .1 Marine lights with protective cast metal cage and glass globes complete with duplex receptacles shall be installed on the wall across from the access doors. One (1) switch with an indicator light shall be installed on the exterior of the unit. Factory wire from switch to all lights in EMT conduit with liquid tight connections. At all split sections, provide a one-foot-long piece of flexible

conduit, with the extra wire spooled, for reconnection on site by the installing contractor. Electrical power shall be 120V/1/60.

2.14. FILTER GAUGES

- .1 Provide Dwyer 2000 (photohelic) magnehelic gauges.
- .2 **Optional:** Provide electronic filter gauges which have a digital display and a DPDT contact to indicate dirty filters. Power the gauges from the lighting circuit.
- .3 **Optional:** Provide electronic filter gauges which have a digital display and a 4-20mA or 0-10VDC signal to indicate air pressure drop. Power the gauges from the lighting circuit.
- .4 Magnehelic gauges shall be accurate to +/- 2% of full range.
- .5 Provide sensing probes and shut off valves for each gauge.
- .6 Provide one gauge flush mounted into the casing for each filter bank.

2.15. ALUMINUM AIRFOIL DAMPERS

- .1 Aluminum airfoil frames and blades shall be a minimum of 12 gauge extruded aluminum. Blades to be 6" wide single air foil design.
- .2 Frames shall be extruded aluminum channel with grooved inserts for vinyl seals. Standard frames 2" x 4" x 5/8" on linkage side, 1" x 4" x 1" on the other sides.
- .3 Pivot rods shall be 7/16" hexagon extruded aluminum interlocking into blade section. Bearings to be double sealed type with a Celcon inner bearing on a rod within a Polycarbonate outer bearing inserted into frame so that the outer bearing cannot rotate.
- .4 Bearing shall be designed so that there are no metal-to-metal or metal-to-bearing riding surfaces. Interconnecting linkage shall have a separate Celcon bearing to eliminate friction in linkage.
- .5 Blade linkage hardware is to be installed in frame out of airstream. All hardware to be on non-corrosive reinforced material or cadmium plated steel.
- .6 Damper seals shall be designed for minimum air leakage by means of overlapping seals.
- .7 Optional: Internal hollows shall be insulated with 7/8" thick polyurethane foam with R factor of 5.0 per inch. Blades shall be 100% thermally broken. Frame shall be insulated with polystyrene, R factor of 5.0 per inch.
- .8 Damper blades shall be maximum 40" long per section.
- .9 Dampers greater than 2 sections wide shall be provided with a jackshaft.
- .10 Acceptable dampers are: T.A. Morrison "TAMCO series 1000" and "RUSKIN CD-50".

2.16. TEST PORTS

- .1 Provide 1" diameter test ports for unit air stream testing in each plenum section between each component within the AHU. Test ports shall have a tube that extends between the inside and outside of the unit and a screwed cap on the exterior to allow access. The test ports shall have been flanged on the exterior to allow air seal and shall be flanged on the interior to cover the penetration of the casing.

2.17. ELECTRICAL

- .1 Factory wire and test all air handling units. Have units approved by CSA or ETLc.
- .2 Supply one @ 208 V/60 Hz/3 Ph power connection for motors and other large electrical devices and one @ 120 V/208V/60 Hz/1 Ph power connection for lights and receptacle.
- .3 Label and number code all wiring and electrical devices in accordance with the unit electrical diagram.
- .4 Wire from the motors to an external junction box located on the outside of the unit casing. Seal the casing penetrations in a manner that eliminates air leaks. At all split sections, provide a 1 foot long piece of flexible conduit, with the extra wire spooled, for reconnection on site by the installing contractor.

2.18. FINISH

- .1 Unit shall be finished painted with two components, etch bond primer and finish painted with alkyd enamel, color as selected by Owner. All uncoated steel shall be painted with grey enamel. All metal surfaces shall be prepainted with vinyl wash primer to ensure paint bonds to metal. Outdoor unit shall be finish coated with polyurethane paint. Paint for outdoor units shall be tested to ATSM B117 for 5000hr salt spray endurance.

2.19. AIR LEAKAGE TESTING

- .1 Unit manufacturer shall factory pressure test air handling unit as chosen by the consultant to ensure the leakage rate of the casing does not exceed 1.0% of the unit air flow at 1.5 times the rated static pressure.
- .2 Test shall be conducted in accordance with SMACNA duct construction manual. A calibrated orifice shall be used to measure leakage airflow.
- .3 An officer of the air handling unit company shall certify test results. Forward copies of certified test results to the consultant. (The consultant shall witness the pressure test on the units. Provide for all transportation for the consultant and owner to the factory).

PART 3 - EXECUTION

3.1. INSTALLATION

- .1 Rig and set the units in place. Ensure that spreader bars are used and the unit is protected from the lifting cables.

- .2 Entire air handling unit shall set on housekeeping pads or roof curbs and leveled.
- .3 Provide traps for all drains with at least {25 mm} [1"] greater trap seal and {25 mm} [1"] greater trap head than the maximum static pressure created by unit and run all drains to funnel floor drains.
- .4 Remove all internal hold-down bolts and shipping fasteners and install any parts which were shipped loose. Level spring isolators.
- .5 Check and re-align all access doors and dampers to ensure smooth operation through the entire range of travel.
- .6 Upon start-up, fan motor is to be checked for fan rotation, and amp draw for each phase. Amp readings are to be marked on the fan scroll.
- .7 Re-adjust all belt drives for tension and alignment.
- .8 Provide a drain valve on each coil drain fitting, and a vent valve on each coil vent.
- .9 All pipe and conduit penetrations to the casing are to be thoroughly sealed and caulked to prevent air leakage.
- .10 Any floor penetrations are to be thoroughly sealed to ensure the water-tightness and integrity of the entire floor.
- .11 Take all necessary precautions including blanket filter media coverage over the entire filter installation for protection during construction and startup.
- .12 Replace prefilter and final-filter media units immediately prior to acceptance.
- .13 Provide field touchup painting of areas damaged during installation.
- .14 Comply with the manufacturer's installation instructions.
- .15 Arrange for manufacturer to certify installation and supervise start-up and commissioning of unit.
- .16 Assemble units if shipped in sections. Ensure that assembly conforms to manufacturer's requirements.
- .17 Provide 120V power in two circuits to the units for lights and power receptacle. Coordinate power source with Division 26 00 00.

3.2. STARTUP AND TESTING

- .1 Include all costs for site review for factory technician of equipment installation and management of equipment startup operations, including:
 - .1 Provide a complete and thorough inspection and adjustment prior to startup.
 - .2 Remove all grease from bearings and recharge the bearings with the proper amount and type of lubricant.

- .3 Check alignment of bearings, drives, motors and be responsible for all proper adjustments. Notify Consultant to coordinate site visit at time of startup.
- .4 Provide copy of startup log to Owner and demonstrate operation and maintenance to Owner's representative. Include for five non-consecutive days of classroom training sessions which shall include presentations by specialized equipment manufacturers' representatives for controls, etc.

END OF SECTION

PART 1 - GENERAL	1
1.1. WORK INCLUDED	1
1.2. ADDITIONAL INSTRUMENTATION	1
PART 2 - PRODUCTS	1
2.1. ELECTRONIC TEMPERATURE SENSORS (THERMISTORS)	1
2.2. ROOM TEMPERATURE SENSORS	2
2.3. TEMPERATURE SWITCHES	2
2.4. CONTROL VALVES	2
2.5. VALVE ACTUATORS - ELECTRIC	3
PART 3 - EXECUTION	3
3.1. INSTALLATION OF INSTRUMENTATION	3
3.2. EXISTING INSTRUMENTATION	4
3.3. NAMEPLATES	4
3.4. WARNING NOTICES	4
3.5. EMCS INSTRUMENTATION LEGEND	4

PART 1 - GENERAL

1.1. WORK INCLUDED

- .1 Comply with Division 01 00 00, General Requirements
- .2 Provide labour, materials, products, equipment, and services to supply, install, wire, calibrate and test the electronic control and monitoring system instrumentation indicated on the Drawings, the Control Drawings, and specified in this Section.
- .3 Existing building automation system is Reliable controls through setpoint controls. Contact info: Mallory Remus, Ph: 705-745-1600, email: ptbosetpoint@bellnet.ca. All controls work shall be done by the named controls contractor as a sub-trade to the mechanical contractor. Mechanical contractor shall provide technical assistance as required.
- .4 Obtain the services of analysts of Pneumatic Systems Ltd, Contact info: Dave Strain, Ph: 905-640-23333, for all pneumatic demolition work.
- .5 Coordinate instrumentation provisions with the EMCS equipment specified in Section 25 50 00. Make compatible without conversion at the DDC System Controller.
- .6 Provide sensor transmitter output of 4 to 20 mA or 0-10VDC unless otherwise specified.
- .7 Refer to legend sheet on the control drawings or Part 3 of this Section for sensor codes.
- .8 All instrumentation provided under this Section of the Specification shall be native BACNet compliant and shall utilize BACNet communications protocol.

1.2. ADDITIONAL INSTRUMENTATION

- .1 Where the application of any software package requires additional instrumentation to meet the requirements specified, provide such instrumentation at no additional cost.

PART 2 - PRODUCTS

2.1. ELECTRONIC TEMPERATURE SENSORS (THERMISTORS)

- .1 Provide precision thermistors with linear characteristics over the complete sensor range.
- .2 Provide sensor ranges consistent with the system requirements.
- .3 Sensor accuracy as determined by BAS reported value shall be $\pm 0.25^{\circ}\text{C}$ to 48°C and $\pm 0.5^{\circ}\text{C}$ above 48°C .
- .4 Provide general purpose duct mount elements, Instrument Code A1 with the following additional requirements:
 - .1 copper sheathed construction

- .2 standard conduit box termination, complete with screw terminal connector block
- .3 length, such that the sensing element is no less than 1/3 of the duct width or diameter from the duct wall

2.2. ROOM TEMPERATURE SENSORS

- .1 Provide wall mounted room temperature sensors, Instrument Code A5, housed in plastic or metal enclosure. There shall be no manufacturer's logo, name or temperature indication on the cover. The sensor casing shall include a plug in connection port (RS 232) suitable for portable operator terminal
- .2 The temperature sensor shall be a 1000 ohm thermistor type sensor complete with all signal conditioning devices.
- .3 Mount sensor 1370 mm above finished floor in locations shown on Drawings. Where temperature sensor allows for adjustment of space temperature set point, mount sensor 1200 mm above finished floor.
- .4 On typical floors and in unfinished retail spaces, connect to 15 m of plenum rated control cable and leave coiled in ceiling space for future mounting by others.

2.3. TEMPERATURE SWITCHES

- .1 Provide temperature switches Instrument Codes A6 (Low Level) and A7 (High Level) with the following:
 - .1 SPST contacts
 - .2 manual reset
 - .3 repeatability +/- 1% of range
 - .4 adjustable differential of at least 0.22°C to 1.7°C.

2.4. CONTROL VALVES

- .1 All new control valves shall be Belimo CCV valves. Valves shall be sized for a max 2 psi pressure drop.
- .2 The normal position of the device (N.O. or N.C.) shall be the failure position which the device goes to if power, control signal or pneumatic signal is lost.
- .3 Provide control valves suitable for the operating pressures and temperatures of the systems. Ensure tight shut off against system operating differential pressures.
- .4 Straight through two-way valves shall have equal percentage flow characteristics.
- .5 Three-way valves shall have linear flow characteristics, to give constant total flow.
- .6 All valves shall have stainless steel stem and packing to suit application.

- .7 Refer to Control Diagrams for location of normally open/closed and common ports. Where normally open or closed ports are defined, provide a valve which will fail to that position if control signal, power or pneumatic pressure is lost.

2.5. VALVE ACTUATORS - ELECTRIC

- .1 Provide actuators for all motorized valves, coordinated with the valve body and intended service. Coordinate supply with the Mechanical Contractor.
- .2 Control valve actuators shall be Belimo, ensure that valve actuators are of the correct size and capacity required to ensure tight shut off of the valve under all operating and static differential pressure conditions. All actuators shall be gear type mechanism with rotary spring return, either clockwise or counterclockwise operation. Linear actuators shall be spring return to retracted position. Provide position feedback on all modulating valves to indicate percentage open to the BAS. Valve actuators for FCU, radiation, etc., less than 50 mm diameter may be non-spring return.
- .3 Select actuators for ease of field replacement and for rotation through 360 degrees for wiring alignment.
- .4 Select actuators to operate on 0-10 VDC, 4-20 mADC, or an increase/decrease signal. Provide emergency power to each actuator. Where normally open or normally closed valves are specified, ensure the valve fails to that position when power, control signal or pneumatic signal is lost.

PART 3 - EXECUTION

3.1. INSTALLATION OF INSTRUMENTATION

- .1 Meet applicable codes, each manufacturer's recommended installation procedures and Division 26 00 00 requirements.
- .2 All installations to be performed by skilled and certified technicians.
- .3 Install instrumentation to be mechanically stable. Fix as necessary to wall or floor. Provide anti-vibration mounted where required to properly isolate the equipment.
- .4 Install instrumentation for easy maintenance access and to not interfere with access to adjacent equipment and personnel in the surrounding space.
- .5 Install instrumentation in locations providing adequate ambient conditions for its specified functioning, allowing for adequate ventilation, without condensate traps.
- .6 Permanently identify each wire, cable, conduit and tube at each point of connection.
- .7 Protect all components placed in areas of high humidity or potentially high humidity.
- .8 Provide complete drawings for Consultant review before any field installation is started giving complete description of all control elements and showing complete schematic piping and wiring diagrams, including functional description.

- .9 Review proposed location of any instrumentation with Consultant prior to its installation.
- .10 Modifications to existing plenum and ductwork to achieve the intent of the Contract Documents shall adhere to the following:
 - .1 Mount sensors with extension necks such that access to sensors is not restricted by insulation.
 - .2 Keep cutting to a minimum and perform in a neat and workmanlike manner.
 - .3 Provide patches and access covers of the same material and thickness as adjoining ductwork. Provide necessary reinforcing and fastening materials.
 - .4 Provide gaskets, seals and insulation to restore to, or exceed as found conditions in areas where this Contractor has made modifications.
- .11 Wire instrumentation which is part of the same control loop to the same field panel.

3.2. EXISTING INSTRUMENTATION

- .1 Remove and dispose of existing instrumentation which becomes redundant in accordance with the Owner's direction.
- .2 Reuse existing thermowells where possible.

3.3. NAMEPLATES

- .1 Provide for each piece of instrumentation and end device, a 50 mm x 75 mm plastic nameplate embossed to indicate the following:
 - .1 mnemonic for point
 - .2 remote field panel and PIU termination
 - .3 English language description
 - .4 field panel
- .2 Affix the nameplate to the instrumentation, valve, etc., via a plastic cable tie or other similar device.
- .3 Submit specimen nameplate and cable tie to Owner for approval prior to installation.

3.4. WARNING NOTICES

- .1 Place warning notices at the MCC Panel, local starter and on or close to all motors under BMS control.

3.5. EMCS INSTRUMENTATION LEGEND

- .1 The following codes are referenced in this specification and are repeated on the Control Diagrams included with the Drawings.

CODE	DESCRIPTION	
A1	Temperature Sensor	Duct Mounted
A2	Temperature Sensor	Pipe Mounted
A3	Temperature Sensor	Averaging Type
A4	Temperature Sensor	Outside Shielded
A5	Temperature Sensor	Room Type
A6	Temperature Switch	Low Limit
A7	Temperature Switch	High Limit
B1	Humidity Transmitter	Duct Mounted
B2	Combined Humidity/Temperature Sensor	
B3	Outdoor Dewpoint Sensor	
C1	Pressure/Current Transmitter	
C2	Pneumatic/Current Transducer	
C3	Static Pressure Sensor	
C4	Pressure/Electric switch	
C5	Waterflow Switch	
C6	Damper Status Switch	
C7	Output to Variable Speed Drive	
C8	Pulsed Output	
C9	Leak/Moisture Detector	
C10	Output to VIV	
D1	Motor Control Relay	
D2	Current Transformer and Relay	
D3	Motor Status Contacts (Current Sensitive)	
D4	Differential Pressure Switch	
D5	Float Switch	Tank Mounted
D6	Float Switch	Pit Mounted
D7	Differential Pressure Transmitter	
D8	Current Sensitive Relay	
D9	Continuous Level Sensor (Ultrasonic)	
D10	Conductivity Controller	
F1	Interface Contact to CACF	
F2	Vibration Detector	
F4	Lighting Control Contact	
F5	Occupancy Sensor (Motion)	
K1	Waterflow Measuring Device	Pitot Tube Type
K2	Waterflow Measuring Device	Turbine Type
K3	Airflow Measuring Device	Heated Thermistor Type
K4	Energy Meter, Flow and Temp. Diff	Air Type
K5	Energy Meter, Flow and Temp. Diff	Water Type
K6 & K9	Gas Detector (CO or CO ₂)	
K7	Pulsed Output Water Meter	
K10	Power Meter	

END OF SECTION



ELECTRICAL SPECIFICATION

FOR

**CHEMONG PUBLIC SCHOOL
SCIENCE LAB UPGRADES
KAWARTHA PINE RIDGE DISTRICT SCHOOL BOARD
1029 GORE STREET
BRIDGENORTH, ONTARIO**

**CONSULTING
ENGINEERS:**

**HAMMERSCHLAG & JOFFE INC.
43 Lesmill Road
Toronto, Ontario
M3B 2T8**

H&J Ref. #21-000-040
Issued for Tender
May 03, 2021

26 05 00	Common Work Results for Electrical
26 05 05	Selective Demolition for Electrical
26 05 26	Grounding and Bonding for Electrical Systems
26 05 33	Raceways, Electrical Devices & Wiring
26 05 48	Vibration and Seismic Controls for Electrical Systems
26 24 16	Panelboards
26 27 26	Wiring Devices
26 28 13	Fuses
26 28 16.16	Enclosed Switches
26 51 00	Interior Lighting
27 00 00	Communications
28 46 00	Single Stage Fire Detection and Alarm

1	GENERAL	3
1.01	REFERENCES	3
1.02	APPLICATION	3
1.03	NOTE RE: BOLD LETTERING	3
1.04	SUBMITTALS	3
1.05	DEFINITIONS	3
1.06	QUALITY ASSURANCE	4
1.07	WORKMANSHIP	5
1.08	CODES, REGULATIONS, AND STANDARDS	5
1.09	IMPERIAL AND METRIC MEASUREMENTS	5
1.10	EXAMINATION OF SITE AND DOCUMENTS	6
1.11	DRAWINGS AND SPECIFICATION	6
1.12	PLANNING AND LAYOUT OF THE WORK, AND ASSOCIATED DRAWINGS	7
1.13	CONSTRUCTION DRAWINGS	8
1.14	COORDINATION OF THE WORK	9
1.15	GENERAL RE: INSTALLATION OF EQUIPMENT	10
1.16	INSTALLATION IN EXIT CORRIDORS AND EXIT STAIRS	10
1.17	PERMITS, FEES, AND CERTIFICATES	10
1.18	WORKPLACE SAFETY	11
1.19	SHOP DRAWINGS AND PRODUCT DATA SHEETS	12
1.20	SAMPLES	13
1.21	CHANGES OR REVISIONS TO THE WORK	13
1.22	SCAFFOLDING, RIGGING, AND HOISTING	15
1.23	TEMPORARY SERVICES	15
1.24	PROJECT CLOSEOUT SUBMITTALS	16
1.25	PROGRESS PAYMENT BREAKDOWN	19
1.26	REQUIREMENTS FOR CONTRACTOR RETAINED ENGINEERS	19
1.27	EXTENDED WARRANTIES	20
1.28	TRIAL USAGE	20
1.29	EQUIPMENT AND MATERIAL MANUFACTURER REQUIREMENTS	20
1.30	LIST OF ACCEPTABLE MANUFACTURERS AND SUPPLIERS	21
1.31	SUBSTITUTED OR ALTERNATIVE PRODUCTS	21
1.32	PHASING OF THE WORK	22
1.33	EQUIPMENT AND SYSTEM MANUFACTURER'S CERTIFICATION	22
1.34	EQUIPMENT AND SYSTEM START-UP	22
1.35	EQUIPMENT AND SYSTEM COMMISSIONING	23
1.36	EQUIPMENT AND SYSTEM O & M DEMONSTRATION & TRAINING	23
2	PRODUCTS	24

2.01	SLEEVES	24
2.02	MULTI-CABLE TRANSITS	25
2.03	FIRESTOPPING AND SMOKE SEAL MATERIALS.....	25
2.04	WATERPROOFING SEAL MATERIALS	25
2.05	ESCUTCHEON PLATES.....	25
2.06	ACCESS DOORS.....	26
2.07	IDENTIFICATION MATERIALS.....	26
2.08	ELECTRICAL ENCLOSURES	27
2.09	ENCLOSURE BACKBOARDS	28
3	EXECUTION	28
3.01	GENERAL ELECTRICAL WORK INSTALLATION REQUIREMENTS.....	28
3.02	WORKMANSHIP.....	29
3.03	INSTALLATION OF SLEEVES	30
3.04	RECTANGULAR OPENINGS:	31
3.05	SLEEVE AND FORMED OPENING LOCATION DRAWINGS	32
3.06	INSTALLATION OF ESCUTCHEON PLATES	32
3.07	INSTALLATION OF FASTENING AND SECURING HARDWARE	32
3.08	SUPPLY OF ACCESS DOORS	33
3.09	ELECTRICAL WORK IDENTIFICATION	33
3.10	INSTALLATION OF TERMINAL BACKBOARDS.....	36
3.11	GENERAL ELECTRICAL WORK TESTING.....	36
3.12	BRANCH CIRCUIT BALANCING.....	36
3.13	FINISH PAINTING OF ELECTRICAL WORK	36
3.14	SUPPLY OF MOTOR STARTERS AND ACCESSORIES	36
3.15	ELECTRICAL WIRING WORK FOR MECHANICAL WORK.....	37
3.16	INTERRUPTION TO AND SHUTDOWN OF ELECTRICAL SERVICES AND SYSTEMS	38
3.17	EQUIPMENT BASES AND SUPPORTS	38
3.18	CONCRETE WORK FOR EQUIPMENT BASES/PADS.....	39
3.19	CUTTING, DRILLING AND PATCHING.....	40
3.20	PACKING AND SEALING CORE DRILLED OPENINGS.....	40
3.21	FLASHING FOR ELECTRICAL WORK PENETRATING THE ROOF	41
3.22	CLEANING ELECTRICAL WORK.....	41
3.23	MAINTAINING EQUIPMENT PRIOR TO ACCEPTANCE	41
3.24	WASTE MANAGEMENT AND DISPOSAL	41
3.25	SEISMIC RESTRAINT ANCHOR POINTS FOR EQUIPMENT	42
3.26	REQUIREMENTS FOR BARRIER-FREE ACCESS.....	43

1 GENERAL

1.01 REFERENCES

- .1 The General Conditions of the Contract, the Supplementary Conditions, and all Sections of Division 01 apply to and are a part of this Section of the Specification.

1.02 APPLICATION

- .1 This Section specifies requirements that are common to electrical work Sections of the Specification and it is a supplement to each Section and is to be read accordingly.

1.03 NOTE RE: BOLD LETTERING

- .1 "Bold" type lettering is used throughout this Specification in an attempt to enhance the readability of the text. The use of "bold" lettering does not indicate a greater level of importance.

1.04 SUBMITTALS

- .1 As specified in this Section, submit the following to the Consultant:
 - .1 **Project close-out documentation:** O & M Manuals, record as-built drawings, and all associated data.
 - .2 **Progress payment breakdown:** a detailed breakdown of the electrical work cost.
 - .3 **Contractor's P. Eng. Documentation:** the name, qualifications, and evidence of current liability insurance for all professional engineers to be retained by the Contractor to perform work associated with the Contract.
 - .4 **Extended Warranties:** copies of all extended warranties specified, and in the name of the Owner.
 - .5 **O & M Training Schedules & Manual:** a proposed schedule of demonstration and training dates and times, and a preliminary copy of the training manual developed for operational and maintenance training.

1.05 DEFINITIONS

- .1 The following are definitions of words found in electrical work Sections of the Specification and on associated drawings:

- .1 "Concealed" – means work hidden from normal sight in furred spaces, shafts, tunnels, ceiling spaces, walls, and partitions.
- .2 "Exposed" – means work normally visible, including work in electrical and equipment rooms and similar spaces.
- .3 "Provide" (and tenses of provide) – means supply and install complete.
- .4 "Install" (and tenses of install) – means install and connect complete.
- .5 "Supply" – means supply only.
- .6 "Finished area" - means any area or part of an area which receives a finish such as paint, or is factory finished.
- .7 "Governing authority" and/or "regulatory authority" and/or "Municipal authority" – means all government departments, agencies, standards, rules, and regulations that apply to and govern the electrical work and to which the work must adhere.
- .8 "Consultant" – means the Architect or Consulting Engineer who has prepared the Contract Documents on behalf of the Owner.
- .9 Wherever the words "indicated", "shown", "noted", "listed", or similar words or phrases are used in the specification they are understood, unless otherwise defined, to mean that the product referred to as "indicated", "shown", "listed", or "noted" on the drawings.
- .10 Wherever the words "approved", "satisfactory", "as directed", "submit", "permitted", "inspected" or similar words or phrases are used in the specification or on the drawings they are understood, unless otherwise defined, to mean that work or product referred to is "approved by", "inspected by", etc., the Consultant.
- .2 In the electrical specification, singular may be read as plural, and vice-versa.

1.06 QUALITY ASSURANCE

- .1 All electrical work is to be done by journeyman tradesmen who perform only the work that their certificates permit, or by apprentice tradesmen under direct on-site supervision of an experienced journeyman tradesman. The use of apprentice tradesmen is to be limited and the journeyman/apprentice ratio is subject to the Consultant's approval.

- .2 An experienced and qualified superintendent is to be on-site at all times when electrical work is being performed.

1.07 WORKMANSHIP

- .1 Install equipment, conduit, and cables in a workmanlike manner to present a neat appearance and to function properly to the satisfaction of the consultant. Install runs parallel and perpendicular to building planes. Install conduit concealed in chases, behind furring or above ceiling, except in unfinished areas exposed conduits and junction boxes shall not be accepted. Install exposed systems neatly and group to present a neat appearance.
- .2 Install all equipment and apparatus requiring maintenance, adjustment or eventual replacement with due allowance therefore.
- .3 Include in the work, all requirements of manufacturers shown on the shop drawings and installation manuals.
- .4 Replace work unsatisfactory to the Consultant without extra cost.
- .5 Make provisions to accommodate future plant and equipment indicated on drawings.

1.08 CODES, REGULATIONS, AND STANDARDS

- .1 All Codes, Regulations, and Standards referred to in this Section and in Sections to which this Section applies are the latest edition of the Codes, Regulations, and Standards in effect at the time of bidding on this Project and applicable to the place of the work.
- .2 All electrical items are to be certified and bear the stamp or seal of an approved recognized testing agency such as CSA, UL, ULC, ETL, etc., or bear a stamp to indicate special electrical utility approval.
- .3 Requirements of the Contract Documents are to take precedence when they are more stringent than codes, ordinances, standards, and statutes.

1.09 IMPERIAL AND METRIC MEASUREMENTS

- .1 Conform to requirements of CAN/CSA-Z234.1, Canadian Metric Practice Guide.
- .2 Both Metric and Imperial units of measurement are indicated in the electrical Specification. Metric measurements are "soft" and have been rounded off. Coordinate material sizes with other trades.

1.10 EXAMINATION OF SITE AND DOCUMENTS

- .1 When estimating the cost of the work and prior to submitting a bid for the work carefully examine all of the bid documents and visit the site to determine and review all existing site conditions that will or may affect the work and include for all such conditions in the bid price.
- .2 Report to the Consultant, prior to bid submittal, any existing site condition that will or may affect performance of the work as per the drawings and specifications. Failure to do so will not be grounds for additional costs.

1.11 DRAWINGS AND SPECIFICATION

- .1 Read the electrical work drawings in conjunction with all other structural, architectural, sprinkler, mechanical, etc., drawings.
- .2 The electrical drawings are performance drawings, diagrammatic, and show approximate locations of equipment and connecting services. Any information regarding accurate measurement of the building is to be taken at the site. Do not scale the drawings, and do not use the drawings for prefabrication work.
- .3 The drawings are intended to convey the scope of work and do not show architectural, structural details or the work of other trades. Provide, at the Electrical Contractor's cost, all offsets, fittings, transformations, and similar products required as a result of obstructions and other architectural and structural details or the work of other trades but not shown on the drawings.
- .4 The locations of equipment and materials shown may be altered, when reviewed by the Consultant, to meet requirements of the equipment and/or materials, other equipment or systems being installed, and of the building, all at the Electrical Contractor's cost.
- .5 Sections of the electrical specification 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 the Sections are to be read as a whole.
- .6 The electrical specification does not generally indicate the specific number of items or extent of material required. The specification is intended to provide product data and installation requirements. It is necessary to refer to drawing schedules, layouts, schematic diagrams, riser diagrams, and details to determine correct quantities.

- .7 The electrical drawings and specification are intended to be cooperative. Perform all work that is shown, specified, or reasonably implied on the drawings but not mentioned in the specification, or vice-versa, as though fully covered by both.
- .8 Make, at no additional cost any changes or additions to materials and/or equipment necessary to accommodate structural conditions (runs around beams, columns, etc.).
- .9 Alter, at no additional cost, the location of materials and/or equipment as directed provided that the changes are made before installation and do not necessitate additional material in excess of 5.0m (15'-0").
- .10 Install all ceiling mounted components (lighting fixtures, detectors, speakers) in accordance with reflected ceiling plans approved by the Consultant. Refer to Architectural drawings for layout. When the scale and date of the drawings are the same, or when the discrepancy exists within the specification, the costliest arrangement will take precedence.
- .11 In the case of discrepancies or conflicts between the drawings and specification, the documents in the case of discrepancies or conflicts between the drawings and specification, the documents with more stringent requirements will prevail.
- .12 In the case of discrepancies between the drawings and specifications, the documents will govern in the order specified in the General Conditions, however, when the scale and date of the drawings are the same, or where the discrepancy exists within the specification, the costliest arrangement will take precedence.

1.12 PLANNING AND LAYOUT OF THE WORK, AND ASSOCIATED DRAWINGS

- .1 Properly plan, coordinate, and establish the locations and routing of services with all subcontractors affected prior to installation such that the services will clear each other as well as any obstructions, including structural components of the building. Unless otherwise specified, the order of right-of-way for services is to be as follows:
 - .1 Piping requiring uniform pitch
 - .2 Piping 100 mm (4") dia. and larger
 - .3 Large ducts (main runs)
 - .4 Electrical cable tray and bus duct
 - .5 Conduit 100 mm (4") dia. and larger

- .6 Piping less than 100 mm (4") diameter
- .7 Smaller branch ductwork
- .8 Conduit less than 100 mm (4") diameter
- .2 Unless otherwise shown or specified, conceal all work in finished areas, and conceal work in partially finished or unfinished areas to the extent made possible by the area construction. Install conduit, raceway, and similar 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.
- .3 Revise or alter the arrangement of work that has been installed without proper coordination, study, and review, even if it was completed in accordance with the Contract Documents, in order to conceal the work behind finishes, or to allow the installation of other work, at no additional cost. In addition, pay for the cost of alterations in other work required by the alterations to the Electrical Contractor's work.
- .4 All junction boxes, 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. Location of required access panels need to be preapproved by the consultant.

1.13 CONSTRUCTION DRAWINGS

- .1 Prepare interference drawings in conjunction with all trades concerned, showing sleeves, cables and conduit, routes, light fixtures, and openings for passage through structure and all insert sizes and locations.
- .2 Prepare composite interference drawings, fully dimensioned, of cable, conduit, cable trays, light fixtures, and equipment in all other critical locations to avoid conflict of trades. Base equipment drawings upon shop drawings and include, but do not necessarily limit to, all details pertaining to access cleanouts, tapings, sleeves, electrical connections, location and elevation of ducts, conduits, etc. obtained from consultation with and agreement of the trades involved.
- .3 Prepare all drawings to scale and dimension. Forward these drawings, approved by all Trades and the Contractor, to the Consultant for his records. Provide transparencies or provide print copies in the number as specified elsewhere in the contract documents, but not less than four (4).

- .4 Provide detailed layouts of all equipment and electrical rooms to ensure selected equipment fits the space.
- .5 Bind one complete set of construction drawings showing "as built" conditions in each operating and maintenance instruction manual. Provide JPEG files of drawings, on a USB drive, in each manual.

1.14 COORDINATION OF THE WORK

- .1 Review all the Contract Documents and coordinate the work with the work of all subcontractors. Coordination requirements are to include, but not be limited to, the following:
 - .1 Written notifications of all concrete work such as housekeeping pads, bases, etc., required for electrical work, and including required dimensions, operating weight of equipment, location, etc.
 - .2 Depth and routing of excavation required for electrical work, and requirements for bedding and backfill.
- .2 Co-operate with other trades and the Tenant's trades whose work is attached to or is affected by the work of this sub-contractor, to ensure a satisfactory installation and to avoid delays.
- .3 No extra compensation shall be considered for interference of equipment that could have been avoided by the co-ordination of the work by each trade.
- .4 Furnish all items to be built in, in time, complete with all pertinent information, commensurate with the progress of the work.
- .5 Coordinate all equipment nomenclature, including however not limited to fire alarm devices, mechanical equipment, escalators, elevators, exit stairs, corridors, and other areas of the facility. Note nomenclature shown on the construction drawings is for construction identification purposes only and does not reflect final user desired nomenclature or code requirements, nor any of the existing facility nomenclature.
- .6 Coordinate and arrange for meetings with AHJ, fire alarm contractor, sprinkler trade and general contractor to ensure life safety and fire alarm systems are coordinated and with nomenclature preapproved by the AHJ.
- .7 Coordinate and arrange for meeting with Landlord user group and provide proposed nomenclature that takes inconsideration existing facility nomenclature. Include for number of meetings as required.

- .8 Coordinate and arrange for meetings with mechanical trade and general contractor to ensure all equipment nomenclature is agreed upon.

1.15 GENERAL RE: INSTALLATION OF EQUIPMENT

- .1 Unless otherwise specified all equipment is to be installed in accordance with the 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.
- .2 Ensure that proper access and service clearances are maintained around equipment, and, where applicable, access space for future equipment removal or replacement is not impeded. Remove and replace any equipment which does not meet this requirement.

1.16 INSTALLATION IN EXIT CORRIDORS AND EXIT STAIRS

- .1 Any conduit or other electrical installation, not relating specifically to a 2 hour or greater time rated enclosure or an exit or corridor or stair shaft, which shall be enclosed in a 2-hour fire rated enclosure. The cost of this enclosure shall be borne by Divisions 26, 27 and 28.
- .2 Contractor shall overlay electrical drawings to provide proposed conduit layout to demonstrate passing through exit pathways is unavoidable.
- .3 Where purpose of corridors, exist or areas are not clearly identified on Architectural set of drawings, contractor shall obtain clarification and shall confirm installation of systems prior commencement of work.

1.17 PERMITS, FEES, AND CERTIFICATES

- .1 Apply for, obtain, and pay for all permits required to complete the electrical work.
- .2 Submit to the Consultant, all approval/inspection certificates issued by governing authorities to confirm that the work as installed is in accordance with the rules and regulations of the governing authorities. Pay any costs associated with issue of the certificates.
- .3 Include a copy of all approval/inspection certificates in each operating and maintenance manual.

- .4 Arrange for inspection of all work by the Authorities Having Jurisdiction over the work. On completion of the work, present to the Owner the Final Unconditional Certificate of Approval of the Inspecting Authorities.
- .5 Comply with the requirements of the latest edition of the Applicable C.S.A. Standards, the requirements of the Authorities Federal, Provincial and Municipal Codes. The Applicable Standards of the Underwriter's Association and all other Authorities Having Jurisdiction. These Codes and Regulations constitute an integral part of these specifications. In case of conflict, the Codes take Precedence over the Contract Documents. In no instance reduce the standard established by the drawings and specification by applying any of the Codes referred to herein.
- .6 Before starting any work, submit the required number of copies of drawings and specifications to the Authorities for their approval and comments. Comply with any changes requested as part of the contract, but notify the Consultant immediately of such changes, for proper processing of these requirements. Prepare and furnish any additional drawings, details or information as may be required.

1.18 WORKPLACE SAFETY

- .1 Comply with requirements of the Workplace Hazardous Materials Information System (WHMIS) regarding the use, handling, storage, and disposal of hazardous materials. Submit WHMIS MSDS (Material Safety Data Sheets) for all products where required and maintain one copy at the site in a visible and accessible location available to all personnel.
- .2 Comply with all requirements of Occupational Health and Safety Regulations and all other regulations pertaining to health and safety, including worker's compensation/ insurance board and fall protection regulations.
- .3 **Asbestos, Mould, Lead Paint, Etc.:** If at any time during the course of the work asbestos containing materials, black mould, lead paint, or any other such materials are encountered or suspected, immediately report the discovery to the Consultant and cease all work in the area in question. Do not resume work in affected areas until the situation has been properly corrected and without written approval from the Owner.

1.19 SHOP DRAWINGS AND PRODUCT DATA SHEETS

- .1 Prior to supplying any products to the site, submit for review, shop drawings and/or product data sheets indicating in detail the design, construction, and performance of products as requested in Sections of this Specification. The number of copies of shop drawings and/or product data sheets will be as later directed.
- .2 Shop drawings are those prepared specifically for the Project. Product data sheets are copies of manufacturer's standard catalogue, etc., literature.
- .3 Unless otherwise specified or required, submit shop drawings/product data sheets via email in AutoCAD, REVIT, or PDF format only.
- .4 Wherever possible, shop drawings and/or product data sheets are to be 215 mm x 280 mm (8½" x 11"), 215 mm x 356 mm (8½" x 14"), or 356 mm x 432 mm (11" x 17") single side white bond paper with sufficient clear space for review stamps, comments, and identification as specified below.
- .5 Shop drawings and product data sheets must confirm that the product proposed meets all requirements of the Contract Documents.
- .6 Each shop drawing or product data sheet is to be properly identified with the project name and the product drawing or specification reference, i.e., "Lighting Fixture F1", and all shop drawing or product data sheet dimensions are to be either SI or Imperial to match dimensions on the drawings.
- .7 Prior to submitting the shop drawing, carefully review each shop drawing and product data sheet prior to submittal to ensure that the proposed product is correct and meets with all requirements of the Project. Endorse each copy of each shop drawing or product data sheet "Correct for Review by Consultant", or "Certified to Be in Accordance with All Requirements" and include company name, the submittal date, and the signature of an officer of the company to indicate the Electrical Contractor's review and approval as above.
- .8 The Consultant will review shop drawings and product data sheets and will indicate the review status by stamping the shop drawings and product data sheets as follows:
 - .1 **"Reviewed" or "Reviewed as Noted"** to indicate that his review is final and no re-submittal is required

- .2 **"Returned for Correction"** to indicate that the submission is rejected and is to be revised in accordance with comments marked on the shop drawings and product data sheets by the Consultant and re-submitted.
- .9 The Consultant will retain one or two copies of each shop drawing or product data sheet submission.
- .10 The following is to be read in conjunction with the wording on the Consultant's review stamp applied to each and every electrical workshop drawing, or product data sheet submitted:
 - .1 "This review is for the sole purpose of ascertaining conformance with the general design concept. This review does not approve the detail design inherent in the product data/shop drawings, responsibility for which remains with the Contractor, and such review does not relieve the Contractor of the responsibility for errors or omissions in the product data/shop drawings or of his 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 coordination of the work of all sub-trades."

1.20 SAMPLES

- .1 Provide working samples of all luminaires and lamps as well as devices and cover plates for approval by the Owner and Consultant, prior to release of orders.

1.21 CHANGES OR REVISIONS TO THE WORK

- .1 Whenever the Consultant proposes in writing to make a change or revision to the design, arrangement, quantity, or type of any work from that required by the Contract Documents, prepare, and submit to the Consultant for approval, a quotation being the Electrical Contractor's proposed cost for executing the change or revision.
- .2 The Electrical Contractor's quotation is to be a detailed and itemized estimate of all products, material, labour, and equipment costs associated with the change or revision, plus overhead and profit percentages and all applicable taxes and duties.
- .3 Unless otherwise stated in the Contract Documents, the following requirements apply to all quotations submitted:

-
- .1 When the change or revision involves deleted work as well as additional work, the cost of the deleted work (less overhead and profit percentages but including taxes and duties) is to be subtracted from the cost of the additional work before overhead and profit percentages are applied to the additional work.
 - .2 Material costs are not to exceed those published in local estimating price guides such as Allpriser, less applicable trade discounts.
 - .3 Costs for journeyman and apprentice labour must not exceed prevailing rates at the time of execution of the Contract and must reflect the actual personnel performing the work.
 - .4 Cost for the site superintendent must not exceed 10% of the total hours of labour estimated for the change or revision, and the change or revision must be such that the site superintendent's involvement is necessary.
 - .5 Costs for rental tools and/or equipment are not to exceed local rental costs.
 - .6 If overhead and profit percentages are not specified in the General Conditions of the Contract, Supplementary Conditions, or elsewhere in preceding Sections of the Specification, but allowable under the Contract, then allowable percentages for mark-up and overhead and profit are to be 10% and 5% respectively.
 - .7 The overhead percentage will be deemed to cover all quotation costs other than actual site labour, product and materials, and rentals.
 - .8 All quotations, including those for deleted work, must include a figure for any required change to the Contract time.
 - .9 **Mark-up for:** cleaning, safety, project manager, union fees, etc. labour rated mark-ups are not applicable.
 - .10 Subcontractor quotation shall be subject to the above.
-
- .4 Labour and material pricing shall be per submitted unit rates where available, additionally labour for small items such as but not limited to straps, connectors, supports, clips, couplings, fasteners, marettes, bushings etc. will not be paid for. For the balance, NECA Table 1 or 2 is to be used where no unit rates exist.
 - .5 Overtime and premium time labour may be applied to quotations when preapproved by Stakeholder and validated to impact project schedule.

- .6 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 the Consultant to expeditiously process the quotation and issue a Change Order will not be grounds for any additional change to Contract time.
- .7 If, in the Electrical Contractor's opinion, changes or revisions to the work should be made, inform the Consultant in writing and, if the Consultant agrees, a Notice of Change will be issued.
- .8 Do not execute any change or revision until written authorization for the change or revision has been obtained.

1.22 SCAFFOLDING, RIGGING, AND HOISTING

- .1 Unless otherwise specified or directed, supply, erect and operate all scaffolding, rigging, hoisting equipment and associated hardware required for the Electrical Contractor's work. Immediately remove from the site all scaffolding, rigging, and hoisting equipment when no longer required.

1.23 TEMPORARY SERVICES

- .1 Refer to General Conditions.
- .2 This contract includes all temporary wiring and connections for the elevators and escalators, as required such that respective contractor has all necessary power and connections available for certification of the equipment, prior to turnover and to meet the schedule. In certain circumstances tenant services will not be in place during elevator and escalator installation. Provide suitable temporary power for Division 25 to commission all their equipment. Mark phase rotation on all mechanical rotating equipment and include for temporary power for start-up prior to permanent tenant power being made available.
- .3 The project is being turned over in phases for occupancy. Ensure fire alarm and emergency lighting are fully functional for occupancy for each phased handover. Provide necessary temporary services. Prior to each phase handover, contractor shall provide ULC 537 partial verification fire alarm report.

- .4 For renovation projects, maintain adequate temporary emergency and regular lighting in all areas. In this regard, provide temporary luminaires under scaffoldings or where ceilings have been removed or in other areas, or where light fixtures have been removed. Provide 30 FC average. Ceilings below 15'-0" above finished floor level (a.f.f.l.) provide LED industrial fluorescent luminaires with wrap around lenses. Emergency lighting shall be to Code requirements. Provide necessary temporary exit signs. Maintain during construction and remove when instructed to do so.
- .5 New luminaires may not be used for temporary construction lighting.

1.24 PROJECT CLOSEOUT SUBMITTALS

- .1 Prior to application for Substantial Performance, submit all required items and documentation specified, including the following:
 - .1 Operating and Maintenance Manuals.
 - .2 As-built record drawings and associated data.
 - .3 Extended warranties for equipment as specified.
 - .4 All operating test certificates, i.e., Fire Alarm System Test Certificate.
 - .5 Testing and commissioning records.
 - .6 Identified keys for electrical equipment and/or panels for which keys are required, and all other items required to be submitted.
 - .7 Other data or products specified.
- .2 **Operating and Maintenance Manuals:** Submit three hard copies of operating and maintenance manuals consolidated in hardcover three "D" ring binders, each binder sized to include approximately 25% spare space for future data, and identified permanently with the Project name, "ELECTRICAL OPERATING AND MAINTENANCE MANUAL" wording, and the date. Manuals are to include the following:
 - .1 An Introduction sheet listing the Consultant's, Contractor's, and Subcontractor names, street addresses, telephone and fax numbers, and e-mail addresses.
 - .2 A Table of Contents sheet, and corresponding index tab sheets.

- .3 A copy of each "Reviewed" or "Reviewed as Noted" shop drawing or product data sheet, with manufacturer's/supplier's name, telephone and fax numbers, email address, and the email address for local source of parts and service.
- .4 Test reports, and certificates issued by governing authorities.
- .3 **Operating Data:** Operating data is to include:
 - .1 A description of each system and its controls.
 - .2 Operation instruction for each system and each component.
 - .3 Description of actions to be taken in event of emergencies and/or equipment failure.
- .4 **Maintenance Data:** Maintenance data is to include:
 - .1 Servicing maintenance, 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 Complete parts list with numbers.
- .5 **Performance Data:** Performance data is to include:
 - .1 Equipment and system start-up data sheets.
 - .2 Equipment performance verification test results including all work sheets, and final commissioning report.
- .6 **Review Submittal:** Assemble one copy of the O & M Manual and submit to the Consultant for review prior to Owner training and instructions and assembling the remaining copies. Incorporate all comments into the final submission.
- .7 **Digital O & M Manuals:** Submit four digital versions of the hard copy manual using the latest version of Adobe Acrobat Portable Document Format and enhanced with bookmarks, internet links, and internal document links. The digital copies are to be copied to CDR with custom labels which indicate the project name, date, the Consultant's name, and "Operating & Maintenance Manual for Electrical Systems".

-
- .8 **Record "As-Built" Drawings and Data:** As work progresses at the site, clearly mark in red in a neat and legible manner on a set of white prints of the Contract Drawings, all significant changes, and deviations from the routing of services and locations of equipment shown on the Contract Drawings and resulting from the issue of Addenda, Site Instructions, Change Orders, and job conditions. Use notes marked in red as required. Maintain the white print red line as-built set at the site for the exclusive use of recording as-built conditions, keep the set up to date at all times, and ensure that the set is always available for periodic review. The as-built set is also to include the following:
- .1 The dimensioned location of all inaccessible concealed work.
 - .2 The locations of control devices with identification for each.
 - .3 The location of all junction boxes, terminal cabinets, etc.
 - .4 For underground conduit, ducts, etc., record dimensions, invert elevations, all offsets, fittings, and accessories if applicable, and locate dimensions from benchmarks that will be preserved after construction is complete.
 - .5 The location of all concealed services terminated for future extension.
- .9 **Digital Record "As-Built" Drawings:** When work on site is complete, transfer all the as-built red line information from the site as-built drawings into REVIT and CAD format. Submit final as-built drawings in both PDF, CAD and REVIT format. As-built drawings shall not include any information regarding the Consultant. Apply 'As-Built' stamp to all drawings and include the Contractor's name and company information on the title block.
- .1 Projects set up in AutoCAD shall be limited to CAD and PDF digital records.
- .10 **Review and Submittal:** Prior to inspection for Substantial Performance of the work, submit for review, the red line site as-built white prints, a CAD disc of the as-built drawings, and a bound set of white prints (of equal quality to the Contract Drawings) made from the disc. The Consultant will review the drawings and, if necessary, return the disc and the marked-up white prints for corrections or further revisions, in which case complete the corrective and/or revision work and resubmit the disc and white prints until they are determined to be acceptable, all prior to issue of a Certificate of Substantial Performance.

1.25 PROGRESS PAYMENT BREAKDOWN

- .1 Submit, prior to submittal of the first progress payment draw, a breakdown of the cost of the electrical work to assist the Consultant in reviewing and approving monthly progress payment claims.
- .2 The payment breakdown is subject to the Consultant's approval and progress payments will not be processed until an approved breakdown is in place. The breakdown is to include one-time claim items such as mobilization and demobilization, insurance, bonds (if applicable), shop drawings and product data sheets, commissioning, and project closeout submittals.

1.26 REQUIREMENTS FOR CONTRACTOR RETAINED ENGINEERS

- .1 All professional engineers retained by the Electrical Contractor to perform consulting services with regard to the Electrical Contractor's work, i.e., structural and seismic engineers, are to be members in good standing with the local Association of Professional Engineers and are to carry and pay for errors and omissions professional liability insurance in compliance with requirements of the governing authorities in the locale of the work.
- .2 The Electrical Contractor's engineer's professional liability insurance is to protect the Electrical Contractor's Consultants and Sub-Consultants, and their respective servants, agents, and employees against any loss or damage resulting from the professional services rendered by the Electrical Contractor's Consultants, Sub-Consultants, and their respective servants, agents, and employees in regards to the work of this Contract.
- .3 Liability insurance requirements are as follows:
 - .1 Coverage is to be a minimum of \$2,000,000.00 inclusive of any one occurrence unless otherwise noted in contract documents provide by Stakeholder.
 - .2 The insurance policy is not to be cancelled or changed in any way without the insurer giving the Owner a minimum of thirty days written notice.
 - .3 Liability insurance is to be obtained from an insurer registered and licensed to underwrite such insurance in the location of the work.

- .4 Evidence of the required liability insurance in such form as may be required is to be issued to the Owner, the Owner's Consultant, and Municipal Authorities as required prior to commencement of the Electrical Contractor's Consultant's services. Submit copies of letters of undertaking and final sign off schedules as may be required by the Authorities Having Jurisdiction (AHJ).

1.27 EXTENDED WARRANTIES

- .1 Unless otherwise specified, all extended warranties specified in electrical work Sections of the Specification are to be full parts and labour warranties, at the site, and in accordance with requirements of the Contract warranty, but direct from the equipment manufacturer/supplier to the Owner. Submit signed and dated copies of extended warranties which clearly state requirements specified above.

1.28 TRIAL USAGE

- .1 Prior to trial usage, checkout procedures and start up procedures to be carried out as per sections 01 70 00 of the specification.
- .2 The Owner has the privilege of the trial usage of electrical systems or parts thereof for the purpose of testing and learning the operational procedures.
- .3 Carry out the trial usage over a length of time as deemed reasonable by the Consultant, at no extra cost.
- .4 Carry out the operations only with the express knowledge and under supervision of the Prime Subcontractor who shall not waive any responsibility because of trial usage.
- .5 Trial usage shall not be construed as acceptance by the Owner, nor the start of the warranty period.

1.29 EQUIPMENT AND MATERIAL MANUFACTURER REQUIREMENTS

- .1 Equipment and materials scheduled or specified on the drawings or in the Specification have been selected to establish a performance and quality standard.
- .2 In most cases, acceptable equipment and material manufacturers are listed for any product specified by manufacturer's name and model number. Unless otherwise stated, the bid price may be based on products supplied by any of the manufacturers named as acceptable for the particular product. If acceptable manufacturers are not listed for a particular product, base the bid price on the products supplied by the specified manufacturers.

- .3 If products supplied by a manufacturer named as acceptable are used in lieu of the products specified by manufacturer's name and model number, ensure that the product is equivalent in performance and operating characteristics (including energy efficiency if applicable) to the specified product. Pay for any additional costs and changes to associated or adjacent work resulting from the use of products supplied by a manufacturer other than the specified manufacturer. In addition, in equipment spaces where products named as acceptable are used in lieu of the specified products and the dimensions of such products differ from the specified products prepare and submit for review, if requested, accurately dimensioned layouts of the rooms affected to prove that all the equipment in the room will fit properly.

1.30 LIST OF ACCEPTABLE MANUFACTURERS AND SUPPLIERS

- .1 Within one day after award of a Contract, submit to the Consultant for review, a list to indicate the name of the manufacturers/suppliers the Electrical Contractor proposes to use for each item of equipment, material, or service listed, except for items such as conduit, branch circuit conductors, and similar products. Manufacturers and/or suppliers on the list must be named in the Specification or on the drawings.
- .2 If the List of Acceptable Manufacturers and Suppliers is not submitted within one day after award of a Contract, the products specified and scheduled by manufacturer's name and model number and on which the Project is based are to be supplied. No substitutions whatsoever will be accepted unless previously approved in writing by the Consultant.
- .3 If a Supplementary Bid Form is issued with the Bid Documents and requests the list of acceptable manufacturers and suppliers, the completed Supplementary Bid Form is to be submitted within one day after the date for bid closing.

1.31 SUBSTITUTED OR ALTERNATIVE PRODUCTS

- .1 Products supplied by a manufacturer/supplier other than a manufacturer specified as acceptable may be considered for acceptance by the Consultant if requested in writing a minimum of five full working days prior to the bid closing date. Requests may be made by letter, or by email. Telephone requests will not be considered.
- .2 Each request for acceptance of a proposed substitution or alternative product must be accompanied by detailed catalogue and engineering data, fabrication information, and performance characteristics to permit the Consultant to make an informed decision.

- .3 Pay for any additional costs and changes to associated or adjacent work resulting from the use of products supplied by a substituted or alternative manufacturer. In addition, in equipment spaces where substituted or alternative products are used in lieu of the specified or acceptable products and the dimensions of such products differ from the specified or acceptable products, prepare, and submit for review, if requested, accurately dimensioned layouts of the rooms affected to prove that all the equipment in the room will fit properly.
- .4 The Consultant's decision regarding any proposed substitution or alternative product is final.

1.32 PHASING OF THE WORK

- .1 Phasing of the work is required to maintain the existing building in operation, all as specified by Consultants and Architect. Include all costs for phasing the work including all required "off hours" premium time labour costs.

1.33 EQUIPMENT AND SYSTEM MANUFACTURER'S CERTIFICATION

- .1 When equipment/system installation is complete, but prior to start-up procedures, arrange and pay for the equipment/system manufacturer's authorized representative to visit the site to examine the installation, and when any required corrective measures have been made, to certify in writing to the Consultant that the equipment/system installation is complete and in accordance with the equipment/system manufacturer's instructions.

1.34 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 electrical work Sections in accordance with the following requirements:
 - .1 Submit a copy of each equipment/system manufacturer's start-up report sheet to the Consultant for review and incorporate any comments.
 - .2 Under direct on-site supervision and involvement of the equipment/system manufacturer's representative, start-up the equipment/systems, make any required adjustments, document the procedures, leave the equipment/systems in proper operating condition, and submit a complete set of start-up documentation sheets signed by the manufacturer/supplier and the Contractor.

1.35 EQUIPMENT AND SYSTEM COMMISSIONING

- .1 After successful start-up and prior to Substantial Performance, commission the electrical work in accordance with requirements of CSA Z320, Building Commissioning. Use commissioning sheets included with the CSA Standard, and any supplemental commissioning sheets required. Submit final commissioning data sheets, TAB reports, project closeout documents, and other required submittals.
- .2 Commission electrical equipment and systems in accordance with the Section entitled Electrical Work Commissioning.
- .3 Cooperate with the Owner's Commissioning Agent who is responsible for commissioning electrical equipment and systems. Refer to and perform duties required the Section entitled Owner's Commissioning Agent.

1.36 EQUIPMENT AND SYSTEM O & M DEMONSTRATION & TRAINING

- .1 Refer to equipment and system operational and maintenance training requirements specified in this and other Divisions of the project.
- .2 Train the Owner's designated personnel in all aspects of operation and maintenance of equipment and systems as specified in electrical work Sections of the Specification. All demonstrations and training are to be performed by qualified technicians employed by the equipment/system manufacturer/supplier.
- .3 For each item of equipment and for each system for which training is specified, prepare training modules as specified below. Operating and Maintenance Manuals are to be used during the training sessions, and training modules are to include:
 - .1 **Operational Requirements and Criteria:** requirements and criteria are to include but not be limited to equipment function, stopping, and starting, safeties, operating standards, operating characteristics, and limitations.
 - .2 **Troubleshooting:** troubleshooting is to include but not be limited to diagnostic instructions, test, and inspection procedures.
 - .3 **Documentation:** documentation is to include but not be limited to equipment/system warranties, and manufacturer's/supplier's parts and service facilities, telephone numbers, email addresses, and the like.

- .4 **Maintenance:** maintenance requirements are to include but not be limited to 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:** repair requirements are to include but not be limited to diagnostic instructions, disassembly, component removal and repair instructions, instructions for identifying parts and components, and review of any spare parts inventory.
- .4 Assemble the training modules into a training manual and submit a copy to the Consultant for review prior to scheduling training. Ensure that each participant in each training session has all required training material.
- .5 Schedule demonstrations and training at mutually agreed to times with a minimum of 7 working days' notice.
- .6 Demonstration and Training Confirmation: Obtain a list of personnel to receive demonstration and training from the Consultant, and have each participant sign the list to confirm that he/she understood the demonstration and training session.

2 PRODUCTS

2.01 SLEEVES

- .1 Galvanized Sheet Steel: Minimum #16-gauge galvanized steel with an integral flange at one end to secure the sleeve to formwork construction.
- .2 Polyethylene: Factory fabricated, flanged, high-density polyethylene sleeves with reinforced nail bosses.
- .3 Waterproof Sleeves: Schedule 40 mild galvanized steel pipe with a welded-on square steel anchor and water stop plate at the sleeve midpoint, or PSI-Thunderline "Century-Line" Model CS HDPE sleeves.
- .4 Galvanized Steel: Schedule 40 mild galvanized steel.

2.02 MULTI-CABLE TRANSITS

- .1 UL/ULC listed and labelled multi-cable transits sized to suit the fire barrier opening and the number of cables/conduits involved and to facilitate a minimum 2-hour watertight fire and smoke seal. Each assembly is to be complete with a stainless steel frame, cadmium plated compression bolts, proper end packing, compression plates, steel stay plates, and fire rated neoprene insert blocks.

2.03 FIRESTOPPING AND SMOKE SEAL MATERIALS

- .1 Firestopping and smoke seal system materials for electrical penetrations through fire rated construction are specified in the electrical work Section entitled Sleeves and Sleeve Seals for Electrical Raceways and Cabling and the work is to be done as part of the electrical work.
- .2 Firestopping and smoke seal system materials approved list include 3M, Hilti and approved equal.

2.04 WATERPROOFING SEAL MATERIALS

- .1 Modular, mechanical seal assemblies consisting of interlocking synthetic rubber links shaped to continuously fill the annular space between the pipe and the pipe sleeve or wall opening, assembled with stainless steel bolts and pressure plates and designed so that when the bolts are tightened the links expand to seal the opening watertight. The seal assemblies are to be selected to suit the pipe size and the sleeve size or wall opening size. Acceptable products are:
 - .1 Thunderline Corp. (Power Plant Supply Co.) "LINK SEAL" Model S-316
 - .2 The Metraflex Co. "MetraSeal" type ES

2.05 ESCUTCHEON PLATES

- .1 One-piece chrome plated brass or #4 finish type 302 stainless steel plates with matching screws for attachment to the building surface, each plate sized to completely cover the conduit/cable sleeve or building surface opening, and to fit tightly around the conduit or cable.

2.06 ACCESS DOORS

- .1 Prime coat painted steel (unless otherwise specified) flush access doors, each complete with a minimum #16-gauge frame, minimum #18-gauge door panel, heavy-duty rust-resistant concealed hinges, a positive locking screwdriver lock, and mounting and finishing features to suit the particular construction in which it is to be installed.
- .2 Access door sizes are to suit the concealed work for which they are supplied, and wherever possible they are to be of a 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. Provide layout to Consultant and Architect for approval prior commencement of work.
- .3 Access doors in fire rated construction are to be ULC listed and labelled and of a rating to maintain the fire separation integrity.
 - .1 Obtain approval by AHJ prior planning installation that requires access doors in fire rated assembly areas.
- .4 Where access doors are located in surfaces where special finishes are required, they are to be of a recessed door type capable of accepting the finish in which they are to be installed so as to maintain the final building surface appearance throughout, and constructed of stainless steel with a #4 finish, or as approved by the Architect.
- .5 Any use of access doors in public areas requires Consultant and Architect preapproval, provide proposed access doors layout coordinated with other disciplines. Access doors shall be proposed grouped with other trades requirements and are subject to coordinated approval by all consultants.
- .6 Any use of access doors in process areas requires Consultant and Architect preapproval, provide proposed access doors layout coordinated with other disciplines. Access doors shall be proposed grouped with other trades requirements and are subject to coordinated approval by all consultants.

2.07 IDENTIFICATION MATERIALS

- .1 **Equipment Nameplates:** 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 single phase starters and switches, minimum 25 mm x 65 mm (1" x 2½") 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 capital letter wording to completely identify the equipment and its use with no abbreviations.
- .2 wording is generally to be as per the drawings, i.e., Lighting Panel A, and is to include equipment service and building area/zone served and where powered from 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 **Self-Adhesive Labels:** Equal to Brother "P-Touch" or Thomas & Betts Canada Ltd. "EZCODE" Model EZL500 electronic labelling system self-adhesive labels with size and colour as directed, and permanently printed circuit identification nomenclature which is to be approved by the Consultant prior to producing the labels.
- .3 **Warning Signs:** Equal to Thomas & Betts Canada Ltd. "BP" Series 250 mm x 355 mm (10" x 14") semi-rigid vinyl signs with corner screw holes, the required printed wording (generally red on a white background with black trim), pressure sensitive adhesive on the back, and stainless steel screws.
- .4 **Conduit and Armoured Cable Identification:** Equal to Brady Canada minimum 50 mm (2") wide self-adhesive coloured vinyl tape.
- .5 **Conductor Terminations:** Equal to Electrovert Ltd. Slip-on "Z" type
- .6 **Conductor Colour Coding:** As specified with the conductors.

2.08 ELECTRICAL ENCLOSURES

- .1 Unless otherwise specified or required by AHJ, electrical enclosures are to be wall mounting NEMA/EEMAC/CSA enclosures as follows:
 - .1 indoor in sprinkler protected areas, Type 2
 - .2 indoor in high humidity/washdown areas, Type 4
 - .3 indoor in corrosive environments, Type 4X, 316 stainless steel
 - .4 indoor explosion-proof, Class 1, Groups C & D, Type 7

- .5 outdoor, minimum Type 3R and as per project drawings, the greater requirements will prevail
- .6 indoor in non-hazardous areas except as noted above, Type 1

2.09 ENCLOSURE BACKBOARDS

- .1 Construction grade Fir plywood, G1S, 20 mm ($\frac{3}{4}$ ") thick with width and length to suit enclosure dimensions, coated on all surfaces with a ULC listed water based latex intumescent flame-retardant paint, ASTM E-84 Class A rated.

3 EXECUTION

3.01 GENERAL ELECTRICAL WORK INSTALLATION REQUIREMENTS

- .1 Unless otherwise specified, locate, and arrange horizontal conduits, raceways, and conductors above or at the ceiling on floors on which they are shown, arranged so that under consideration of all other work in the area, the maximum ceiling height and/or usable space is maintained.
- .2 Unless otherwise specified, install all conduits and conductors concealed in finished spaces, and concealed to the degree possible in partially finished and unfinished spaces. Refer to and examine the Architectural drawings and room finish schedules to determine finished, partially finished, and unfinished areas. Note that walls which are painted are considered finished.
- .3 Unless otherwise specified conduits and main distribution conductors may be exposed in equipment rooms.
- .4 Install all exposed conduits, raceways, and conductors parallel to building lines and to each other.
- .5 Do not install conduit, raceway, or conductors within 150 mm (6") of "hot" piping or equipment.
- .6 All conduit, raceway, conductors, etc., must be supported from the structure, not from ceiling hangers, piping, ductwork, cable tray, and similar mechanical or electrical products.
- .7 Neatly group and arrange all exposed work. Do not install conduit to prevent access into equipment.

- .8 **Access:** Locate all work to permit easy access for service or maintenance as required and/or applicable. Locate all products which will or may need maintenance or repairs and which are installed in accessible construction so as to be easily accessible from access doors. Where such products occur in vertical services in shafts, pipe spaces or partitions, locate the accessories at the floor level.
- .9 **Manufacturer's Instructions:** Ensure that equipment and material manufacturer's installation instructions are followed unless otherwise specified herein or on the drawings, and unless such instructions contradict governing codes and regulations.
- .10 **Cleaning:** Carefully clean all conduits, raceway, and fittings prior to installation. Temporarily cap or plug ends of conduit, which are open and exposed during construction.
- .11 **Surfaces to Receive the Electrical Contractor's Work:** Inspect surfaces and structure prepared by other trades before performing electrical work. Verify that surfaces or the structure to receive electrical 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 this Electrical Contractor's work will constitute acceptance of such surfaces as being satisfactory.
- .12 **Repair of Finished Surfaces:** For factory-applied finishes, repaint or refinish all surfaces damaged during shipment and installation. The quality of the repair work is to match the original finish. This requirement also applies to galvanized finishes.
- .13 **Work in High Humidity Areas:** Where electrical 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 the products to protect against corrosion or provide products which will not corrode in the environment.

3.02 WORKMANSHIP

- .1 Install equipment, conduit, and cables in a workmanlike manner to present a neat appearance and to function properly to the satisfaction of the consultant. Install runs parallel and perpendicular to building planes. Install conduit concealed in chases, behind furring or above ceiling, except in unfinished areas exposed conduits and junction boxes shall not be accepted. Install exposed systems neatly and group to present a neat appearance.

- .2 Install all equipment and apparatus requiring maintenance, adjustment or eventual replacement with due allowance therefore.
- .3 Include in the work, all requirements of manufacturers shown on the shop drawings and installation manuals.
- .4 Replace work unsatisfactory to the Consultant without extra cost.
- .5 Make provisions to accommodate future plant and equipment indicated on drawings.
- .6 In parking garages raceways runs shall be located at the parking stalls and away from main drive aisle.

3.03 INSTALLATION OF SLEEVES

- .1 Where conduits, round ducts, and armoured cable pass through concrete and/or masonry surfaces, provide 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.
- .2 Waterproof Sleeves: Provide waterproof sleeves in the 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 all floors equipped with waterproof membranes.
 - .4 In the roof slab.
 - .5 In waterproof walls.
- .3 Size sleeves, unless otherwise specified, to leave 12 mm ($\frac{1}{2}$ ") clearance around the conduit, duct, cable, etc.
- .4 Pack and seal the void between the sleeves and the conduit, duct, cable, etc., in non-fire rated construction for the length of the sleeves as follows:

- .1 Interior construction: pack sleeves in interior construction with mineral wool and seal both ends of the sleeves with non-hardening silicone base caulking compound.
- .2 Exterior walls above grade: pack sleeves in exterior walls above grade with mineral wool and seal both ends of the sleeves water-tight with approved non-hardening silicone base caulking compound unless mechanical type seals have been specified.
- .3 Exterior walls below grade: 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 below.
- .5 Where sleeves are required in masonry work, accurately locate, and mark the sleeve location, and hand the sleeves to the mason for installation.
- .6 Terminate sleeves that will be exposed so that the sleeve is flush at both ends with the building surface concerned so that the sleeve may be completely covered by an escutcheon plate, except for sleeves in waterproof floors which are to terminate 100 mm (4") above the finished floor.
- .7 "Gang" type sleeving will not be permitted.
- .8 Where sleeves are provided in non-fire rated construction for future services, or where conduit, ducts, cable, etc., has been removed from existing sleeves, cap, and seal both ends of the sleeved opening.

3.04 RECTANGULAR OPENINGS:

- .1 Rectangular openings for cable tray, raceways, multiple conduits and/or cables and similar rectangular openings will be provided in new poured concrete work, masonry, drywall, and other building surfaces by the trade responsible for the particular construction in which the opening is required.
- .2 **Waterproof Openings:** Provide watertight link type mechanical seals in exterior wall openings where shown or specified. Assemble and install each mechanical seal in accordance with the manufacturer's instructions. After installation, periodically check each mechanical seal installation for leakage and, if necessary, tighten link seal bolts until the seal is completely watertight.
- .3 **Openings in Non-Fire Rated Construction:** For all rectangular openings in non-fire rated construction, pack and seal the space between the conduits, ducts, cables, etc., with mineral wool for the full thickness of the building surface penetrated, and seal both ends.

- .4 **Openings in Fire Rated Construction:** Provide multi-cable transits in all fire rated openings and install in accordance with the manufacturer's instructions.

3.05 SLEEVE AND FORMED OPENING LOCATION DRAWINGS

- .1 Prepare and submit for review, reproducible drawings indicating the size and location of all 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.

3.06 INSTALLATION OF ESCUTCHEON PLATES

- .1 Provide escutcheon plates suitable secured over all exposed conduits, ducts, armoured cable, etc., 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 the plates so that they are tight against the building surface concerned and ensure that the plates completely cover sleeves and/or openings, except where waterproof sleeves extend above floors, in which case the plate is to fit tightly around the sleeve.

3.07 INSTALLATION OF FASTENING AND SECURING HARDWARE

- .1 Provide fastening and securing hardware required for electrical work to maintain installations attached to the structure or to finished floors, pads, walls, and ceilings in a secure and rigid manner capable of withstanding the dead loads, live loads, superimposed dead loads, and any vibration of the 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 the loads, provide additional framing or special fasteners to ensure proper securement to the structure. 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 given, comply with requirements of CAN3-Z166.1 and .2.
- .5 Do not attach fasteners to steel deck without written consent from the Consultant.

3.08 SUPPLY OF ACCESS DOORS

- .1 Supply access doors to give access to all electrical work which may need maintenance or repair, but which is concealed in inaccessible construction, except as otherwise specified herein or on the drawings.
- .2 Locate access doors as inconspicuously as possible in walls and partitions and arrange electrical work such that it is clearly within view and accessible for inspection and servicing, and to suit access door locations shown on the reviewed and approved white prints of reflected ceiling plan and elevation drawings submitted as per Part 1 of this Section.
- .3 Group services to ensure the minimum number of access doors is required. Access doors will be installed by the trades responsible for the particular type of construction in which the doors are required.
- .4 Submit a sample of each proposed access door for review prior to ordering.

3.09 ELECTRICAL WORK IDENTIFICATION

- .1 Identify all new/relocated electrical work in accordance with existing identification standards at the site.
- .2 Identify all electrical work, including conduit systems and wiring, as follows:
 - .1 the size and wording of identification nameplates must be approved by the Consultant.
 - .2 Identification wording for equipment is to follow drawing nomenclature unless otherwise specified.
 - .3 Secure nameplates to equipment with stainless steel screws unless such a practice is prohibitive, in which case use epoxy cement applied to cleaned surfaces.
 - .4 Locate nameplates in the most conspicuous and readable location.
 - .5 For multi-cell or multiple component equipment provide a main nameplate and a smaller nameplate for each cell or component.

- .6 Where electrical work is to be identified in conjunction with mechanical work, coordinate with the mechanical trades to ensure identical tagging.
- .7 All identification wording is to be in English.
- .8 All identification and colour coding are to be indicated on record drawings.
- .3 **Terminal Cabinets, Pull Boxes, Junction Boxes, Etc.:** Clearly identify terminal cabinets, main pull, and junction boxes by neatly spray painting the outside surface of the cover with a paint colour as specified below for conduit and conductor identification. Provide a nameplate on terminal boxes, main pull and junction boxes in communication systems specified in Division 27.
- .4 **Transformers:** Transformer nameplated must identify the transformer capacity as well as primary and secondary voltages.
- .5 **Branch Circuit Panelboards:** Panelboard nameplates must identify the electrical source connected to the panelboard, each circuit breaker, and, neatly typed on the door directory card, the load connected to each breaker.
- .6 **Motor Starters and Disconnect Switches:** Provide nameplates for each motor starter and disconnect located in a motor control centre or on a motor starter panel, and on each individually mounted starter and disconnect provided as part of the electrical work. Nameplates must also indicate the voltage and phase.
- .7 **Luminaires on Emergency Circuits:** Identify all luminaires on emergency circuit by means of a 15 mm ($\frac{1}{2}$ ") diameter self-adhesive red label secured to the T-bar ceiling component adjacent to the luminaire, or if not in a T-bar ceiling, to the frame of the luminaire.
- .8 **Lighting Switches & Receptacles:** Identify each lighting switch and each receptacle by means of a permanent self-adhesive label indicating the source panelboard and circuit number and secured to the device faceplate.
- .9 **Communication Equipment/Systems:** Identify all "head end" equipment with nameplates and all "downstream" devices with self-adhesive labels indicating circuit numbers.
- .10 **Warning Signs:** Provide appropriately worded warning signs secured in place with stainless steel hardware in locations as follows:
 - .1 On all doors into transformer vaults.
 - .2 On all doors into high voltage switchgear rooms.

- .3 On all collector bus enclosures.
- .4 On pad mounted transformer enclosures.
- .5 Wherever else required by Code.

- .11 **Conduit & Armoured Cable:** Colour code conduit and armoured cable by means of 25 mm (1") wide primary colour plastic adhesive backed tape or neatly applied suitable paint with, where scheduled, a 20 mm (¾") wide auxiliary colour at all points where the conduit or cable penetrates a wall, ceiling, floor, at 6 m (20') intervals or at least once in each room or accessible ceiling space, at each access door location, and elsewhere at 15 m (45') intervals. Unless otherwise indicated/specified, colours are to be as follows:

Service	Primary Colour	Secondary Colour
up to 250 volts	yellow	
250 to & including 600 volts	yellow	green
above 600 volts to 5 kV	yellow	blue
above 5 kV to 28 kV	yellow	red
communications	green	
fire alarm	red	
emergency voice	red	blue
security systems	red	yellow
isolated power	orange	

- .12 **Wire & Cable Terminations:** Identify both end of wire and cable terminations with the same unique number. Where numbers are not indicated or specified, assign a number, and record them.
- .13 **Buried Cable/Duct Runs:** Identify buried cable/duct runs under paved and landscaped areas with appropriate concrete markers, flush with grade at each change in direction, at least twice on runs less than 60 m (200') and on 60 m (200') centres on longer runs.

- .14 **Overhead Wiring Service Poles:** Unless otherwise indicated on the drawings identify poles with wording such as "HV#1". For wooden poles, use 50 mm (2") high non-corrosive embossed aluminium pole markers. For concrete poles use non-corrosive metal plated secured to the pole with metal strapping.
- .15 **Distribution System Schematic Diagrams:** Prepare AutoCAD, coloured, 1200 mm x 900 mm (48" x 36") schematic diagrams of electrical distribution systems to identify all equipment and circuits. Install framed and glazed diagrams in electrical rooms housing the system equipment. Confirm location prior to installation. Include reduced size copies of the diagrams in each copy of the O & M Manuals.

3.10 INSTALLATION OF TERMINAL BACKBOARDS

- .1 Provide properly sized plywood backboards for wiring terminals in terminal cabinets and enclosures where shown/specified/required.

3.11 GENERAL ELECTRICAL WORK TESTING

- .1 Perform testing in accordance with the Electrical Work Testing Section, and, in addition, any tests required by governing Codes, Standards.

3.12 BRANCH CIRCUIT BALANCING

- .1 Connect all branch circuits to panelboards so as to balance the actual loads (wattage) to within 5%. If required, transpose branch circuits to achieve this requirement.
- .2 After the building is occupied and if requested by the Consultant, demonstrate that branch circuit balancing has been achieved.

3.13 FINISH PAINTING OF ELECTRICAL WORK

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

3.14 SUPPLY OF MOTOR STARTERS AND ACCESSORIES

- .1 Motor starters for mechanical equipment will be supplied as part of the mechanical work.

3.15 ELECTRICAL WIRING WORK FOR MECHANICAL WORK

- .1 Unless otherwise specified or indicated, the following electrical wiring work for mechanical equipment is to 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 the starters or disconnects to the equipment.
 - .2 Mounting of individual starters, "line" side power wiring to individual wall mounted starters, and "load" side wiring from the starters to the equipment.
 - .3 "Line" side power wiring to pre-wired power and control panels and variable frequency drives, and "load" side power wiring from the panels and VFD's to the equipment.
 - .4 Provision of receptacles for plug-in equipment.
 - .5 Provision of disconnect switches for all motors that are in excess of 10 m (30') from the starter location, or that cannot be seen from the starter location, and all associated power wiring.
 - .6 All 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 Provision of dedicated 120 volt, 15A-1P circuits terminated in junction boxes in mechanical equipment rooms for automatic control and building automation system wiring connections to be made as part of the automatic controls work.
 - .9 120 volt power connections to electrical receptacles integral with small ceiling exhaust fans, including wiring through light switches or speed controllers.
 - .10 120 volt wiring connections to lighting fixture/switch combinations integral with air handling units.
 - .11 120 volt wiring connections to duplex receptacles integral with air handling unit control panels.
- .2 Mechanical wiring work not listed above, specified herein, or on the drawings will be done as part of the mechanical work in accordance with wiring requirements specified for the electrical work.

3.16 INTERRUPTION TO AND SHUTDOWN OF ELECTRICAL SERVICES AND SYSTEMS

- .1 Co-ordinate all shutdown and interruption to existing electrical systems with the Owner. Generally, shutdowns may be performed out of building operating hours typically late nights to early mornings, assume no more than 6 hours per night.
- .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 the Owner and Consultant in writing seventy-two hours in advance of a minor proposed shut-down or interruption and obtain written approval to proceed. Major proposed shutdowns have to be planned weeks in advance. Do not shutdown or interrupt any system or service without such written approval.
- .4 Perform work associated with shut-downs and interruptions as continuous operations to minimize the shut-down time and to reinstate the systems as soon as possible, and, prior to any shut-down, ensure that all materials and labour required to complete the work for which the shut-down is required are available at the site.

3.17 EQUIPMENT BASES AND SUPPORTS

- .1 **Concrete Housekeeping Pads:** Unless otherwise specified or required, set all floor mounted equipment on minimum 100 mm (4") high reinforced concrete housekeeping pads 200 mm (8") clear of the equipment on each side and end, or a minimum of 200 mm (8") from the centreline of equipment anchor bolts to the edge of the base, whichever is larger. Conform to the 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 the concrete pour and be responsible for all required levelling, alignment, and grouting of the equipment.
 - .3 As a minimum, use wire mesh reinforcement, however, for pads for large heavy equipment, use reinforcement as per structural drawing details.
- .2 **Transformer to be installed on the precast, vault type pad as follows:**
 - .1 Concrete 4500 PSI (32 MPa), minimum 6" and selected to accommodate the transformer weight, and exceed with tolerance no less than 20%
 - .2 Pad dimensions to exceed all transformer dimensions, by less than 300mm.

- .3 Cable entry openings – PVC seal for 103mm and 127mm ducts as indicated on the drawings
- .4 Reinforcing steel to CSA CAN A23.1
- .5 Sized to accommodate the seismic zone of the installation and carry certification for its intended use.
- .6 Coordinate and obtain guidance from the utility company as it relates to minimum size precast pad and type.
- .7 Include for all costs, civil, coordination and precast pad to deliver a turnkey, levelled, and finished installation inclusive of site civil prep work to install the transformer pad with the required drainage provisions.
- .8 Minimum drainage provisions are inclusive of 12" crushed stone compacted bedding to 100% ratio, installed under the transformer precast vault.
- .3 **Structural Steel Stands/Supports:** For equipment not designed for base mounting, where required, provide welded, cleaned, and prime coat painted structural steel stands or supports conforming to the following requirements:
 - .1 All stands and supports, except those for small equipment, are to be designed by a structural engineer registered in the jurisdiction of the work and stamped and signed design drawings with calculations are to be submitted as shop drawings for review.
 - .2 All steel stands are to be flange bolted to concrete housekeeping pads.
 - .3 All stands and supports are to be seismically restrained in accordance with applicable requirements.
- .4 **Seismic compliance:** notwithstanding the above in municipalities where seismic certification is required structural pads and equipment supports shall be verified and certified for seismic compliance. Electrical contractor to carry all costs for a third party seismic engineer per item 3.26.

3.18 CONCRETE WORK FOR EQUIPMENT BASES/PADS

- .1 Provide all poured concrete work, including reinforcing and formwork, required for electrical equipment bases/pads. Perform concrete work in accordance with requirements specified in Division 03.
- .2 Concrete is to be minimum 32,000 kPa with 5% to 8% air entrainment ready-mix concrete exceeding CAN/CSA-A23.1 and the Building Code.

- .3 Ensure that bases and pads are keyed into the structure to meet seismic restraint requirements.

3.19 CUTTING, DRILLING AND PATCHING

- .1 Perform all cutting, drilling, and patching of the existing building for the installation of this Electrical Contractors work. Perform all cutting and drilling with proper tools and equipment. Confirm the exact location of cutting and drilling with the Consultant prior to commencing the cutting and/or drilling work.
- .2 Patch surfaces, where required, to exactly match existing finishes using tradesmen skilled in the particular trade or application worked on.
- .3 Where new conduits, conductors, etc., pass through existing construction, core drill an opening. Size openings to leave 12 mm (½") clearance around the product involved.
- .4 Prior to drilling or cutting an opening in poured concrete construction, determine the location, if any, of existing services concealed in the construction to be drilled or cut. X-ray or Ferro Scan Test the walls or slabs if required. Do not drill or cut post tensioned or precast slabs without permission.
- .5 This Electrical Contractor will be responsible for the repair of any damage to existing services, exposed or concealed, caused as a result of their own cutting or drilling work.
- .6 Where drilling is required in waterproof slabs, size the opening to permit snug and tight installation of a sleeve which is sized to leave 12 mm (½") clearance around the product involved. Provide a sleeve in the opening. Sleeves are to be Schedule 40 galvanized steel pipe with a flange at one end and a length to extend 100 mm (4") above the slab. Secure the flange to the underside of the slab and caulk the void between the sleeve and slab opening with proper non-hardening silicone base caulking compound to produce a watertight installation.

3.20 PACKING AND SEALING CORE DRILLED OPENINGS

- .1 Pack and seal the void between the core drilled opening and the service insulation for the length of the opening as follows:
 - .1 **Non-fire rated interior construction:** pack openings in non-fire rated interior construction with mineral wool and seal both ends of the opening with non-hardening silicone base caulking compound to produce a water-tight seal.

- .2 **Fire rated interior construction:** seal openings in fire rated interior construction with approved sealant at both ends of the opening with approved fire rated sealant. Ensure application of sealant is in accordance with manufacturer installation guidelines, adjust as require at no cost and ensure conduits and sleeves spacing is adequate and proper and as per sealant installation requirements. Conduit layouts penetrating through fire rated assembly shall not be completed prior selecting and obtaining approval for specific sealant use.

3.21 FLASHING FOR ELECTRICAL WORK PENETRATING THE ROOF

- .1 Do all required flashing work, including counterflashing, for electrical work penetrating and/or set in the roof. Engage the services of an Owner approved waterproofing sub-contractor.
- .2 Perform flashing work in accordance with requirements of drawing details, and requirements specified in Division 07.

3.22 CLEANING ELECTRICAL WORK

- .1 Refer to cleaning requirements specified in Division 01.
- .2 Clean **all** electrical work prior to application for Substantial Performance of the work.

3.23 MAINTAINING EQUIPMENT PRIOR TO ACCEPTANCE

- .1 Maintain all equipment in accordance with the manufacturer's printed instructions prior to start-up, testing and commissioning.

3.24 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with requirements specified in Division 01.
- .2 Separate and recycle waste materials in accordance with requirements of Canadian Construction Association Standard Document CCA 81, A Best Practices Guide to Solid Waste Reduction.
- .3 Prepare a waste management and reduction plan and submit a copy for review prior to work commencing at the site.
- .4 Place materials defined as hazardous or toxic waste in designated containers.
- .5 Ensure emptied containers are sealed and stored safely for disposal.

3.25 SEISMIC RESTRAINT ANCHOR POINTS FOR EQUIPMENT

- .1 All electrical equipment requiring seismic restraint (see the electrical work Section entitled Seismic Control and Restraint) is to be complete with manufacturer designed and rated seismic restraint anchor points and attachments, certified by the equipment manufacturers, so that the equipment may be bolted down or restrained in the field.
- .2 The equipment to be restrained must be designed such that the strength and anchorage of the internal components of the equipment exceeds the force level used to restrain and anchor the equipment itself to the supporting structure.
- .3 Contractor shall retain and pay for a registered seismic engineer to design and inspect the seismic restraints of the electrical system components covered under division 16 for this contract.
- .4 The seismic engineer retained by contractor shall provide for the following:
 - .1 Signed and sealed letters of assurance of professional design and commitment for field review and summary of design and field review as required by authorities having jurisdiction.
 - .2 Certified detailed drawings of seismic restraints.
 - .3 Detailed specification for seismic restraints.
 - .4 Written reports of site reviews.
 - .5 Signed and sealed letter of assurance of professional review and compliance.
- .5 Substantial performance will not be considered without the submission of the above documents. All the above documents shall be submitted to the consultant for further distribution and files.
- .6 Electrical Contractor shall cooperate with the seismic engineer and promptly supply such information, including weights of equipment and base frame or mounting plate layouts, as requested by the seismic engineer necessary to support the design and details for seismic restraint.
- .7 Electrical Contractor shall not be entitled to any additional compensation arising from the technical direction provided by the seismic engineer for seismic restraint and anchorage of electrical systems.

- .8 Electrical Contractor and seismic restraint engineer shall note specific structural design and construction requirements for this building and shall design and install the seismic restraint system to suit.

3.26 REQUIREMENTS FOR BARRIER-FREE ACCESS

- .1 Include for all applicable requirements for barrier-free access to electrical devices in accordance with governing Codes and Regulations, whether shown on the drawings, specified, or not.

END OF SECTION

1	GENERAL	2
1.01	APPLICATION	2
1.02	SUBMITTALS	2
1.03	REFERENCE STANDARD	2
2	PRODUCTS	2
	NOT APPLICABLE	2
3	EXECUTION	2
3.01	CONTINUATION OF ELECTRICAL SERVICES	2
3.02	DISCONNECTION AND REMOVAL OF EXISTING ELECTRICAL WORK	3
3.03	HAZARDOUS MATERIALS AND WASTE.....	4
3.04	INTERRUPTION TO AND SHUTDOWN OF ELECTRICAL SERVICES AND SYSTEMS	4
3.05	ROOFING WORK	4

1 GENERAL

1.01 APPLICATION

- .1 This Section specifies requirements, criteria, methods, and execution for electrical demolition work that are common to one or more electrical 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 that all PCB material and/or equipment containing PCB material has been properly removed and disposed of as applicable.
- .2 Submit documentation to confirm all oil field equipment have been properly removed and disposed of as applicable. Note oil filled equipment should be drained on site, oil removed from equipment and handled in accordance or MOE and handled in separate containers prior removal from site to ensure no environmental impact beyond the project site.

1.03 REFERENCE STANDARD

- .1 Perform demolition work in accordance with requirements of CAN/CSA-S350, Code of Practice for Safety in Demolition of Structures.

2 PRODUCTS

Not Applicable

3 EXECUTION

3.01 CONTINUATION OF ELECTRICAL SERVICES

- .1 Critical systems such as fire alarm, building automation controls, communication systems that may be affected by the demolition scope shall be kept operational and if required to be relocated temporary provisions shall be implemented to replace and provide equal performance for the duration of the period while systems are re-established.
- .2 Provide any required temporary supports for system that will require to remain during times of work in the area of demolition.

- .3 Provide permanent supports of all passing through service is existing supports are affected by the demolition scope of work. Note, existing services required to remain may not all be visible and identified on the electrical set of drawings especially of scope of work include removal and or rework of concealed systems and structures.

3.02 DISCONNECTION AND REMOVAL OF EXISTING ELECTRICAL WORK

- .1 Where indicated on the drawings, disconnect, and remove existing electrical work, including hangers, supports, etc. Disconnect at the point of supply, remove obsolete connecting services, and make the system safe. Cut back obsolete conduit behind finishes and cap unless otherwise specified.
- .2 The scope and extent of the demolition or revision work is only generally indicated on the drawings. Estimate the scope, extent, and cost of the work at the site during the bidding period scheduled site visit(s).
- .3 Where deemed necessary by the Owner and Consultant, existing shafts, walls, and inaccessible ceilings will be opened by the Owner to permit site visit inspection of services to be removed/revised as part of the work but usually concealed behind such construction.
- .4 Claims for extra costs for demolition work not shown or specified but clearly visible or ascertainable at the site during bidding period site visits will not be allowed.
- .5 If any re-design is required due to discrepancies between the electrical drawings and site conditions, notify the Consultant who will issue a Site Instruction. If, in the opinion of the Consultant, discrepancies between the electrical drawings and actual site conditions are of a minor nature, the required modifications are to be done at no additional cost.
- .6 Where existing electrical services extend through or are in an area to serve items which are to remain, maintain the services in operation. Include for rerouting existing services concealed behind existing finishes and which become exposed during the renovation work, so as to be concealed behind new or existing finishes.
- .7 Unless otherwise specified, remove from the site, and dispose of all existing materials which have been removed and are not to be relocated or reused.

- .8 Unless otherwise specified, remove from the site, and dispose of all existing materials which have been removed and are not to be relocated or reused, except for the following which are to be handed over to the Owner at the site:

- .1 Any excess LED lighting.

3.03 HAZARDOUS MATERIALS AND WASTE

- .1 If hazardous materials and/or waste not listed in the Specification is found, stop the associated work, notify the Owner and Consultant immediately, and await directions.

3.04 INTERRUPTION TO AND SHUTDOWN OF ELECTRICAL SERVICES AND SYSTEMS

- .1 Co-ordinate all shutdown and interruption to existing electrical systems with the Owner. Generally, shutdowns may be performed only between the hours of 12:00 midnight Friday until 6:00 a.m. Monday morning.
- .2 Areas where restaurants are located may be shut down only after 3:00 a.m.
- .3 Upon award of contract, submit a list of anticipated shutdown times and their maximum duration.
- .4 Prior to each shutdown or interruption, inform the Owner in writing seventy-two hours in advance of the proposed shutdown or interruption and obtain written approval to proceed. Do not shut down or interrupt any system or service without such written approval.
- .5 Perform work associated with shutdowns and interruptions as continuous operations to minimize the shutdown time and to reinstate the systems as soon as possible, and, prior to any shutdown, ensure that all materials and labour required to complete the work for which the shutdown is required are available at the site.

3.05 ROOFING WORK

- .1 Where roof revisions and/or replacements are part of the project, include for disconnecting, lifting, or temporarily removing electrical equipment and electrical connections to other roof mounted equipment as required to permit completion of the roofing work, and for re-installing/re-connecting the equipment when the roofing work is complete.

END OF SECTION

1	GENERAL	2
1.01	SUBMITTALS	2
1.02	QUALITY ASSURANCE	2
1.03	COORDINATION.....	2
1.04	FIELD QUALITY CONTROL REPORT	2
2	PRODUCTS	2
2.01	GROUND PLATES	2
2.02	GROUND BUS	3
2.03	FLEXIBLE GROUND BRAID	3
2.04	GROUND CONDUCTORS.....	3
2.05	GROUNDING AND BONDING CONNECTIONS.....	3
2.06	COMMUNICATIONS, ACCESS CONTROL, & ELECTRONIC SAFETY SYSTEM GROUND BUS ..	3
2.07	IT AND LAN ROOM/CLOSET GROUND BUS	3
3	EXECUTION	4
3.01	GENERAL RE: SECONDARY GROUNDING AND BONDING	4
3.02	INSTALLATION OF GROUND BUS	4
3.03	NEUTRAL GROUNDING.....	5
3.04	CABLE SHEATH GROUNDING.....	5
3.05	IT AND LOCAL AREA NETWORK (LAN) ROOM/CLOSET GROUNDING	5
3.06	ELECTRICAL SERVICE EQUIPMENT GROUNDING AND BONDING	5
3.07	ELECTRICAL BONDING AND/OR GROUNDING FOR AUTOMATION, CONVEYANCE, OR SIMILAR PANELS	6
3.08	ELECTRICAL GROUNDING FOR MECHANICAL EQUIPMENT	6

1 GENERAL

1.01 SUBMITTALS

- .1 **Product Data:** Submit product data sheets for all products specified in Part 2 of this Section except for copper wire/cable conductors.

1.02 QUALITY ASSURANCE

- .1 Grounding and bonding work is to be in accordance with requirements of the following:
 - .1 CSA C22.2 No. 41, Grounding and Bonding Equipment (Tri-National Standard with UL 467)
 - .2 CSA C22.2 No. 0.4, Grounding and Bonding of Electrical Equipment
 - .3 requirements of the Electrical Safety Authority and any other governing authority
 - .4 CAN/CSA Z32, Electrical Safety and Essential Electrical Systems in Health Care Facilities

1.03 COORDINATION

- .1 Coordinate the installation of grounding hardware and conductors associated with concrete with the trades providing the concrete work.

1.04 FIELD QUALITY CONTROL REPORT

- .1 Submit written and signed report(s) indicating successful results of the ground continuity tests specified in Part 3.

2 PRODUCTS

2.01 GROUND PLATES

- .1 Copper plates, 1 m² (11 ft.² surface area, 6 mm (¼") thick.

2.02 GROUND BUS

- .1 Solid electrical grade copper, minimum 50 mm x 6 mm (2" x ¼"), minimum 600 mm (24") long but with lengths as required (continuous lengths for health care and data centre projects), predrilled for two-hole lug connections, suitable for wall or backboard mounting and complete with corner angles, tamper-proof stainless steel hex head bolts, nuts, and spring lock washers, standoff insulators, and all connection hardware.

2.03 FLEXIBLE GROUND BRAID

- .1 Flat 98% conductivity tinned copper grounding braid with dimensions to suit the application.

2.04 GROUND CONDUCTORS

- .1 Unless otherwise specified and/or shown. Stranded un-tinned soft annealed copper wire, bare or green PVC insulated conforming to requirement of the Section entitled Wire and Box Connectors (0-1000volts).

2.05 GROUNDING AND BONDING CONNECTIONS

- .1 **Below Grade:** Equal to Erico International Corp. "CADWELD" exothermic welded connections.
- .2 **Above Grade:** Compression type connectors with zinc-plated fasteners and external tooth lock washers, or, if approved by the Consultant, exothermic Erico International Corp. "CADWELD" welded connections.

2.06 COMMUNICATIONS, ACCESS CONTROL, & ELECTRONIC SAFETY SYSTEM GROUND BUS

- .1 As per the electrical work Section entitled Grounding and Bonding for Communications.

2.07 IT AND LAN ROOM/CLOSET GROUND BUS

- .1 Solid electrical Grade copper bus bars, 300 mm x 50 mm x 9 mm (12" x 2" x ¾") with 8 drilled holes, suitable for wall mounting and equipped with standoff insulators.

3 EXECUTION

3.01 GENERAL RE: SECONDARY GROUNDING AND BONDING

- .1 Perform all required secondary electrical work grounding and bonding work in accordance with the Contract Documents and requirements of governing Codes and Standards, including the Electrical Safety Authority.
- .2 Bond metallic conduits, boxes, cable tray, ducts, and non-current carrying metal parts of equipment together to form a continuous ground system. In electrical equipment rooms, solidly bond circuits, panelboards, conduits, equipment enclosures, and other equipment to perimeter ground bus using bronze connectors and hardware.
- .3 Protect exposed conductors from injury. Install underground conductors a minimum of 450 mm (18") below grade.
- .4 Use tinned copper conductors for aluminium structures.
- .5 Do not use bare copper conductors adjacent to un-jacketed lead sheath cables.

3.02 INSTALLATION OF GROUND BUS

- .1 Provide ground bus in each electrical and IT/LAN room and where shown/specified on the electrical drawings. Wall mount 300 mm (12") above finished floor level on standoff insulators and follow the outline of doorframes and room corners using 90° bus angles to form continuous bus. Connect the ground bus to the ground rod grid by means of two minimum #3/0 copper conductors terminated with approved fittings.
- .2 Provide flexible braided copper ground straps from the ground bus to each steel doorframe and door in each High Voltage electrical room, each securely bolted in place. Connect all metal structure, frames, equipment inside the electrical High Voltage room.
- .3 Tighten all bus bar joint connection bolts and lug using a torque wrench to the bus manufacturer's prescribed tension, then coat the bus with two 100% covering coats of shellac to prevent copper oxidization.

3.03 NEUTRAL GROUNDING

- .1 Connect transformer neutral and distribution neutral together using 1000 volt insulated conductor to one side of a ground test link, the other side of the test link being connected directly to the main station ground. Ensure that distribution neutral and neutrals of potential transformers and service banks are bonded directly to the transformer neutral and not to the station ground.
- .2 Connect the neutral of the station transformer to the main neutral bus with a tap of the same size as the secondary neutral.
- .3 Ground the transformer tank with a continuous conductor from the tank ground lug through the connector on the ground bus to the primary neutral. Connect the neutral bushing at the transformer to the primary neutral in the same manner.

3.04 CABLE SHEATH GROUNDING

- .1 Bond single conductor metallic sheathed cables together at one end only. Break the sheath continuity in an approved manner and provide #6 AWG flexible copper ground conductor soldered (not clamped) to the cable sheath.

3.05 IT AND LOCAL AREA NETWORK (LAN) ROOM/CLOSET GROUNDING

- .1 Provide minimum 3/0 AWG insulated copper ground conductors and wall mounted copper ground bus in each LAN Room. Connect the ground bus to computer equipment racks and to the building ground system.

3.06 ELECTRICAL SERVICE EQUIPMENT GROUNDING AND BONDING

- .1 Provide green insulated ground wire in electrical service conduits feeding electrical service switchboard, panels, disconnect switches, splitters, and similar distribution equipment.

Note: Electrical service equipment shall not rely on conduit for bonding and grounding.

- .2 Ground wire shall be minimum #6 AWG and sized in accordance to the Electrical Safety Code.

3.07 ELECTRICAL BONDING AND/OR GROUNDING FOR AUTOMATION, CONVEYANCE, OR SIMILAR PANELS

- .1 Provide a **separate**, insulated bonding conductor inside electrical service conduits (sized per National/Provincial Electrical Code), that feed conveyor panels, automation distribution panels, battery charger panels, Material Handling Equipment panels, etc. The conduit shall not be used as a bonding means
- .2 Ground wire shall be minimum #6 AWG and sized in accordance to the Electrical Safety Code.

3.08 ELECTRICAL GROUNDING FOR MECHANICAL EQUIPMENT

- .1 Provide green insulated ground wire in electrical service conduits feeding mechanical equipment, and to each started, Motor Control Centre and VFD.
- .2 Ground wire size shall be selected to be no less than the minimum code required ground wire.

END OF SECTION

1	GENERAL	2
1.01	SUBMITTALS	2
2	PRODUCTS	2
2.01	OUTLET BOXES	2
2.02	SPLITTER TROUGH	3
2.03	PULL BOXES AND JUNCTION BOXES	3
2.04	EMT	4
2.05	RIGID GALVANIZED STEEL CONDUIT	4
2.06	FLEXIBLE GALVANIZED STEEL LIQUID-TIGHT CONDUIT	4
2.07	FLEXIBLE GALVANIZED STEEL CONDUIT	4
2.08	RIGID ALUMINUM CONDUIT	4
2.09	RIGID BRONZE CONDUIT	4
2.10	RIGID PVC CONDUIT	5
2.11	FLEXIBLE PVC CONDUIT	5
2.12	FLEXIBLE POLYETHYLENE CONDUIT	5
2.13	EPOXY COATED RIGID GALVANIZED STEEL CONDUIT	5
2.14	COLOUR COATED EMT	5
2.15	STAINLESS STEEL CONDUIT	5
2.16	FISH CORD	6
3	EXECUTION	6
3.01	INSTALLATION OF OUTLET AND CONDUIT BOXES	6
3.02	INSTALLATION OF SPLITTER TROUGH	8
3.03	INSTALLATION OF PULL BOXES AND JUNCTION BOXES	8
3.04	GENERAL RE: INSTALLATION OF CONDUIT	9
3.05	CONDUIT INSTALLATION REQUIREMENTS	9
3.06	CONDUIT INSTALLED IN POURED CONCRETE	11
3.07	UNDERGROUND AND CONDUIT UNDER SLAB ON GRADE	13
3.08	CONDUIT INSTALLATION FOR FLOOR OUTLETS	13
3.09	SEALED CONDUIT PENETRATIONS	14
3.10	CONDUIT SUPPORT	14
3.11	CONDUIT SYSTEM BONDING	15
3.12	CONDUITS IN EXIT RATED CORRIDORS AND STAIRS	15

1 GENERAL

1.01 SUBMITTALS

- .1 **Product Data:** Submit product data sheets for all products where submittal is specified in Part 2 or Part 3 of this Section.
- .2 **Colour Coated EMT Colour Chart:** Submit the colour coated EMT manufacturer's standard colour chart for colour selection(s) by the Consultant.
- .3 **Drawing(s) of Conduit Locations/sizes In Structural Poured Concrete:** As specified in Part 3 of this Section, submit drawings to indicate the proposed location, size, and length of run for conduit proposed to be installed in structural poured concrete work.
- .4 **Samples:** If requested, submit samples of products specified in this Section.

2 PRODUCTS

2.01 OUTLET BOXES

- .1 Unless otherwise specified, each box is to be CSA certified, suitable in all respects for the application, single or multi-gang as required, and complete with suitable securing lugs, connectors suitable for the connected conduit, knockouts, and, where necessary, suitable plaster rings, concrete rings, covers and any other required accessory. Unless otherwise specified, outlet boxes are to be as follows:
 - .1 Stamped, electro-galvanized steel outlet boxes.
 - .2 Zinc coated cast malleable iron or cast aluminium "FS and "FD" boxes with threaded inlet/outlet hubs.
 - .3 Rigid PVC outlet boxes.
 - .4 Equal to Hubbell Canada Inc. UL/ULC or ETL listed, single or multi-gang as required, fully adjustable both vertical and angular, formed galvanized cast iron, round, rectangular, or square as required flush concrete floor boxes complete with adjustable collars and brass screw-on hinged flip-open cover with provisions for installation of duplex power receptacles, telephone data jacks, and, for boxes containing both power and communication system outlets, proper barriers.
 - .5 Hubbell or Legrand-Wiremold flush, fire rated "poke-through" box assemblies to suit the devices required, with grey, black, or brass flanges and covers as selected by the Consultant.

- .6 Cooper Crouse-Hinds or approved equal boxes for fire alarm systems, red epoxy paint, ULC listed and approved for fire alarm system wiring.
- .7 Outlet box exterior fire seal shall be 3M™ Fire Barrier Moldable Putty Pads MPP.
- .8 Fire suppression gasket in fire rated wall is required each time outlet box is installed inside fire rated assembly. The fire suppression gasket shall be made by Intumescent Technologies, LLC and PyroPhobic Systems, Ltd. - FireBløK™ Gasket, RECTORSEAL "Bio Fireshield or alternative equal.

2.02 SPLITTER TROUGH

- .1 Heavy Duty, minimum formed #16 gauge steel Type 1 splitter trough in accordance with CSA C22.2 No. 76, Splitters, finished inside and outside with ANSI 61 grey heat cured powder epoxy paint, and complete with welded seams ground smooth, various size knockouts on each side, back mounting holes, removable doors with stainless steel hinges and hinge pins, terminal blocks for conductor connections, a single point ground lug.
- .2 **Enclosures:** Unless otherwise specified, enclosures are to be in accordance with the following NEMA/EEMAC ratings:
 - .1 All enclosures located in sprinklered areas – Type 2.
 - .2 All enclosures except as noted above – Type 1.

2.03 PULL BOXES AND JUNCTION BOXES

- .1 Each box is to be CSA certified, sized to suit the number and size of conduit and conductors, and complete with connecting and securing facilities. Unless otherwise specified, pull boxes and junction boxes are to be as follows:
 - .1 Heavy duty galvanized or prime coat plated steel, suitable in all respects for the application and complete with screw-on or hinged covers as required and connectors suitable for the connected conduit.
 - .2 "Condulet", heavy duty, threaded galvanized cast iron or cast aluminium pull boxes and junction boxes of an exact type to suit the application, each complete with a screw-on gasketed cover.
 - .3 Rigid plastic (PVC), junction boxes and access fittings with solvent weld type joints and screw-on PVC covers.

- .4 Equal to Square D (Schneider Canada) Catalogue No. 970 cast bronze water-proof junction box for underwater lighting.

2.04 EMT

- .1 Galvanized steel to CSA C22.2 No. 83, Electrical Metallic Tubing, complete with factory made bends where site bending is not possible, and joints and terminations made with steel couplings and set screw type connectors, concrete tight where required.

2.05 RIGID GALVANIZED STEEL CONDUIT

- .1 Rigid galvanized steel to CSA C22.2 No. 45, Rigid Metal Conduit, with an enamel interior coating, galvanized threads where factory threaded, red lead coated threads where site threaded, factory made bends where site bending is not possible, factory made threaded fittings and connectors, and terminations made with rigid couplings, concrete tight where required.

2.06 FLEXIBLE GALVANIZED STEEL LIQUID-TIGHT CONDUIT

- .1 Flexible galvanized steel liquid-tight conduit to CSA C22.2 No. 56, Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit, complete with Ideal Industries Inc. "Steel Tough" liquid-tight connectors at terminations.

2.07 FLEXIBLE GALVANIZED STEEL CONDUIT

- .1 Galvanized steel flexible conduit to CSA C22.2 No. 56, Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit, complete with proper and suitable squeeze type connectors at terminations.

2.08 RIGID ALUMINUM CONDUIT

- .1 Factory or site threaded rigid aluminium to CSA C22.2 No. 45, Rigid Metal Conduit, with bending, threading, fitting, coupling, etc., requirements as specified for rigid galvanized steel conduit.

2.09 RIGID BRONZE CONDUIT

- .1 Factory threaded rigid bronze conduit with water-tight screwed joints, fittings, and terminations.

2.10 RIGID PVC CONDUIT

- .1 Rigid PVC conduit to CSA C22.2 No. 211.1, Rigid Types EB1 and DB2/ES2 PVC Conduit, FT-4 rated, complete with site made heat gun bends for conduit to and including 50 mm (2") diameter, factory made fittings for conduit larger than 50 mm (2") diameter, solvent weld joints, factory made expansion joints where required, and terminations made with proper and suitable connectors and adaptors.

2.11 FLEXIBLE PVC CONDUIT

- .1 Equal to Ipex Electrical Inc. "Cor-line" flexible, water-tight, corrugated PVC conduit with Ipex "Kwikon" fittings and ESU conduit supports spaced at every 600 mm to 900 mm (2' to 3"), and proper and suitable terminations and adapters.

2.12 FLEXIBLE POLYETHYLENE CONDUIT

- .1 Polyethylene pipe to CSA-B137.1, Polyethylene (PE) Pipe, Tubing and Fittings for Cold Water Pressure Service, minimum Series 75, supplied in continuous coils of the proper length.

2.13 EPOXY COATED RIGID GALVANIZED STEEL CONDUIT

- .1 Rigid galvanized steel to CSA C22.2 No. 45, Rigid Metal Conduit, with an additional epoxy coating both inside and outside, factory made bends where site bending is not possible, factory made threaded fittings and connectors, and terminations made with rigid couplings.

2.14 COLOUR COATED EMT

- .1 Equal to Allied Tube and Conduit "True Colour" EMT as specified for standard EMT but factory coated with colours selected by the Consultant from the conduit manufacturer's standard colours.

2.15 STAINLESS STEEL CONDUIT

- .1 Equal to Allied Tube and Conduit rigid stainless steel conduit to CSA C22.2 No. 45, Rigid Metal Conduit, Type 316 for corrosive environments, Type 304 elsewhere, complete with a smooth polished finish, standard NPT threads on each end, stainless steel fittings to match the conduit type where site bending is not possible, and water-tight rigid stainless steel couplings at terminations.

2.16 FISH CORD

- .1 Polyethylene or nylon fish cord/tape with cable pull accessories to suit the application.

3 EXECUTION

3.01 INSTALLATION OF OUTLET AND CONDUIT BOXES

- .1 Provide an outlet box or back box for each luminaire, wiring device, telephone outlet, fire alarm system component, communications systems components, and all other such outlets.
- .2 **Stamped Galvanized Steel:** Outlet boxes flush mounted in interior construction, surface mounted in concealed interior locations, and surface mounted in exposed interior locations where the connecting conduit is EMT are to be stamped galvanized steel outlet boxes unless otherwise noted.
- .3 **"FS" and "FD" Series Boxes:** Outlet boxes for surface mounted for exterior lighting, receptacles, and other device outlets, boxes flush mounted in exterior building surfaces, and boxes mounted in interior device locations where the connecting conduit is rigid, and for boxes in perimeter walls where insulation and vapour barrier are present, are to be "FS" or "FD" Series cast boxes unless otherwise noted, cast iron inside the building, cast aluminium outside the building.
- .4 **Rigid PVC Boxes in New Concrete Slabs:** Provide rigid PVC outlet boxes in locations as follows:
 - .1 In underground polyethylene conduit systems.
 - .2 For devices connected to isolated power system panelboards.
 - .3 For rigid PVC conduit systems where permitted.
- .5 **Steel Fire Alarm Boxes,** red epoxy painted for fire alarm systems.
 - .1 Where exposed to exterior element or installed in areas subject to humidity, wet areas or areas with negative temperatures, connections to the fire alarm boxes shall be made at the bottom of the fire alarm box.
- .6 Outlet or junction boxes installed in fire rated assembly shall be completed with highest due diligence, openings in the wallboard facing are to be cut so that the clearance between the box and wallboard shall not exceed 3 mm (1/8 inch).

- .1 Exterior of the outlet or junction box shall be sealed with 3M™ Fire Barrier Moldable Putty Pads.
- .2 Interior of the outlet box shall be protected by a fire suppression gasket rated no less than the wall rating.
- .7 Outlet boxes for special wiring devices, for special equipment and special applications if required, are specified hereinafter in other Sections or on the drawings.
- .8 The size and arrangement of outlet boxes are to suit the device, which they serve.
- .9 Generally, mounting heights and locations for outlets are indicated on the drawings, however, confirm the exact location and arrangement of all outlets prior to roughing-in. Architectural drawings and the Consultant's instructions have precedence over electrical drawing diagrammatic layouts and specified mounting height and locations. In addition, abide by the following requirements:
 - .1 Locate flush mounting boxes in masonry walls to require cutting of the masonry unit corner only, and coordinate masonry cutting to achieve a neat opening.
 - .2 Position outlet boxes to locate luminaires as shown on reflected ceiling plans.
 - .3 Coordinate mounting heights and locations of outlets mounted above counters, benches, and backsplashes.
- .10 Do not install outlet or back boxes "back-to-back" in walls and partitions. Stagger such outlets and seal against noise transmission with acoustic insulation. "Thru-wall" type boxes will not be permitted for any application.
- .11 Where boxes are multi-ganged or grouped together, mount boxes level and spaced consistently.
- .12 Temporarily pack all open boxes located in concrete and masonry to prevent debris from entering the box.
- .13 Include all costs for installed boxes that have not been covered by wall/ceiling finishes, to be relocated up to 1 m (3') to suit final device location coordination.
- .14 Provide blank coverplates over all boxes left empty for future installation of devices. Clearly identify each box as to its intended use to the Consultant's approval. Generally, blank overplates are to be stainless steel.

3.02 INSTALLATION OF SPLITTER TROUGH

- .1 Provide all required splitter trough in accordance with drawing plans, schedules, details, and requirements of the Specification.
- .2 Rigidly secure the splitter trough in place, level and plumb.
- .3 Ensure that the splitter trough itself, and all branch circuits, are properly identified.
- .4 Ensure equipment is suitable for intended use and environment where installed.

3.03 INSTALLATION OF PULL BOXES AND JUNCTION BOXES

- .1 Provide pull boxes in conduit systems wherever shown on the drawings, and/or wherever necessary to facilitate conductor installations. Generally, conduit runs exceeding 30 m (100') in length, or with more than three 90° bends, are to be equipped with a pull box installed at a convenient and suitable intermediate accessible location.
- .2 Provide junction boxes wherever required and/or indicated on the drawings.
- .3 Unless otherwise specified, boxes are to be as follows:
 - .1 In rigid conduit and EMT inside the building – stamped galvanized or prime coated steel.
 - .2 In exterior rigid conduit – “Condulet” cast aluminium gasketed boxes unless otherwise noted.
 - .3 In plastic conduit – rigid PVC boxes.
 - .4 In bronze underwater conduit – cast bronze boxes.
- .4 All pull boxes and junction boxes must be accessible after the work is complete.
- .5 Accurately locate and identify all concealed pull boxes and junction boxes on “as-built” record drawings.
- .6 Cover boxes in fire walls with aluminium tape and seal with caulking.
- .7 Ensure equipment is suitable for intended use and environment where installed.

3.04 GENERAL RE: INSTALLATION OF CONDUIT

- .1 Refer to the article entitled General Conduit and Conductor Installation Requirements in the electrical work Section entitled Basic Electrical Materials and Methods.
- .2 Ensure that all open empty conduit ends are properly protected against dirt and debris during the construction process.
- .3 Provide and install pull rope for conduits larger than 41 mm and pull nylon wire for any smaller conduit.

3.05 CONDUIT INSTALLATION REQUIREMENTS

- .1 Unless otherwise specified, provide conduit for all conductors except armoured cable, mineral insulated fire rated cable, and except where cable tray, cable duct, or a similar raceway is used.
- .2 **Conduit Types:** Conduit is to be as follows:
 - .1 For main distribution wiring in electrical rooms and similar areas – rigid galvanized steel.
 - .2 For exposed conduit from floor level to 1.2 m (4") above the floor in mechanical and other service rooms – rigid galvanized steel.
 - .3 For concealed conduit in exterior walls – rigid galvanized steel.
 - .4 For explosion-proof wiring – rigid galvanized steel.
 - .5 For conduit exposed outside the building, except where rigid PVC conduit is noted on the electrical drawings, contractor shall use rigid galvanized steel.
 - .6 For conduit associated with pool area outlets but not submerged in water – rigid galvanized steel.
 - .7 As an alternative to rigid galvanized steel, except in poured concrete construction – rigid aluminium conduit.
 - .8 For conduit in corrosive areas – epoxy coated rigid galvanized steel.
 - .9 For short (minimum 450 mm (18"), maximum 600 mm (24"), with a 180° loop wherever possible) runs of conduit to electric motors, distribution transformers, and vibration isolated equipment – flexible galvanized steel liquid-tight conduit.

- .10 At points where exposed conduit crosses building expansion joints – flexible galvanized steel conduit.
- .11 For branch circuit conductors underground inside the building, and underground outside the building beneath structures and concrete or asphalt paving – rigid PVC.
- .12 For branch circuit conductors outside the building at roof level – rigid PVC.
- .13 For branch circuit conductors in concrete slabs on grade, and in concrete and masonry walls except exterior walls - rigid PVC.
- .14 For concealed branch circuit conductors associated with isolated power systems – rigid PVC.
- .15 For branch circuit conductors in concrete slabs above grade – flexible PVC.
- .16 For underwater conduit – rigid bronze.
- .17 For exposed conduit in corrosive areas, food processing and preparation areas, chemical plants, wash down areas, and hygienically clean rooms or areas – rigid stainless steel with stainless steel support hardware to match conduit type.
- .18 For fire alarm system, and communications/security systems conductors – colour coated EMT with colours as selected.
- .19 For all conduit except as specified above – EMT.
- .3 **Conduit Fittings:** Unless otherwise specified, conduit fittings are to be of the same material as the conduit and suitable in all respects for the application. Provide proper adaptors for joining conduit of different materials.
- .4 **Conduit Connectors:** Unless otherwise specified, conduit connectors are to be of the same material as the conduit and suitable in all respects for the application.
 - .1 For areas which are sprinklered or wet rated connectors shall be rain or seal tight.
 - .2 Exterior equipment connections shall be with sealed type connectors rated for ambient temperature and moisture.
 - .3 Connectors to sensitive equipment such as fire alarm equipment, IT or similar rack mounted systems connectors shall be rain or seal tight.

- .5 **Conduit Bends:** Site made bends for conduit must be made using proper bending equipment, bends must maintain the full conduit diameter with no kinking, and conduit finishes, and lining must not flake or crack when the conduit is bent.
- .6 **Site Cutting Conduit:** Cut square and ream all site cut conduit ends.
- .7 **Conduit Threads:** Site cut rigid steel conduit using proper thread cutting equipment, in an approved area. Protect the area and building surfaces from being soiled/damaged by the threading process. Clean and lubricate threads and coat threads with red lead or other zinc rich coating.
- .8 **Conduit Sizes:** Generally, conduit is sized on the drawings. Conduit not sized on the drawings is to be sized in accordance with the governing Codes/Regulations. The sizes of branch circuit conductors shown/specified are minimum sizes and must be increased to suit length of run and voltage drop, and where this occurs, increase the conduit size to suit. Do not use conduit less than 15 mm ($\frac{1}{2}$ ") diameter.
- .9 **Empty Conduit:** Ensure that all conduits left empty for future wiring are clean, capped, and properly identified. Provide end bushings and fish cord in all such conduit.
- .10 **Empty Conduit at Panelboards:** Where a suspended ceiling occurs, provide 4, empty, 20 mm ($\frac{3}{4}$ ") diameter conduits from each flush wall mounted panelboard terminated in the suspended ceiling above, capped and identified.

3.06 CONDUIT INSTALLED IN POURED CONCRETE

- .1 Where conduit is to be embedded in structural poured concrete, obtain the Consultant's approval. Submit a drawing indicating the location and size of the conduit, the length of run, and any other required details. Obtain the Consultant's written approval prior to conduit installation. The Consultant's decision regarding conduit in structural poured concrete is final and is not the basis of a claim for additional costs.
- .2 When and where conduit is permitted in structural poured concrete, abide by the following requirements:
 - .1 Install the conduit in accordance with requirements of CAN/CSA-A23.1, Concrete Materials and Methods of Concrete Construction.

- .2 The conduit must be secured in a manner such that the concrete will not be displaced when the concrete is poured, and during the concrete pour, monitor the conduit installation to prevent displacement or damage, and immediately report any misplacement or damage observed.
- .3 Where conduit extends adjacent to a column, stay away from the column a minimum of 2 times the thickness of the slab and drop away from the column.
- .4 Where conduits terminate adjacent to a column or wall, bring the conduit in toward the column/wall as close to 90° to the face of the column/wall as possible.
- .5 Where more than 2 conduits are adjacent to each other they are to be spaced the greater of 3 conduit diameters or 100 mm (4") apart.
- .6 The total depth of conduits crossing over each other is to be less than 1 third the thickness of the slab.
- .7 Place conduit in the middle third of the slab thickness, and do not in any case lay conduit directly on reinforcing steel.
- .8 Do not locate conduit adjacent to parallel reinforcing bars.
- .9 The maximum size of any conduit is 1/5th of slab thickness.
- .10 Do not install conduit longitudinally in a beam without specific approval of the Consultant and extend conduit through a beam at right angles to the beam span.
- .11 Where conduits extend through beams stay a minimum of twice the depth of the beam away from the supports.
- .12 Do not install conduit in the slab beside a drop or beam within twice the depth of the slab from the edge of the drop or beam.
- .13 Do not install conduits through shear walls or columns without written approval from the consultant.
- .14 Do not install conduit in parking garage structures, garage ramps, water retaining structures, or any other concrete subject to the application of de-icing products.

- .15 In areas where installation of conduit embedded in concrete is not permitted, extend conduit through beams in sleeves, if the installation of the sleeves is permitted.
- .16 Slope all underground conduits to drainage points and ensure that the conduits can be drained.

3.07 UNDERGROUND AND CONDUIT UNDER SLAB ON GRADE

- .1 Where conduit is to be installed under a slab on grade, the system is to be a pull-in system, must consider and address any effects of magnetic fields, and the following is to apply:
 - .1 Concrete encased duct bank with non-ferrous conduits is to be used.
 - .2 Conduit is to be sloped to a proper drainage pit and away from the building.
 - .3 20% spare conduit (minimum 1) is to be provided.
 - .4 Conduits to be water sealed at each connection point into equipment and structure.

3.08 CONDUIT INSTALLATION FOR FLOOR OUTLETS

- .1 Refer elsewhere to requirements for scanning and cutting the floor. Every floor shall be x-rayed or scanned by Div.26 prior to cutting or coring.
- .2 Coordinate with the Tile Contractor to ensure conduits and outlets are correctly aligned with new floor surface. Outlets to be in the centre of tiles and shall not bridge tile joints. Ensure that sufficient non-shrink grout or non-shrink caulking is provided to prevent movement of outlets and cover the total installation and shall be trip free.
- .3 Install sufficient conduit access points to satisfy the requirement of the specification and locations of electrical rooms.
- .4 Conduits shall not be installed on surface in any public area.
- .5 Hand over 20% spare floor outlet complete covers (IT and power) to Owner at end of project.

3.09 SEALED CONDUIT PENETRATIONS

- .1 For isolation rooms, any conduit penetration any surface of the room is to be sealed with a suitable elastomeric and intumescent material to ensure complete isolation of the room/area. The sealing material must be non-hazardous and suitable in all respects for the specific application, including a fire rating if required. Submit product data for the proposed sealing material as well as WHMIS sheets and product installation instructions.
- .2 For areas where ambient temperature is controlled substantially different then the balance of the facility, or any areas where temperature is maintained below 5°C, any conduit penetration any surface of the area is to be sealed with a suitable elastomeric and intumescent material to ensure complete isolation of the room/area. The sealing material must be non-hazardous and suitable in all respects for the specific application, including a fire rating if required. Submit product data for the proposed sealing material as well as WHMIS sheets and product installation instructions.
 - .1 In areas such as coolers, freezers, install junction boxes back-to-back on both side of the wall to allow for sealant inspection and proper installation.
 - .2 When connection to equipment sensitive to moisture connection shall be made to the bottom end of the equipment to prevent condensation damages.

3.10 CONDUIT SUPPORT

- .1 **Underground Conduit:** Unless otherwise shown or specified, support underground conduit on a well tamped bed of earth or sand, free from rocks or protrusions of any kind.
- .2 **Surface Mounted & Suspended Single/Double Conduit Runs:** Support and secure single and double runs of conduit at support spacing in accordance with Code requirements by means of galvanized steel pipe straps, conduit clips, ring bolt type hangers with galvanized steel hanger rods, or by other approved manufactured devices.
- .3 **Conduit Expansion Facilities:** Abide by the following:
 - .1 Wherever concealed or surface mounted conduit extends across a building expansion joint, provide expansion facilities to permit free movement without imposing additional stress or loading on the support system, and to prevent excessive movement at joints and connections.

- .2 Provide manufactured expansion joint fittings in rigid PVC conduit at spacing recommended by the expansion joint fitting manufacturer.
- .3 Make "snaked" bends in underground flexible polyethylene conduit.

3.11 CONDUIT SYSTEM BONDING

- .1 Provide bond wire in each installed conduit.
- .2 Bond wire to be sized in accordance to the Electrical Safety Code.
- .3 Where noted on the drawings or required by code or provide separate ground and bond wire in each conduit.

3.12 CONDUITS IN EXIT RATED CORRIDORS AND STAIRS

- .1 Where conduit feeds go through exit corridors, engages services of the on-site approved dry wall and framing contractor to provide fire rate shaft assembly to conceal the conduit to Code requirements. Include all costs in this regard.
- .2 Provide fire rated access door for conduits installed in exit assemblies where required by code and as required by AHJ.
- .3 Electrical installation in the exit rated areas shall be of non-combustable rating.
- .4 Contractor shall overlay electrical drawings to provide proposed conduit layout to demonstrate passing through exit pathways is unavoidable.
- .5 Where purpose of corridors, exist or areas are not clearly identified on Architectural set of drawings, contractor shall obtain clarification and shall confirm installation of systems prior commencement of work.

END OF SECTION

1	GENERAL	2
1.01	APPLICATION	2
1.02	SEISMIC CONSULTANT	2
1.03	SUBMITTALS	2
1.04	QUALITY ASSURANCE	3
2	PRODUCTS	3
2.01	GENERAL	3
2.02	ACCEPTABLE MANUFACTURERS	4
2.03	SLACK CABLE RESTRAINTS	4
2.04	ANCHOR BOLTS	4
3	EXECUTION	4
3.01	INSTALLATION OF SEISMIC RESTRAINT MATERIALS	4
3.02	SITE INSPECTION AND LETTERS OF CERTIFICATION	6

1 GENERAL

1.01 APPLICATION

- .1 This Section specifies seismic control and restraint requirements that are common to electrical work Sections of the Specification and it is a supplement to each Section and is to be read accordingly.

1.02 SEISMIC CONSULTANT

- .1 Retain and pay for the services of an experienced Seismic Consultant who is a registered professional engineer licensed in the area of the work and a member in good standing of a Professional Engineers Association in the area of the work.
- .2 The Seismic Consultant is to:
 - .1 Determine the proper seismic hazard level, design, recommend, and review all proposed electrical work seismic restraint shop, placement and securing drawings, and sign and stamp all drawings prior to submittal for review as specified below.
 - .2 Supervise installation of all electrical work seismic restraint and, when work is complete, certify in writing that the seismic restraint work has been installed in accordance with signed, stamped, and reviewed drawings.
 - .3 Prepare and submit to the Municipality and authorities having jurisdiction, on a form approved by the Municipality and authorities having jurisdiction, at the beginning of seismic restraint work and when the work is complete, original signed and sealed Letters of Assurance for the design, installation, and field review of all seismic restraint work.

1.03 SUBMITTALS

- .1 **Shop Drawings/Product Data Sheets:** Obtain all required equipment information and submit manufacturer's shop drawings/product data sheets for all restraining devices and steel bases. Include placement data, and details of attachment to both the equipment and the structure meeting requirements of the forces involved. All product data sheets and drawings are to be signed and stamped by the Seismic Consultant referred to above.
- .2 **Seismic Consultant's/Seismic Control Product Manufacturer's Certification Letters:** Submit copies of the Seismic Consultant's Letters of Assurance as specified above. Submit copies of the Seismic Consultant and seismic control manufacturer's certification letters as specified in Part 3 of this Section.

- .3 **Samples:** If requested, submit samples of seismic restraint materials for review.

1.04 QUALITY ASSURANCE

- .1 Seismic restraints are to be designed by a Seismic Consultant as specified above and are to be installed by qualified tradesmen under the supervision of and to the approval of the Seismic Consultant.
- .2 Unless otherwise specified seismic control and restraints are to be designed in accordance with
 - .1 National Building Code of Canada
 - .2 CAN/CSA-S832, Seismic Risk Reduction of Operational and Functional
 - .3 local Code requirements
- .3 All restraint products must be tested in an independent testing laboratory, or certified by the Vibration Isolation and Seismic Control Manufacturer's Association and Seismic Consultant, to confirm that the restraint products meet all requirements of this Section, i.e., dynamic ultimate limit load state as required by the Code, "Fail Safe" design, etc. If particular tests are carried out to represent a restraint type, the test is to be valid for the full load range of the restraint. Submit such tests or certification when requested.
- .4 Seismic control and restraint product manufacturers are to provide all required assistance during the installation, and, when the installation is complete, submit written reports from the manufactures listing any deficiencies to the installation.

2 PRODUCTS

2.01 GENERAL

- .1 Isolation, anchors, bolts, bases, restraints, etc., are to be designed to withstand without failure or yielding, the dynamic G load as specified in the Code for the seismic zone in which the building is located. Design loads are ultimate limit state loads (1.5 times working load) acting through the centre of gravity of the anchored or restrained equipment. "Fail Safe" designs are acceptable.
- .2 For both isolated and non-isolated floor mounted equipment, design and provide anchors and bolts to withstand, without failure or yielding, a dynamic ultimate limit state load as defined in the Code, of the greater of 0.3 g or as required by the Code, applied horizontally through the centre of gravity.
- .3 Where impact forces may be significant, use ductile materials.

- .4 Seismic restraining devices, which are factory supplied with equipment, are to meet all requirements of this Section.

2.02 ACCEPTABLE MANUFACTURERS

- .1 Acceptable seismic restraint product manufacturers are:
 - .1 Mason Industries Inc.
 - .2 Kinetics Noise Control
 - .3 Vibro-Acoustics Ltd.
 - .4 The VCM Group

2.03 SLACK CABLE RESTRAINTS

- .1 Galvanized steel aircraft cable slack cable restraints meeting all current requirements of the Building Code, sized to suit the application and complete with all required cable ties, anchor hardware (selected for a load equal to twice the weight of the equipment), and similar connection accessories.

2.04 ANCHOR BOLTS

- .1 Equal to Mason Industries type SAB seismic anchor bolts.

3 EXECUTION

3.01 INSTALLATION OF SEISMIC RESTRAINT MATERIALS

- .1 Provide seismic restraint for all electrical equipment, conduit, raceways, lighting fixtures, etc., as per the requirements of the current edition of the Building Code and this Section of the Specification.
- .2 Provide structural steel bases for all equipment unless the equipment manufacturer certifies direct attachment capabilities.
- .3 Space restraints under equipment so that the minimum distance between adjacent corner restraints is at least equal to the height of the centre of gravity of the equipment. Include the height of the centre of gravity on shop drawings, otherwise, design for increased forces on the supports and submit design calculations with shop drawings.

- .4 Floor mounted isolated equipment is to be installed on concrete housekeeping pads (design and thickness as selected by the Seismic Consultant) with at least 200 mm (8") clearance between drilled inserts and the edges of the pads. Ensure that all housekeeping pads are keyed to the structure to resist seismic displacement.
- .5 Requirements pertaining to seismic control work are as follows:
 - .1 Execute seismic control and restraint work in accordance with drawing details and reviewed product data and shop drawings.
 - .2 Seismic control systems are to work in all directions.
 - .3 Fasteners and attachment points are to resist the same maximum load as the seismic restraint.
 - .4 Drilled or power-driven anchors and fasteners are not permitted.
 - .5 No equipment, equipment supports, or mounts are to fail before failure of the structure.
 - .6 Seismic control measures are not to interfere with the integrity of firestopping.
 - .7 All equipment is to be bolted to the structure, and all bolts are to be fitted with isolation washers.
 - .8 The number, size, type, and installation of anchor bolts are to be as recommended by the anchor bolt manufacturer and the Seismic Design Consultant.
 - .9 Where more than a 3 mm (1/8") differential exists between an anchor or attachment bolt diameter, an anchor and attachment point hole, or an isolator gap attachment bolt and equipment anchor attachment hole, pack the air gap with Mason type 0.5 FastSteel reinforced epoxy putty.
 - .10 All hung equipment and hangers are to be fitted with a means of preventing upward movement, and non-isolated equipment and hanger rods are to be fitted with oversized steel washers and nuts above and below the hanger or equipment attachment point, locked tight to prevent uplift of the equipment or hanger.
 - .11 Where suspended equipment hanger rod length exceeds 50 rod diameters between the structure and the equipment attachment point, reinforce the rods with angle iron to prevent bending due to uplift forces.

- .12 Seismic control measures are not to jeopardize noise and vibration isolation systems, and 6 mm (¼") to 9 mm (3/8") clearance during normal operation of equipment and systems is to be provided between seismic restraint and equipment.
- .13 Where hold-down bolts for seismic restraint equipment penetrate roofing membranes coordinate with roofing trade for installation of pitch pockets/"gum cups" and sealing compound to maintain the water-tight integrity of the roof.
- .14 Where friction type clamps are used for support of equipment and connecting services, secure clamps to steel work by means of welding or other positive means to prevent slippage or loosening of the clamps due to seismic force.

3.02 SITE INSPECTION AND LETTERS OF CERTIFICATION

- .1 When all seismic control products have been installed, arrange for the seismic control product manufacturer and Seismic Consultant to examine the installation of all seismic control products and to certify in writing (separate letters) that the products have been properly installed in accordance with governing Codes and Regulations, and recommendations and instructions. The Seismic Consultant is to apply his signed and dated professional stamp to the letter.

END OF SECTION

1	GENERAL	2
1.01	SUBMITTALS	2
1.02	QUALITY ASSURANCE	2
2	PRODUCTS	2
2.01	BRANCH CIRCUIT PANELBOARDS	2
2.02	DISTRIBUTION PANELBOARDS	5
3	EXECUTION	8
3.01	INSTALLATION OF BRANCH CIRCUIT PANELBOARDS	8
3.02	INSTALLATION OF DISTRIBUTION PANELBOARDS	9
3.03	DISTRIBUTION EQUIPMENT MOUNTING	9
3.04	INSTALLATION OF LOAD CENTRE PANELBOARDS	9
3.05	EQUIPMENT SPRINKLER PROTECTION	10
3.06	EQUIPMENT MOUNTING	10

1 GENERAL

1.01 SUBMITTALS

- .1 **Product Data:** Submit product data sheets for products specified in this Section.
- .2 **Panelboard Door Keys:** Submit identified keys (minimum 6) for panelboard doors.
- .3 Shop drawings will not be accepted without the short circuit and coordination study where specified.

1.02 QUALITY ASSURANCE

- .1 Panelboards are to be rated to interrupt and withstand short circuit faults greater than the available fault current. Indicate conformance with this requirement on product data sheets submitted for review.
- .2 Circuit breakers shall be in accordance to specification section; Moulded Case Circuit Breakers and built to CSA standards.

2 PRODUCTS

2.01 BRANCH CIRCUIT PANELBOARDS

- .1 **General Re: Panelboards:** Breaker type branch circuit panelboards are to be dead front, factory assembled panelboards designed for sequence phase connection of branch circuit breakers, as per the drawing schedule and plans, and in accordance with requirements CAN/CSA-C22.2 No. 29, Panelboards and Enclosed Panelboards Industrial Products. Comply with OESC Rule 14-014 series rated combinations of over-current protective devices and ensure that equipment in which the lower rated devices are installed are marked with a series combination interrupting rating minimum 50% higher than the available fault current. Each panelboard is to be complete with:
 - .1 Electrical grade, 95% conductivity copper sequence phase bus mains for the full length of each enclosure.
 - .2 A fully capacity neutral unless otherwise specified.
 - .3 Main and branch circuit conductor solderless set-screw type lugs approved for copper conductors.
 - .4 Neutral bus and main lugs at the same end, and a removable cover for main lugs.

- .5 The panelboards and breaker type combination shall allow for installation of three pole breakers with amperage rating no less than 50% of the panel rating without use of special purpose breaker kit and not requiring more than three single pole breaker spaces.
- .6 A manufacturer's nameplate which indicates panelboard characteristics including the fault current that the panelboard, including breakers, has been constructed to withstand.
- .2 **Panelboard Enclosures:** Panelboard enclosures, unless otherwise specified, are to be EEMAC 2 sprinkler-proof, flush or surface mounted as indicated, constructed of Code gauge galvanized sheet steel, equipped with drip shields, and factory cleaned, primed, and finished with ASA-61 light gray equipment enamel. Each enclosure is also to be equipped with:
 - .1 Wiring gutter space on all sides in accordance with CAN/CSA-C22.2 No. 29 requirements.
 - .2 Space for future breakers as applicable and as per the drawing schedule.
 - .3 A concealed hinged door and flush latch with keyed alike lock, and a frame with acetate cover and a circuit directory card on the inside face of the panel door.
 - .4 Mylar circuit breaker identification strips secured in place.
- .3 **Circuit Breakers:** Breakers are to be moulded case, bolt-on breakers in accordance with CSA/C22.2 No. 5, Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit Breaker Enclosures, rated 75°C, calibrated for operation in a 40° C (105° F) ambient temperature, sized in accordance with the drawing schedules, and as follows:
 - .1 Branch circuit breaker interrupting capacity is to suit the panelboard voltage and be as scheduled, or in accordance with Code requirements to suit the application.
 - .2 Minimum size of mains shall be governed by size of fuse or breaker protecting the panel. Panels shall be rated at a minimum 10 KA IC for 208 volt and minimum 18 KA IC for 600V. Tenders to be based on prospective fault level delivered by the Utility.
Note, where the panels are located in the main electrical room, and not fed from a separate transformer, the fault level rating will be minimum 35 KA on the 347/600 volt panels and minimum 22 KA on the 120/208 volt.

-
- .3 Odd numbered breakers on left and even on right, with each breaker identified by permanent number identification as to circuit number.
 - .4 For ground fault breakers, CSA Class A, Group 1 combination thermal magnetic trip breakers with solid-state ground default interrupters.
 - .5 For breakers 225 amperes and larger, a solid-state adjustable trip unit with long time, short-time, and instantaneous time functions and time delays, set at ratings in accordance with the distribution coordination study.
 - .6 For dedicated breakers, handle lock devices.
 - .7 As scheduled or shown, spare breakers or space for future breakers.
 - .8 Two pole and three pole breakers shall have common trip; tie handles will not be accepted.
 - .9 "Duplex, 13mm" or "twin" series rated breakers will not be accepted.
 - .10 Circuit loads shall be balanced across phases as closely as possible.
 - .11 Complete typewritten legend shall be provided on the inside of the door of each panel mounted in a metal frame and covered with transparent plastic.
 - .12 Circuit breakers feeding weatherproof receptacles and heat tracing shall be ground fault interrupter type.
 - .13 Panels shall contain number of branch circuits breakers shown on the drawings plus 20% spare breakers and 25% spare space.
 - .4 **Modification & Accessories:** Where indicated on the drawings or scheduled, panelboards are to be factory equipped with modifications and accessories as follows:
 - .1 Insulated ground bus assembly.
 - .2 Sub-feed lugs.
 - .3 Through-feed lugs.
 - .4 A non-automatic or automatic (as schedule) main breaker.
 - .5 A shunt trip for the main breaker.
 - .6 Isolated ground bus.

.5 **Acceptable Manufacturers:** Acceptable Manufacturers are:

- .1 Eaton Canada
- .2 Schneider Electric Canada
- .3 Siemens Electric Canada

2.02 DISTRIBUTION PANELBOARDS

- .1 **General Re: Panelboards:** Distribution panelboards are to be dead front, factory assembled panelboards designed for sequence phase connection of branch circuit devices, as per the drawing schedule and plans, and in accordance with requirements of CAN/CSA- C22.2 No. 29, Panelboards and Enclosed Panelboards Industrial Products.

Comply with OESC Rule 14-014 series rated combinations of over-current protective devices and ensure that equipment in which the lower rated devices are installed are marked with a series combination interrupting rating minimum 50% higher than the available fault current.

Distribution panelboards shall be fully rated, minimum 22 KA IC for 208 volt and 25 KA IC for 600V. Tenders to be based on prospective fault level delivered by the Utility.

Note: where the panels are located in the main electrical room, and not fed from a separate transformer, the full fault level rating will be minimum 42 KA on the 347/600 volt panels and minimum 25 KA on the 120/208 volt.

Each distribution panelboard is to be complete with:

- .1 Silver plated, electrical grade, 95% conductivity copper bus mains for the full length of each enclosure.
- .2 Main and branch circuit conductor solderless lugs approved for copper conductors.
- .3 Neutral bus and main lugs at the same end, and a removable cover for main lugs.
- .4 For panelboards in Elevator and/or Escalator Machine Rooms, hardware to permit padlocking the switch or breaker in the open position.
- .5 The panelboards and breaker type combination shall allow for installation of three pole breakers with amperage rating no less than 50% of the panel rating without use of special purpose breaker kit and not requiring more than three single pole breaker spaces.

- .6 A manufacturer's nameplate which indicates panelboard characteristics including the fault current that the panelboard, including breakers, has been constructed to withstand.
- .2 **Panelboard Enclosures:** Panelboard enclosures, unless otherwise specified, are to be EEMAC 2 sprinkler-proof, constructed of Code gauge galvanized sheet steel, equipped with drip shields, and factory cleaned, primed, and finished with ASA-61 light grey equipment enamel. Each enclosure is also to be equipped with:
 - .1 Wiring gutter space on all sides in accordance with CAN/CSA-C22.2 No.29 requirements.
 - .2 Space for future breakers/switches as applicable and as per the drawing schedule, and where spare breaker space is scheduled, breaker connector kits.
 - .3 For panelboards in areas other than secure Electrical, etc., Rooms, a concealed hinged door and flush latch with keyed alike lock.
 - .4 For free-standing floor mounted panelboards, reinforcement as required for a rigid enclosure.
- .3 **Circuit Breaker Panelboards:** Breakers are to be moulded case, bolt-on breakers in accordance with CSA-C22.2 No. 5, Moulded-Case Circuit Breakers, Moulded-Case Switches, and Circuit Breaker Enclosure, rated 75°C calibrated for operation in a 40° C (150° F) ambient temperature, sized in accordance with the drawing schedules, and complete with:
 - .1 A top main breaker.
 - .2 For breakers 225 amperes and larger, a solid-state adjustable trip unit with long time, short time, and instantaneous time functions and time delays, set at ratings in accordance with the distribution coordination study.
 - .3 Handle lock devices.
 - .4 As scheduled or shown, spare breakers or space for future breakers.
 - .5 Panelboard loads shall be balanced across phases as closely as possible.
- .4 **Switch and Fuse Panelboards:** Fusible switches are to be quick-make, quick-break, visible contact bolt-on switches in accordance with CSA-C22.2 No. 5, Moulded-Case Circuit Breakers, Moulded-Case Switches, and Circuit Breaker Enclosures, sized in accordance with the drawing schedules, and complete with:

- .1 A top main switch.
- .2 Operating handles which protrude through the dead front enclosure, interlocked with the switch mechanism, and equipped with facilities for padlocking in either the "ON" or "OFF" position.
- .3 Fuse clips, and HRC fuses as per the drawing schedule.
- .4 Where downstream equipment rating is dependable on fuses, fuses, fuse holder equipment shall be selected to provide series rating.
- .5 **Modifications & Accessories:** Panelboards are to be factory equipped with modifications and accessories as follows:
 - .1 200% rated neutral
 - .2 insulated ground bus assembly
 - .3 isolated ground bus assembly
 - .4 sub-feed lugs
 - .5 through-feed lugs
 - .6 entry plates for Corflex cable
 - .7 a barriered main breaker or switch
 - .8 a main breaker/switch through the cover key interlock
 - .9 a shunt trip for the main breaker
 - .10 undervoltage release for the main breaker
 - .11 an alarm switch for the main breaker
 - .12 a surge protection package with audible alarm, counter, and silence button, from "C" relay contact, and EMI/RFI filtering providing 50 dB noise attenuation at 100 kHz

3 EXECUTION

3.01 INSTALLATION OF BRANCH CIRCUIT PANELBOARDS

- .1 Provide breaker type branch circuit panelboards where shown. Ensure adequate operation and maintenance clearance on all sides of each panelboard as per Code requirements.
- .2 Unless otherwise specified, supply panelboards from a single manufacturer only.
- .3 Wall mount panelboards independent of connected conduit. Accurately install with reference to wall finish and confirm exact locations prior to roughing-in.
- .4 Where 2 or more panelboards are installed in 1 enclosure equip the panelboards with double lugs and increase gutter capacity to accommodate additional cabling.
- .5 In addition to load circuit breakers scheduled and indicated for each normal power panelboard, provide five 15A-1P additional breakers for small power and miscellaneous mechanical loads, each connected with 30 m (100') of 12 mm (½") diameter EMT and two # 12 AWG plus ground, with terminations as directed during construction.
- .6 In each panelboard adjacent to mechanical equipment spaces, provide a dedicated 15A-1P breaker with lock-on device, and 12 mm (½") diameter EMT and two #12 AWG plus ground terminated in an identified junction box (BAS) in the equipment space.
- .7 Provide additional devices and accessories for panelboards as indicated and/or scheduled.
- .8 Test each surge protection device in accordance with the manufacturer's instructions.
- .9 For each GFI breaker demonstrate in the presence of the Consultant that the protected circuit will trip when a simulated ground fault is applied to the "load" side of the breaker, and meggar the "load" side neutral to ensure that the neutral is not grounded on the "load" side of the GFI.
- .10 Circuit loads shall be balanced across phases as closely as possible. Provide written report identifying loading per phase. Include to rework wire connections to improve on panel loading where required.

3.02 INSTALLATION OF DISTRIBUTION PANELBOARDS

- .1 Provide distribution panelboards where shown. Ensure adequate operation and maintenance clearance on all sides of each panelboard as per Code requirements.
- .2 Wall mount panelboards independent of connected conduit.
- .3 Secure each free-standing panelboard, level and plumb, to a concrete housekeeping pad.
- .4 Connect neutral conductors to common neutral bus with respective neutral identified.
- .5 Identify each panelboard and each panelboard component with an engraved Lamacoid nameplate in accordance with requirements of the Section entitled Basic Electrical Materials and Methods. Confirm nameplate wording with the Consultant prior to manufacture. Include a printed circuit directory card in a frame with acetate cover.
- .6 Test each surge protection device in accordance with the manufacturer's instructions.
- .7 Circuit loads shall be balanced across phases as closely as possible. Provide written report identifying loading per phase. Include to rework wire connections to improve on panel loading where required.

3.03 DISTRIBUTION EQUIPMENT MOUNTING

- .1 Where required based on selected distribution panelboards provide 4" housekeeping pad.

3.04 INSTALLATION OF LOAD CENTRE PANELBOARDS

- .1 Provide load centre type panelboards where shown. Ensure adequate operation and maintenance clearance on all sides of each panelboard as per Code requirements.
- .2 Wall mount panelboards independent of connected conduit. Accurately install with reference to wall finish and confirm exact locations prior to roughing-in.
- .3 For each GFI breaker demonstrate in the presence of the Consultant that the protected circuit will trip when a simulated ground fault is applied to the "load" side of the breaker, and meggar the "load" side neutral to ensure that the neutral is not grounded on the "load" side of the GFI.

3.05 EQUIPMENT SPRINKLER PROTECTION

- .1 Electrical equipment located in area with fire protection sprinkler shall be provided with suitable protection against water flow from sprinkler heads. This protection shall be of a type acceptable to the Local Electrical Inspection Department.

3.06 EQUIPMENT MOUNTING

- .1 Panels shall be flush mounted except in electrical rooms and closets where they shall be surface mounted. All panels shall be sprinkler proof and shall have copper bus bars.

END OF SECTION

1	GENERAL	2
1.01	SUBMITTALS	2
1.02	QUALITY ASSURANCE	2
1.03	WIRING DEVICE AND PLATE COLOURS	2
2	PRODUCTS	3
2.01	SWITCHES	3
2.02	SPECIFICATION GRADE STANDARD RECEPTACLES	3
2.03	SPECIFICATION GRADE LOCKING RECEPTACLES	4
2.04	SPECIFICATION GRADE ISOLATED GROUND RECEPTACLES	4
2.05	SPECIFICATION GRADE GROUND FAULT RECEPTACLES	5
2.06	SPECIFICATION GRADE TAMPER-RESISTANT DUPLEX RECEPTACLES	5
2.07	CLOCK HANGER RECEPTACLES	5
2.08	PHOTO ELECTRIC SWITCH	5
2.09	TIME SWITCH	5
2.10	DEVICE FACEPLATES	6
2.11	FIRE RATED GASKETS	6
3	EXECUTION	6
3.01	GENERAL RE: INSTALLATION OF WIRING DEVICES	6
3.02	WIRING DEVICE AND FACEPLATE TYPES AND COLOURS	7
3.03	INSTALLATION OF FIRE RATED GASKETS	8
3.04	TESTING	8
3.05	ADJUSTMENTS AND SETTINGS	8
3.06	LABELS	8

1 GENERAL

1.01 SUBMITTALS

- .1 **Product Data:** Submit product data sheets for wiring devices. Ensure that the sheets indicate colours and faceplate finishes.
- .2 **Wiring Device Samples:** Submit identified samples in original packaging of the following wiring devices:

1.02 QUALITY ASSURANCE

- .1 All wiring devices are to be CSA certified as a minimum, in accordance with the following standards, as applicable:
 - .1 CAN/CSA C22.2 No. 42, General Use Receptacle, Attachment Plugs and Similar Wiring Devices
 - .2 CAN/CSA C22.2 No. 42.1, Cover Plates for Flush Mounted Devices
 - .3 CSA C22.2 No. 111, General Use Snap Switches
- .2 Wherever possible, all wiring devices are to be supplied by the same manufacturer.
- .3 **Acceptable Manufacturers:** Unless otherwise specified in this Section or on the drawings, acceptable manufacturers are:
 - .1 Hubbell Canada LP
 - .2 Cooper Industries (Arrow Hart)
 - .3 Legrand/Pass & Seymour
 - .4 Leviton Canada
 - .5 Cooper Crouse-Hinds

1.03 WIRING DEVICE AND PLATE COLOURS

- .1 Unless otherwise specified, wiring device colours will be as specified in Part 3 of this Section.

2 PRODUCTS

2.01 SWITCHES

- .1 Unless otherwise specified, Specification Grade, Premium Quality, back and side wired, 20 ampere, 120-277 volt A.C. quiet action toggle switches, single pole, 2-pole, 3-way, or key type as indicated on the drawings, each complete with a nickel plated steel ground terminal, brass power wiring terminals and screws, silver cadmium oxide contacts with a moveable brass contact arm, and nylon toggle with colour as specified below. Switch types are as follows:
 - .1 **Standard Wall Toggle Switches:** As above.
 - .2 **Illuminated Handle Standard Wall Toggle Switch:** As above for standard switches but with a clear red or green polycarbonate toggle which is illuminated when the switch is on or off. Confirm toggle colour and position when illuminated prior to ordering.
 - .3 **Decorative Wall Rocker Switch:** Generally, as specified above for standard toggle switches but rectangular decorative rocker type with rocker handles.
 - .4 **Illuminated Decorative Wall Rocker Switch:** Generally, as specified above for decorative toggle switches but with a rocker type illuminated handle.
 - .5 **Door Switch:** Box, switch and plate assemblies with a 125 volt 3 ampere illuminated switch which is on or off when the door is open (confirm prior to ordering), a 34 mm x 94 mm x 40 mm (1 11/32" x 3 11/16" x 1 1/2") box, cover plate, and mounting screws.
 - .6 **Motor Control Snap Action Switch:** Illuminated handle snap action horsepower rated switch, CSA certified for motor control and sized to suit the application.
 - .7 **Occupancy Sensor Switch:** Digital passive infrared and ultrasonic sensor type – dual technology, 120-277 volt A.C. with integral photo sensor and selected to suit the area and occupancy of the room served.

2.02 SPECIFICATION GRADE STANDARD RECEPTACLES

- .1 Back or side wired, U-ground, 2 pole receptacles as follows:
 - .1 **15 Amp. 125 Volt Duplex Receptacle:** 3-wire receptacles, NEMA configuration 5-15R

- .2 **15 Amp. 250 Volt Duplex Receptacle:** 3-wire receptacles, NEMA configuration 6-15R
- .3 **20 Amp. 125 Volt Duplex Receptacle:** 3-wire receptacles, NEMA configuration 5-02R
- .4 **20 Amp. 250 Volt Duplex Receptacle:** 3-wire receptacles, NEMA configuration 6-20R
- .5 **30 Amp. 250 Volt Simplex Receptacle:** 3-wire receptacles, NEMA configuration 6-30R
- .6 **30 Amp. 125/250 Volt Simplex Receptacle:** 3-wire receptacles, NEMA configuration 14-30R
- .7 **50 Amp. 250 Volt Simplex Receptacle:** 3-wire receptacles, NEMA configuration 6-50R
- .8 **50 Amp. 125/250 Volt Simplex Receptacle:** 4-wire receptacles, NEMA configuration 14-50R

2.03 SPECIFICATION GRADE LOCKING RECEPTACLES

- .1 Specification Grade, back or side wired, U-ground 2-pole, 3-wire locking type receptacles as follows:
 - .1 **15 Amp. 125 Volt Duplex Receptacle:** NEMA configuration L6-15R
 - .2 **15 Amp. 250 Volt Duplex Receptacle:** NEMA configuration L6-15R
 - .3 **20 Amp. 125 Volt Duplex Receptacle:** NEMA configuration L5-20R
 - .4 **20 Amp. 250 Volt Duplex Receptacle:** NEMA configuration L6-20R

2.04 SPECIFICATION GRADE ISOLATED GROUND RECEPTACLES

- .1 **120 Amp. 125 Volt Duplex Receptacle:** Back and side wired, duplex, U-ground, 2-pole, 20 ampere, 125 volt, 3-wire, orange colour, surge suppression isolated ground nylon construction receptacles, NEMA configuration 5-20R.

2.05 SPECIFICATION GRADE GROUND FAULT RECEPTACLES

- .1 Heavy-duty, 15/20 ampere, 125 volt, ULC Class A, Group 1. automatic ground fault circuit interrupting duplex receptacles with a 10 kA short circuit current rating automatic self-test diagnostics, green power on LED, and red ground fault LED. Ground fault receptacles for indoor climate controlled and outdoor or non-climate controlled areas are to be as follows:
 - .1 indoor climate controlled areas: equal to Hubbell Canada No. GFST15/GFSTt20 "AUTOGUARD"
 - .2 outdoor areas and indoor non-climate areas: equal to Hubbell Canada No. GFR5262TR/GFR 4362TR "AUTOGUARD"

2.06 SPECIFICATION GRADE TAMPER-RESISTANT DUPLEX RECEPTACLES

- .1 Specification Grade, back or side wired, U-ground, 2-pole, 3-wire tamper-resistant duplex receptacles as specified above, 15 ampere or 20 ampere, 125 volt as indicated on the drawings, each with thermoplastic shutters to limit access to energized contacts.

2.07 CLOCK HANGER RECEPTACLES

- .1 Equal to Legrand/Pass & Seymour #S3713W 15 ampere, 125 volt white recessed simplex receptacle with smooth white wall plate.

2.08 PHOTO ELECTRIC SWITCH

- .1 Equal to Tork 2105 Series weather-proof, 12 mm (½") dia. conduit mounting photoelectric SPST control switch with model number to suit the voltage and connected load, complete with an adjustable slide for on-off adjustment, a turn-on of one to five fc and a turn-off of three to five fc without the slide in position, a die-cast zinc gasketed enclosure, cadmium sulphide epoxy coated cell, normally closed contacts which fail in the open position, a delay of up to four minutes to prevent false switching due to light from vehicles, lightning, etc., three colour coded 150 mm (6") # 16 AWG leads, a fixed base for conduit connection, and, if required, an accessory bracket for wall mounting the device.

2.09 TIME SWITCH

- .1 Flush wall mounting Honeywell RPLS740B1000/U 7-Day Programmable Light Switch Timer Series.

2.10 DEVICE FACEPLATES

- .1 Device faceplates are to be ULC listed and CSA certified and, unless otherwise specified, supplied by the device manufacturer. Where two or more devices are installed in a common box, a common one-piece faceplate is to be used. Faceplate colours are specified in Part 3. Faceplates, unless otherwise specified, are to be as follows:
 - .1 Phenolic switch and receptacle faceplates, complete with matching screws
 - .2 “Decorator” type Phenolic switch and receptacle faceplates
 - .3 type 302 stainless steel switch and receptacle faceplates, brush finish or satin finish as directed, with stainless steel screws
 - .4 high impact smooth finish switch and receptacle faceplates
 - .5 hot dipped galvanized steel switch and receptacle faceplates
 - .6 NEMA 3 rated, single gang, horizontal/vertical mounting, weather-proof in use, gasketed cast aluminium, receptacle faceplates to suit the type of receptacle used
 - .7 weather-proof, gasketed, water-tight single gang type 302 stainless steel switch plate with clear silicone rubber bubble over the switch toggle

2.11 FIRE RATED GASKETS

- .1 Intumescent Technologies, LLC and PyroPhobic Systems, Ltd. - FireBløk™ Gasket, RECTORSEAL “Bio Fireshield or alternative equal. single highly intumescent component fire rated gasket for use with electrical boxes located in fire rated construction, UL listed to UL 263/ASTM E-19, Fire Tests of Building Construction and Materials.

3 EXECUTION

3.01 GENERAL RE: INSTALLATION OF WIRING DEVICES

- .1 Provide all required wiring devices and faceplates
- .2 Confirm exact locations, including mounting heights prior to roughing-in.
- .3 For barrier-free mounting heights for devices, conform to requirements of the governing code or regulation.

- .4 Ensure that switches located adjacent to doors are located at the strike side of the door. Confirm door swings prior to roughing-in.
- .5 Install single throw switches with the handle in the up position when the switch is closed.
- .6 Confirm all switch, receptacle and faceplate types, colours, and finishes prior to ordering
- .7 Provide a separate insulated ground conductor for each isolated ground receptacle.
- .8 Faceplates for computer equipment receptacles are to be permanently identified with "Computer Equipment Only" wording.
- .9 Faceplates for housekeeping receptacles are to be permanently identified with "Housekeeping Only" wording.
- .10 Do not install faceplates for flush devices until wall, etc., finishing work is complete
- .11 Where devices are to be installed in casework, millwork, or similar construction, carefully coordinate device installations and device openings with the trade providing the casework, millwork, etc.
- .12 In areas accessible to public, all devices and their supporting hardware shall be flush mounted where applicable.
- .13 Device locations indicated on the drawings are approximate, and, if requested, relocate the device up to 3 mm (10') away from the location shown at no additional cost.

3.02 WIRING DEVICE AND FACEPLATLE TYPES AND COLOURS

- .1 Unless otherwise specified, wiring devices colours and faceplate types and colours are to be confirmed with Architectural division prior ordering or as follows:
 - .1 **"Decorator" switches & receptacles in finished areas-non-essential circuits:** white or ivory, with white or ivory "Decorator" Phenolic faceplates
 - .2 **switches & receptacles in finished areas-non-essential circuits:** ivory, stainless steel faceplates

- .3 **switches & receptacles in unfinished areas-non-essential circuits:** ivory, stainless steel faceplates
- .4 **switches & receptacles in finished areas-essential power circuits & isolated power switches:** red, with stainless steel faceplates
- .5 **isolated power receptacles:** cast aluminium gasketed weather-proof faceplates to suit the type of receptacle installed
- .6 **weather-proof switches:** weather-proof stainless steel faceplates with clear silicone bubble over the switch toggle
- .2 Notwithstanding the above wiring devices and their respective faceplates shall be selected to closely match the colour of the wall finishes in areas exposed to public and shall be stainless steel finish type in back of house areas and utility room areas.

3.03 INSTALLATION OF FIRE RATED GASKETS

- .1 Provide fire rated gaskets in outlet boxes for single and double switches and receptacles located in fire rated construction. Install in accordance with the manufacturer's instructions.

3.04 TESTING

- .1 When installation is complete, test operation of all devices.
- .2 Devices installed in patient care facilities shall be subject to commissioning scope as specified in Z32.

3.05 ADJUSTMENTS AND SETTINGS

- .1 When installation is complete, adjust operation of all devices sensor type devices to time and settings desired by final user.
- .2 Coordinate and take leadership in order to organise meeting with Stakeholder user group to set all sensor control points as required by final user.

3.06 LABELS

- .1 Provide lamaroid label 12mm x 40 mm to identify circuit number and panel fed by.
- .2 Apply labels to all outlets.

- .3 Outlets in public areas shall have label attached to the wall area behind the faceplate.

END OF SECTION

1	GENERAL	2
1.01	SUBMITTALS	2
1.02	QUALITY ASSURANCE	2
2	PRODUCTS	2
2.01	GENERAL RE: FUSES.....	2
2.02	FUSE TYPES	2
2.03	FUSE STORAGE CABINET	3
3	EXECUTION	3
3.01	INSTALLATION OF FUSES.....	3
3.02	INSTALLATION OF FUSE STORAGE CABINETS	4
3.03	OVERCURRENT COORDINATION	4
3.04	SPARE FUSES	4

1 GENERAL

1.01 SUBMITTALS

- .1 **Product Data:** Submit product data sheets for products and accessories.

1.02 QUALITY ASSURANCE

- .1 Fuses are to be CSA certified and marked in accordance with the following Standards:
- .1 HRC fuses – CAN/CSA C22.2 No. 106, HRC – Miscellaneous Fuses
 - .2 plug and cartridge fuses – CSA 248-14, Fuses for Supplementary Overcurrent Protection (600 Volts, Maximum)

2 PRODUCTS

2.01 GENERAL RE: FUSES

- .1 HRC fuses are to have an interrupting capability of 200,000 amperes symmetrical.
- .2 Unless otherwise specified, fuses are to be the products of 1 manufacturer.
- .3 Fuse type references L1, L2, J1, R1, etc., have been adopted for use in this Specification.

2.02 FUSE TYPES

- .1 Fuse types are to be as follows:
- .1 HRC-J fuses (formerly Class J):
 - .1 type J1: time delay, capable of carrying 500% of its rated current for 10 s minimum
 - .2 type J2: fast acting
 - .2 HRC-L fuses (formerly Class L):
 - .1 type L1: time delay, capable of carrying 500% of its rated current for 10 s minimum
 - .2 type L2: fast acting

- .3 HRCI-R fuses (formerly Class R – for UL Class RK1 fuses, peak let-through current and 12t values are not to exceed limits of UL 198E table 10.2):
 - .1 type R1: (UL Class RK1, time delay, capable of carrying 500% of its rated current for 10 s minimum to meet UL Class RK1 maximum let-through limits
 - .2 type R2: same as R1 however, 100,000 interrupting capacity based on RK5, time delay, capable of carrying 500% of its current for 10 s minimum
 - .3 type R3: (UL Class RK1), fast acting Class R, to meet UL Class RK1 maximum let-through limits
- .4 HRCII-C fuses (formerly Class C)

2.03 FUSE STORAGE CABINET

- .1 Wall mounting #12 gauge aluminium, 750 mm x 600 mm x 300 mm (30" x 24" x 12"), complete with a piano hinged and key lockable door, a black baked enamel exterior finish, and a 300 mm x 100 mm (12" x 4") black-white-black engraved "SPARE FUSES" Lamacoid nameplate as per the electrical work Section entitled Basic Electrical Material and Methods, secured to the door with stainless steel screws.

3 EXECUTION

3.01 INSTALLATION OF FUSES

- .1 Provide fuses for secondary distribution equipment in accordance with equipment specifications and drawing requirements. Ensure that the correct fuses are assigned to each electrical circuit.
- .2 Generally, fuses are to be as follows:
 - .1 **Motor Loads, Elevators:** Type R1 or R2 for up to and including 600 amperes and type L1 for ratings above 600 amperes
 - .2 **Transformers:** Type J1 for up to and including 600 amperes and type L1 for ratings above 600 amperes
 - .3 **Service Entrance Feeder Circuits:** Type J2 for up to and including 600 amperes and type L2 for ratings above 60 amperes

- .4 **Other Service and Equipment:** A type either indicated on the drawings, specified with the equipment, or required for the purpose
- .5 **Specialty Fuses:** For specialty application and equipment that has specialty fuses manufactured for such as Solar – Photovoltaic fuses or Wind DG systems, TVSS, Telecommunication, DC fuses, etc including and not limited to the notes and other similar application fuses shall be selected to be the type specially manufactured for its given application.
- .3 Ensure that circuit fuses are fitted to physically matched mounting devices. Provide Class R rejection clips for HRCI-R fuses.

3.02 INSTALLATION OF FUSE STORAGE CABINETS

- .1 Provide a spare fuse storage in each electrical room housing fused distribution equipment. Confirm exact locations prior to installation.

3.03 OVERCURRENT COORDINATION

- .1 Interchange fuses at no cost to client in order to achieve selective coordination.
- .2 Fuse procurement shall be completed upon coordination study completion. Specified fuses are guidance for general selection, type of fuse, and its speed performance shall be confirmed with the coordination study.

3.04 SPARE FUSES

- .1 Supply a complete set of spare fuses in original packaging for all fused secondary distribution equipment.
- .2 Unless otherwise specified, store the spare fuses in fuse storage cabinets.

END OF SECTION

1	GENERAL	2
1.01	SUBMITTALS	2
2	PRODUCTS	2
2.01	DISCONNECT SWITCHES	2
3	EXECUTION	4
3.01	INSTALLATION OF DISCONNECT SWITCHES	4
3.02	OVERCURRENT COORDINATION	4

1 GENERAL

1.01 SUBMITTALS

- .1 **Product Data:** Submit product data sheets for disconnect switches and accessories.

2 PRODUCTS

2.01 DISCONNECT SWITCHES

- .1 All disconnect switches shall be heavy duty, horsepower rated, Quick-Make/Quick-Break operating mechanisms Load-Make/Load-Break rated.
 - .1 Three poles (3P) or four poles (4P) rated, unless indicated on the drawings disconnect switches shall be three poles rated, suitable for the Voltage and Amperage indicated on the drawings.
 - .2 Service entrance rated as required.
 - .3 Non-fusible safety switches may carry 100 percent of the nameplate current rating.
 - .4 Fusible safety switches shall carry 80 percent of the nameplate current rating, unless otherwise noted.
 - .5 AC and DC horsepower rated.
 - .6 Up to 200 K RMS Symmetrical Amperes Fault Current.
 - .7 Shall include:
 - .1 lock-off guard
 - .2 internal barrier kits switch wiring diagram
- .2 **General Purpose:** Heavy-duty, CSA certified, front operated switches each in accordance with CAN/CSA – C22.2 No. 4, Enclosed Switches, each complete with a red handle suitable for padlocking in the “off” position, and a NEMA/ EEMAC enclosure. Fusible units are to be complete with fuse clips in accordance with CSA-C22.2 No. 39, Fuseholder Assemblies and to suit fuse types specified below.

- .3 **Specialty Application:** Disconnect switches shall be selected to be suitable for its purpose, elevator and VFD style shall include a shunt trip switch, distributive generation disconnect switches shall include a viewing window allowing to see the switch blade position.
- .4 **Fuses:** Unless otherwise scheduled or specified fuses are to be equal to Bussmann. Current limiting fuses, Low Peak Time Delay, Class "J" for constant running equipment and Fusetron (Dual-Element, Time-Delay) Class "RK5" for equipment that cycles on and off and equipment with high inrush such as transformers.
- .5 **Enclosures:** Unless otherwise specified, enclosures are to be in accordance with the following NEMA/EEMAC ratings:
 - .1 all enclosures located in sprinklered areas – Type 2
 - .2 all enclosures exposed to the elements – Type 4R, constructed of stainless steel
 - .3 all enclosures inside the building in wet areas – Type 4R, constructed of stainless steel
 - .4 all enclosures in explosion rated area – Type 7 with exact requirements to suit the area and application
 - .5 all enclosures except as noted above – Type 1
 - .6 all enclosures located in finished areas – as above but recess type with brushed stainless steel faceplate
- .6 **Acceptable Manufacturers:** Acceptable manufacturers are:
 - .1 Rockwell Automation (Allen-Bradley)
 - .2 Eaton Canada
 - .3 Siemens Canada
 - .4 Schneider Electric Canada

3 EXECUTION

3.01 INSTALLATION OF DISCONNECT SWITCHES

- .1 Provide all required disconnect switches in accordance with drawing plans, schedules, details, and requirements of the Specification.
- .2 Provide fuses for fusible disconnects.

3.02 OVERCURRENT COORDINATION

- .1 Interchange fuses at no cost to client in order to achieve selective coordination.
- .2 Fuse procurement shall be completed upon coordination study completion. Specified fuses are guidance for general selection, type of fuse, and its speed performance shall be confirmed with the coordination study.

END OF SECTION

1	GENERAL	2
1.01	SUBMITTALS	2
1.02	QUALITY ASSURANCE	3
2	PRODUCTS	3
2.01	GENERAL RE: LIGHTING FIXTURES AND LAMPS	3
2.02	DISCONNECTING MEANS – FLUORESCENT FIXTURES	10
3	EXECUTION	11
3.01	INSTALLATION OF LIGHTING FIXTURES	11
3.02	SUSPENDED LIGHTING FIXTURES	11
3.03	LIGHTING FIXTURES IN FIRE RATED CEILING CONSTRUCTION	12
3.04	LIGHTING FIXTURES ALIGNMENT	12
3.05	BALLASTS	12
3.06	LAMPS	12
3.07	INSTALLATION OF LENSES/LOUVRES	13
3.08	LIGHTING FIXTURES CIRCUIT WIRING	13
3.09	EXISTING LIGHTING FIXTURES	13
3.10	CLEANING	13
3.11	OWNER SUPPLIED LIGHTING	14

1 GENERAL

1.01 SUBMITTALS

- .1 **Shop Drawings/Product Data:** Submit product data for ballasts, drivers, lamps, lenses, and louvres with the data sheets for the lighting fixtures they are associated with. Include:
 - .1 Lamp type wattage, base type, rated life, and lumen rating in accordance with CSA IESNA testing procedures.
 - .2 Ballast data such as input voltage, temperature range, maximum THD, power factor, noise rating, and confirmation of compatibility with the lamps they operate.
 - .3 Drivers data as input voltage, temperature range, maximum THD, power factor, noise rating, and confirmation of compatibility with the lamps they operate, control protocol options, dimming options.
- .2 **Lighting Fixture Colour(s):** For all lighting fixtures where the colour is to be selected after award of the Contract, submit colour charts, and obtain fixture colour information in writing prior to ordering.
- .3 **Extended Ballast Warranty:** Solid-state ballasts are to be covered by a four year extended parts and labour warranty. Submit a signed copy of the extended warranty.
- .4 **Extended LED Driver Warranty:** Solid-state drivers are to be covered by a five year extended parts and labour warranty. Submit a signed copy of the extended warranty.
- .5 **Extended LED Chipset Warranty:** LED chipset are to be covered by a five year extended parts and labour warranty. Submit a signed copy of the extended warranty.
- .6 **Extended Fluorescent Lamp Warranty:** Fluorescent lamps are to be covered by a lamp replacement warranty (no labour) as specified in Part 2 of this Section. Submit a signed copy of the extended warranty.
- .7 **Spare Lamps:** Submit spare lamps as specified in Part 3 of this Section.

1.02 QUALITY ASSURANCE

- .1 All lighting fixtures are to be ULC listed and/or CSA certified and labelled.

2 PRODUCTS

2.01 GENERAL RE: LIGHTING FIXTURES AND LAMPS

- .1 Lighting fixtures and lamps are scheduled on the drawings.
- .2 **Lighting Fixture Construction:** Unless otherwise specified the following requirements apply to lighting fixture construction:
 - .1 bodies are to be constructed of minimum #20 gauge cold rolled prime coat steel, of rigid construction and complete with knockouts as required
 - .2 fixtures are to be suitable in all respects for the mounting locations indicated on the drawings, and are to be complete with all required mounting hardware
 - .3 any fixture located in a high humidity area, i.e., swimming pool areas, must be gasketed and corrosion-resistant, regardless of what is selected on the fixture schedule
 - .4 unless otherwise specified, any fixture operated by means of a ballast must be equipped with its own ballast
- .3 **Lighting Fixture Finish:** Unless otherwise specified, lighting fixtures are to be finished in two coats of spray applied baked white enamel applied to chemically degreased and neutralized surfaces. Reflecting surfaces are to be white with a reflectance of minimum 85%. Confirm exact colour and finish of fixtures at the submittals stage and prior to ordering.
- .4 **Light Emitting Diodes (LEDs) Drivers and chipset**
 - .1 **Quality Assurance:** Fixture ballasts, as applicable, are to be in accordance with requirements of (latest editions):
 - .1 IEEE Recommended Practices for Modulating Current in High-Brightness LEDs for Mitigating Health Risks to Viewers, IEEE 1789
 - .2 UL8750, Standard for Light Emitting Diode (LED) Equipment for Use in Lighting Products.
 - .3 CSA C22.2 NO. 250.13

- .4 ANSI C82.77-10 American National Standard for Lighting Equipment-- Harmonic Emission Limits & Related Power Quality Requirements
- .5 IES LM-84 Measuring Luminous Flux and Colour Maintenance of LED Lamps, Light Engines, and Luminaires
- .6 IES LM-86 Measuring Luminous Flux and Colour Maintenance of Remote Phosphor Components
- .7 TM-16 Solid State Lighting Sources and Systems
- .8 TM-30 IES Method for Evaluating Light Source Colour Rendition
- .9 LM-80 Measuring Luminous Flux and Colour Maintenance of LED Package, Arrays and Modules
- .10 LM-79 Electrical and Photometric Measurements of Solid State Lighting Products
- .2 **Quality Assurance:** It is manufacturer and supplier responsibility to advise compliance ahead of procurement of the specified fixtures with the above minimum standards.
- .3 **LED Chipset and Driver:** provide manufacturer cross-reference testing to confirm components certified and tested performance in accordance to specified references and no less than confirmation for flickering and colour stability when dimming.
- .4 **LED Driver,** shall include minimum following options:
 - .1 Dimmable to from 100% to 10% while maintain IEEE 1789 published performance. Applicable methods of dimming:
 - .1 0-10 Volt
 - .2 Phase cut
 - .3 DALI
 - .4 DMX 512
 - .2 Maintain THD-V < 5%
 - .3 Maintain THD-I < 20%

- .4 Power factor >0.9 at 100~277Vac 50/60Hz input, with 50%~100% load conditions
- .5 **LEDs:** Current technology LEDs with a minimum colour temperature of from 2700K, to 6500K, a minimum CRI > 80 with R9 > 50, a rated life of from 50,000 to 70,000 hours based on 70% lumen depreciation level, and heat sinks to remove heat from the bottom of the semiconductors.
 - .1 Colour Consistency: < 2 Step MacAdam Ellipse
 - .2 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.
 - .3 Acceptable manufacturers are:
 - .1 Philips Colour Kinetics
 - .2 OSRAM Opto Semiconductors
 - .3 Cree Inc.
 - .4 Nitchia Corp.
 - .5 Philips Lumileds Lighting Co.
 - .6 Xicato
 - .7 Citizen
- .6 Heat sink shall be mechanical type, no active electrical fan components. Include for thermal protection of the driver/chipset.

- .7 Glare Control, unless otherwise selected, shall be Semicutoff—The luminous intensity at or above an angle of 90° above nadir does not numerically exceed 5% of the luminous flux of the lamp or lamps in the luminaire, and the luminous intensity at or above a vertical angle of 80° above nadir does not numerically exceed 20% of the luminous flux of the lamp or lamps in the luminaire.

.5 Ballasts

- .1 **Quality Assurance:** Fixture ballasts, as applicable, are to be in accordance with requirements of:
 - .1 ANSI/NEMA C82 Series, American National Standard, for Lamp Ballasts
 - .2 UL 935, Standard for Fluorescent Lamp Ballasts
 - .3 CAN/CSA-C654, Fluorescent Lamp Ballast Efficiency Measurements
 - .4 CAN/CSA-C22.2 No. 74, Equipment for Use with Electric Discharge Lamps
 - .5 ANSI/ASHRAE/IESNA 90.1, Final Determination Quantitative Analysis Energy Standard for Buildings Except Low-Rise Residential Buildings
- .2 **Acceptable Ballast Manufacturers:** Unless otherwise scheduled or specified, acceptable ballast manufacturers are:
 - .1 Philips Advance
 - .2 OSRAM Sylvania Ltd.
 - .3 G.E. Lighting
 - .4 Universal Lighting Technologies
 - .5 Keystone Technologies LLC
 - .6 Sola Canada Lighting & Power Inc.
 - .7 Lutron Electric Co.

- .3 **Fluorescent Fixture Standard Ballasts:** Instant start electronic ballasts designed for the voltage indicated and for use with the lamps they operate. Ballasts to be controlled by sensors are to be programmed start type. Non-sensor controlled ballasts are to be instant start type. Each ballast is to be totally encased and designed for 40° C (104° F) ambient temperature, contain no PCB, is to be capable of starting lamps at temperature as low as -18° C (0° F), and is to be complete with:
 - .1 a Class A sound rating
 - .2 total harmonic distortion not greater than 10%
 - .3 a minimum power factor of 0.98 and a minimum ballast factor of 1.0 for primary lamp applications
 - .4 a maximum lamp current crest factor of 1.7
 - .5 anti-striation provisions
 - .6 frequency of operation between 20 kHz minimum to 60 kHz maximum, but not between 30 kHz, and lamps are not to flicker
 - .7 EMI/RFI filtering
 - .8 a permanent nameplate indicating the ballast manufacturer, model number, type, voltage and frequency, sound rating, CSA certification, the number, and types of lamps the ballasts will operate, power factor value, and a schematic wiring diagram
 - .9 automatic re-start circuitry to re-start lamps without re-setting power
 - .10 a 5 year (four year extended) replacement warranty
- .4 **Fluorescent Fixture Dimming Ballasts:** Generally as specified above for standard ballasts but compatible with the dimming equipment and lamps to be dimmed, and capable of dimming lamps from 100% to 5% of output.
- .6 **Lamps**
 - .1 **Acceptable Lamp Manufacturers:** Unless otherwise specified, acceptable lamp manufacturers are:
 - .1 Philips Lighting
 - .2 OSRAM Sylvania Ltd.

- .3 G.E. Lighting
- .4 Venture Lighting International Inc.
- .2 **T8 Fluorescent Lamps:** Equal to Philips Lighting “ALTO II” T8, rapid start, high efficiency, low mercury content (maximum 1.7 mg) lamps with “Cathode Guard” for 95%, lumen maintenance throughout the life of the lamp and reduced lamp end blackening, and the following:
 - .1 a minimum colour temperature of 3500k which is to be confirmed prior to ordering
 - .2 a minimum colour rendering index (CRI) of 85
 - .3 a rated average life of 36,000 hours (with programmed start ballasts and 12 hour cycling per start), and minimum initial lumen of 2950 for a 1.37 m (4') lamp
 - .4 for non-climate controlled areas, high output and suitable for reliable starting and operation at -29° C (-20° F) when equipped with a low temperature ballast
 - .5 a 30 month replacement warranty
- .3 **T5 and T5-HO Fluorescent Lamps:** Equal to Philips Lighting “ALTO Silhouette” T5, rapid start, high efficiency, low mercury content (maximum 1.7 mg) lamps with “Cathode Guard” for 95% lumen maintenance throughout the life of the lamp and reduced lamp end blackening, and the following:
 - .1 a minimum colour temperature of 3500K which is to be confirmed prior to ordering
 - .2 a minimum colour rendering index (CRI) of 85
 - .3 a rated average life of 20,000 hours (with programmed start ballasts and 12 hour cycling per start)
 - .4 for non-climate controlled areas, T5-HO high output and suitable for reliable starting and operation at -29° C (-20° F) when equipped with a low temperature ballast, and an average life of 25,000 hours
 - .5 a 24 month replacement warranty

- .4 **Light Emitting Diodes (LEDs):** Current technology LEDs with a minimum colour temperature of from 2700K, to 6500K, a minimum CRI > 80 with R9 > 50, a rated life of from 50,000 to 70,000 hours based on 70% lumen depreciation level, and heat sinks to remove heat from the bottom of the semiconductors.
- .5 **Quality Assurance:** Fixture ballasts, as applicable, are to be in accordance with requirements of:
 - .1 IEEE Recommended Practices for Modulating Current in High-Brightness LEDs for Mitigating Health Risks to Viewers, IEEE 1789
 - .2 UL8750, Standard for Light Emitting Diode (LED) Equipment for Use in Lighting Products.
 - .3 CSA C22.2 NO. 250.13-17
 - .4 ANSI C82.77-10-2014 American National Standard for Lighting Equipment--Harmonic Emission Limits & Related Power Quality Requirements
 - .5 IES LM-84-14, Measuring Luminous Flux and Colour Maintenance of LED Lamps, Light Engines, and Luminaires
 - .6 IES LM-86-14, Measuring Luminous Flux and Colour Maintenance of Remote Phosphor Components
 - .7 Colour Consistency: < 2 Step MacAdam Ellipse
 - .8 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.
 - .3 Acceptable manufacturers are:
 - .1 Philips Colour Kinetics

- .2 OSRAM Opto Semiconductors
- .3 Cree Inc.
- .4 Nitchia Corp.
- .5 Philips Lumileds Lighting Co.
- .6 Xicato
- .7 Citizen
- .9 **Incandescent Lamps:** Unless otherwise specified or scheduled, incandescent lamps are to incorporate the following features:
 - .1 rated for a 125 volt power supply and for use with a 120 volt nominal power supply
 - .2 clear or frosted as scheduled
 - .10 suitable for operation in any position
 - .11 a minimum life of 2000 burning hours for reflector lamps and 1000 burning hours for conventional filament lamps
 - .12 a colour temperature of 2700K
- .6 **Compact Fluorescent Lamps:** Twin or quad tube configuration compact fluorescent lamps, each with a rated burning life of minimum 12,000 hours, a colour temperature of 4100K, a minimum colour-rendering index of 80, and an electric energy saving rapid start ballast in the base.
- .7 **Lenses/Louvres:** Unless otherwise specified, lenses/louvres are scheduled with the fixtures they are associated with. Lenses/louvres are specified in the Section entitled Ballasts, Lamps, Lenses and Louvres.

2.02 DISCONNECTING MEANS – FLUORESCENT FIXTURES

- .1 Each fluorescent lighting fixture connected to a branch circuit with a voltage exceeding 150 volts-to-ground is to be equipped with a disconnecting means integral with the fixture that simultaneously opens all circuit conductors between the branch circuit conductors and the conductors connecting the ballast(s). The disconnect device is to be identified in a conspicuous, legible, and permanent manner.

3 EXECUTION

3.01 INSTALLATION OF LIGHTING FIXTURES

- .1 General Installation Requirements:** Provide lighting fixtures and lamps where shown. Include for all required site assembly and provide all required installation and support hardware. Additional requirements are as follows:
 - .1 confirm exact lighting fixture locations prior to roughing-in
 - .2 in finished areas, refer to architectural reflected ceiling plans and/or wall elevations
 - .3 in equipment rooms, shafts, and similar unfinished areas, install fixtures after the equipment is roughed-in, and shelving and similar items are installed, and do not suspend fixtures from piping, ductwork, conduit equipment, or similar items
 - .4 prior to roughing-in for lighting fixture installations, examine drawings and site conditions to determine that suitable space is available for the fixture installation as shown. If sufficient space is not available, notify the Consultant immediately and, if required, relocate the fixtures within reasonable distances without additional cost
 - .5 locate recessed downlights, troffers, and surface mounted fixtures in or on suspended tile ceilings in or on full tiles, and where ceiling tile openings are cut for fixtures, cut to exact sizes so that there are no gaps, and fixture trim completely covers the perimeter of the opening
 - .6 provide plaster frames for fixtures in suspended plaster or drywall ceilings
 - .7 use clean gloves when handling reflector cones, louvres, halogen lamps, glass sconces, and all exposed surfaces of fixtures

3.02 SUSPENDED LIGHTING FIXTURES

- .1 Support all lighting fixtures in suspended ceilings from the slab or building construction above, independent of the suspended ceiling construction. Support 1.2 m (4') fluorescent fixtures with a minimum of 2 aircraft type cable supports or 2 #3 Tensos Chains. Support HID or incandescent fixtures with 1 #3 Tensos Chain or 1 aircraft type cable. All supports are to be in accordance with requirements of governing Codes and Regulations.
- .2 Support continuous rows of fixtures at minimum 1.2 m (48") centres.

3.03 LIGHTING FIXTURES IN FIRE RATED CEILING CONSTRUCTION

- .1 Where lighting fixtures penetrate a fire rated ceiling, they are to be enclosed in an enclosure with a rating to match that of the ceiling. The enclosure is to be constructed by the trade constructing the ceiling. Ensure that conductors connecting the fixtures are fire rated type and that ceiling penetrations for conductors are properly sealed with fire stopping and smoke seal material. Fixtures installed in the fire rated enclosures are to be equipped with thermal overload protection.

3.04 LIGHTING FIXTURES ALIGNMENT

- .1 Align lighting fixtures mounted in continuous rows to form straight uninterrupted lines. Alignment variation is not to exceed 6 mm ($\frac{1}{4}$ ") in any 5 m (15') run.
- .2 Align lighting fixtures mounted individually parallel and/or perpendicular to building lines.
- .3 Aim accent and spot lighting as indicated and/or as directed by the Consultant and secure the fixture positions after the Consultant's approval.

3.05 BALLASTS

- .1 Unless otherwise shown, specified, or scheduled, ballasts are to be integral with the lighting fixture they are associated with.
- .2 Install remote ballasts on proper racks as close to the fixture(s) as possible and, unless otherwise specified, connect with type TEW cable in conduit. Remote ballasts are to be black and properly identified.

3.06 LAMPS

- .1 Provide new lamps for each lighting fixture.
- .2 Include a full listing of lamps in O & M Manuals.
- .3 At Substantial Performance, replace all lamps used for construction lighting.
- .4 Supply 15% of spare lamps for each fixture type (rounded out to a full carton if more than $\frac{2}{3}$ of a carton), and hand to the Owner at Substantial Performance as specified in Part 1 of the Section. Identify all lamp packaging with the associated fixture type.

- .5 Operate all high pressure sodium and metal halide lamps for a “settling down” period of a continuous 100 hour burn or by 10 hour continuous burns, unless otherwise recommended by the lamp manufacturer, in which case follow the lamp manufacturer’s recommendations. After the “settling down” period, take luminance measurements to confirm design specifications.

3.07 INSTALLATION OF LENSES/LOUVRES

- .1 Unless otherwise specified or scheduled, lenses/louvres are to be integral with the fixture they are associated with.

3.08 LIGHTING FIXTURES CIRCUIT WIRING

- .1 Connect lighting fixtures to circuits indicated with wiring as shown/specified.
- .2 Minimize the number of splices required.

3.09 EXISTING LIGHTING FIXTURES

- .1 Where existing lighting fixtures are to be reused, examine the fixtures during the bidding period and include for replacing faulty ballasts, broken lenses, and any other obvious damage, include for replacing all lamps at Substantial Performance, and conform to the following requirements:
 - .1 disconnect existing fixtures to be reused, safely store where directed, relocate, and reinstall
 - .2 unless otherwise directed, disconnect, and remove obsolete fixtures, identify, and make wiring safe, and dispose of the fixtures off-site in an approved manner
 - .3 if existing fixtures to be removed are equipped with ballasts that contain PCB’s, engage the services of a disposal company licensed by the MOE to remove and destroy PCB ballasts, to remove the ballasts and destroy them off-site at an approved facility, and the disposal company is to be fully insured, registered, and in good standing with the WSIB, and is to issue a Certificate of Destruction upon completion of the work

3.10 CLEANING

- .1 When all lighting fixture installation work is complete, clean all fixtures and lamps, and any ceiling, wall, etc., surfaces soiled as a result of the fixture installation work.

- .2 If wall and ceiling surfaces are damaged as a result of the fixture installation, replace the wall or ceiling surface to the Consultant's approval.

3.11 OWNER SUPPLIED LIGHTING

- .1 The Owner supplied luminaires will be supplied and delivered to site by others. Electrical Contractors shall include as part of their base bid the following:
- .2 Attendance on the supply of the fixtures in lieu of mark-up.
- .3 Liaise with manufacturer.
- .4 Check shop drawings.
- .5 Coordinate delivery schedule and expedite as required.
- .6 Receive on site.
- .7 Off-load and check for damage.
- .8 Store and later place in position.
- .9 Unwrap and dispose of packing material off site.
- .10 Assemble fixtures.
- .11 Erect, install, connect, and lamp.
- .12 Provide all warranty services as if the Electrical Contractor had supplied these luminaries.

END OF SECTION

1	GENERAL	2
1.01	NETWORK AND TELEPHONE CABLING	2
1.02	FACEPLATES.....	2
1.03	BACKBONE CABLE	3
1.04	COMMUNICATIONS ROOMS AND PATCH PANELS	3
1.05	LABELLING	4
1.06	PHONE SYSTEMS	5
1.07	WI-FI & WIRELESS ACCESS POINTS (APS)	5
1.08	PUBLIC ADDRESS (PA) SYSTEM.....	6
1.09	BUILDING AUTOMATION SYSTEMS.....	8
1.10	THIRD-PARTY FACILITY PARTNERS	8
1.11	TESTING AND DOCUMENTATION.....	9
1.12	MOBILE TECHNOLOGY CHARGING TOWERS.....	9
1.13	AUDIO-VISUAL EQUIPMENT	10
1.14	APPENDIX A – PANDUIT PARTS LIST.....	12

1 GENERAL

1.01 NETWORK AND TELEPHONE CABLING

- .1 Data cables to be Cat6 with dark blue outer sheath.
- .2 Phone cables to be Cat6 with dark blue outer sheath.
- .3 PA speaker cables to be Cat6 with white outer sheath.
- .4 All cable to be FT6 rated when used in plenum spaces.
- .5 All data drops to be home-run to nearest appropriate Communications Room.
- .6 Ensure all cable lengths are enough to allow for slack, vertical runs, wastage, and future moves.
- .7 The maximum cable run length is not to exceed 91.4m (300'). If this cannot be met, contractor must consult with Owner to determine a suitable alternative.
- .8 In renovations/refreshes, Ethernet TIA cabling standard to be maintained consistently throughout school (i.e., for example, if TIA standard "A" is prevalent in the school, continue with "A" standard for all new cabling in the school).
- .9 All cabling to be run within existing conduit/raceways/cable trays/cable hooks/paths wherever possible.
- .10 All data drops and corresponding cables removed in construction, which are not re-used immediately as part of the project, are to be fully removed and un-terminated from the patch panel to which it connects. This includes full removal of the redundant cable from applicable ceilings/walls/conduits/raceways/cable trays/cable hooks, and the removal of labels at the patch panel.
- .11 All copper cabling to follow standards as dictated by TIA 568.0-D, 568.01-D, 568.02-D in each respective scenario.
- .12 All cabling to be grounded and bonded as needed by TIA 607-D standards.
- .13 All cabling to be concealed and protected in appropriate cable trays or conduit or raceway, unless otherwise safely and aesthetically hidden in ceiling or wall space.
- .14 Modular jacks to be Category 6 compliant.

1.02 FACEPLATES

- .1 Faceplates shall be UL Listed and CSA Certified.

- .2 Faceplate material and colour to match electrical faceplates.
- .3 Faceplate sizing to match electrical faceplates.
- .4 Faceplates shall be available to mount up to six in a single gang, and up to twelve in a double gang configuration.

1.03 BACKBONE CABLE

- .1 Provide fibre optic backbone cables from the main Communications Room to all new or relocated secondary Communications Rooms, each as a dedicated home run.
- .2 Provide 25 pair cat6 backbone cable from the main Communications Room to all new or relocated secondary Communications Rooms, each as a dedicated home run. If cat6 in 25 pair is not available, cat5e for the 25 pair is acceptable.

1.04 COMMUNICATIONS ROOMS AND PATCH PANELS

- .1 No Communications Rooms or IT equipment with, are to be moved, added, or removed without explicit approval from Owner.
- .2 Communications Rooms moved or added must include fibre optic backbone cable to primary Communications Room.
- .3 Primary systems for PA and telephone and data should all be in the same room with fibre connectivity between all Communications Rooms.
- .4 Primary Communication Rooms to have floor mounted racks, ideally installed 36" from back wall, and minimum of 24" from the back wall.
- .5 Secondary Communications Rooms may have floor or wall mounted racks dependent on the number of connections and equipment required.
- .6 In each Communications Room, a dedicated Category 6 patch panel connected to a 25 pair Cat6 cable is required and to be connected at data rack and terminated on BIX1A punch down blocks mounted in the same BIX10A as the phone system. This 25 pair cable must be run behind the BIX10A mount.
- .7 Racks to be standard 19" module compatible.
- .8 Racks to be '4 post' model.
- .9 Patch panels to be mounted in 19" rack(s) and/or cabinets.

- .10 Maximum dimensions: 22" W x 24" D, height dependent on the number of connections required
- .11 Racks must have 10/32" size screw holes.
- .12 Racks and patch panels must be black in colour.
- .13 All floor mounted racks are to be complete with the following features: Vertical cable management on each side, four horizontal cable management trays required per rack spaced with 2U gap between each tray, minimum top 2U must be leave open for patch panels, and one vertical power bar with surge protection.
- .14 All Patch panels should meet or exceed industry standards, fit into a 19" rack and be 1RU in height.
- .15 Panel shall have an adapter tray that accepts 6 six-pack adapter plates with LC multimode adapters. The panel adapter tray shall be removable from the front of the panel by sliding the tray forward. Panel shall have built in patch cable management incorporated into the front of the adapter tray and hold 12-24 fibre connections.
- .16 Required patch panel manufacturer: Panduit. Note that raceway, conduit, and jacks may be of other brands; so long as they can meet the required quality of TIA standards.

1.05 LABELLING

- .1 Supply and install labels at each terminated location. Labels shall be affixed to the faceplate on the space provided by the manufacturer.
- .2 Labels shall be mechanically or digitally printed. Handwritten labels are not acceptable.
- .3 Labelling at the wall plate on the client end and the network rack patch panel to be in the format "PATCH PANEL LETTER {dash} ROOM# {dash} DROP#". For example, a cable connected in Room 101, Patch Panel A, to patch panel drop 12 shall be labelled as "A-101-12" at both terminated ends.
- .4 Port numbers within a room should be sequential and maintain sequential numbering across adjacent rooms.
- .5 PA cables to be labelled as room number on both ends of cable.

1.06 PHONE SYSTEMS

- .1 Voice cables to be run and patched to main phone system. Confirm this location with Owner, as it is not always in the main Communications Room.
- .2 New voice jacks to be dedicated patched to Cat 6 patch panel for voice.
- .3 For non-VoIP phone systems, a 25 pair cable must be terminated at the (Voice) Patch Panel into a 24 port loaded patch panel, with the other end terminated at the BIX1A punch down blocks mounted in BIX10A at phone system.
- .4 All new phone system installs shall be IP based utilizing 'Avaya IP Office 500v2'. Contractor to engage with Owner to collaboratively configure system and phones. Install specs from manufacturer:
<https://downloads.avaya.com/css/P8/documents/101028367>

1.07 WI-FI & WIRELESS ACCESS POINTS (APS)

- .1 Wherever possible mount APs in middle of room on dropped ceiling.
- .2 When installing APs in a dropped ceiling, cut discrete hole for the data cable to come through, allowing the ceiling tile to lay flat.
- .3 Contractor to install/reinstall all APs. Physical mounting instructions can be found here:
https://documentation.meraki.com/MR/Installation_Guides/MR42_Installation_Guide. Refer to the 'Installation Instructions' heading.
- .4 Data drops for APs to be terminated as a fully contained data jack. An example is the Panduit CBX1WH-A surface mount box
(link:<https://www.panduit.com/en/products/copper-systems/faceplates-boxes/surface-mount-boxes/cbx1wh-a.html>) with the Panduit CJ688TGBU UTP Jack Module (link: <https://www.panduit.com/en/products/copper-systems/connectors/jack-modules/cj688tgbu.html>).
- .5 APs that are temporarily removed during construction must be re-installed back to their original location, unless otherwise specified by Owner or the plans.
- .6 APs that are 'existing to be removed' must be safely removed by the contractor and returned to Owner.
- .7 When APs are being removed (to be reinstalled), APs must be stored by contractor, be temporarily labelled (i.e. with masking tape) with room number, and in cases with multiple APs per room to also include coordination N, E, S, W marking.

- .8 For APs that are damaged or not returned, a charge back cost of \$1,000 will be applied.
- .9 For new APs not already existing, contractor must be provided a minimum of 5 business days' notice to Owner, allowing Owner to prepare and supply APs to the contractor.

1.08 PUBLIC ADDRESS (PA) SYSTEM

- .1 All new or moved PA cables must be run back to the main PA system. Confirm this location with Owner, as it is not always in the main Communications Room.
- .2 All new or moved PA cables must be terminated on a 36D BIX or BIX1A or similar modular Jack which must be installed 4'-6" A.F.F. where space permits.
- .3 All new PA Systems to be Carehawk model 'CH1000-2I-2A-2PG' with 'Email Alert Module' and 'SS16' or 'SS32' termination points.
- .4 Each 'SS16' or 'SS32' is to have a dedicated homerun, via cat6 cable, to the main PA system.
- .5 Each room to be configured as its own dedicated channel.
- .6 Each hallway to be configured as a single channel but can be adapted as needed for specific circumstances. All hallways programmed to the hallway zone (Zone 2).
- .7 Require Cat6 cable run from main PA system to PA console (microphone or phone). The console is usually located in the main office.
- .8 Require a shielded 4 wire 18 gauge cable from main PA system to the tuner box. Note the tuner box is usually located in the main office near the secretary.
- .9 Configuration of PA system to include bells on school's schedule, pre-recorded messages including but not limited to lockdown messaging. If configuration is not able to be completed, contractor must work with Owner to arrange alternative.
- .10 Outdoor horns to be Bogen Paging horns 25V 15 watt.
- .11 In suspended ceilings, speakers must be McBride white square grill. Speakers to be installed on the ceiling T-bars with 25 Volt transformers. Speaker part number without grill: 8LS822-19
(link:<https://mcbrideloudspeaker.com/images/specs/8LS82219.pdf>)
- .12 As required, install the McBride MCT25 Transformer
(<https://qcomponents.ca/McBride-MCT25.html>)

- .13 In suspended ceilings, speaker rails must be supported by ceiling rails.
- .14 Ceiling mounted speakers are not to have call buttons.
- .15 Speakers in the following spaces to be programmed for emergency paging only: calming / quiet rooms and spaces used primarily by third-party facility partners (i.e., daycares).
- .16 Gyms and hallways require multiple speakers each, spaced approximately 20' apart.
- .17 In gyms, shops, and boiler rooms speakers are to be tapped to 2-4 watts.
- .18 In offices speakers are to be tapped to 0.25 watt.
- .19 In all other applications speakers to be tapped to 1 watt.
- .20 There must be a white toggle call button installed in every classroom, meeting room, resource room, staff room, and office.
- .21 In gyms, install a white toggle call button in a recessed box with cover.
- .22 In shops install a white toggle call button as well as a PA handset.
- .23 Do not connect to privacy switch in any room.
- .24 PA systems to be installed in a clean, well-organized, and thoroughly labelled manner. A proper backboard and cable management is required. Example pictured below.
- .25 All wires not used on a speaker are to be taped individually or cut and taped so that the wires do not touch metal or each other.
- .26 The white/blue pair is to be terminated to the speaker and not continue down to the call button.



Image of ideal CH1000 installation

1.09 BUILDING AUTOMATION SYSTEMS

- .1 All data connections for Building Automation Systems (BAS) to be installed under the same standards as all other data cabling, including cat6 cabling and a home run to the nearest Communications Room.

1.10 THIRD-PARTY FACILITY PARTNERS

- .1 All other standards within this document are to be adhered to in these spaces. Specific additional requirements for these spaces are listed here.
 - .1 The priority for location of third-party IT equipment is to utilize a space within the rented area. If no reasonable space exists for the operator/renter's IT equipment they may, where space allows, place their equipment in Owner's Communication Room. In these cases, the Facility Partner's cabling is to be connected to their own independent data rack, keeping it separate from Owner's equipment, creating both a logical and physically separate entity for the networks.

- .2 Facility Partner is responsible for supplying and paying for their own internet and telecommunications access and infrastructure.
- .3 Facility Partner may choose to have their service providers install their modem/demarcation equipment into KPR's Communication Room but must connect to the Facility Partner's own data rack.
- .4 Facility Partner is responsible for the setup and maintenance of their own network, telecommunications, and other technology infrastructure.
- .5 Any cabling required for network connectivity, telephone systems, point of sale systems, et al must be specified by Facility Partner.
- .6 Facility Partner's wireless communications equipment is not to cause interference with Owner's wireless communications. While the Owner may at times collaborate to assist, Facility Partner is responsible for any configuration and costs associated to ensuring this need is met.
- .7 PA speakers in these spaces to be programmed for emergency paging only.
- .8 If Facility Partner does not provide specifications for data and telecom infrastructure, the following defaults will be applied: 1x network drop installed in each room, 1x phone drop installed in each room, 1x network drop installed above ceiling in each room.

1.11 TESTING AND DOCUMENTATION

- .1 All cables and termination hardware shall be 100% tested for defects in installation and to verify cabling system performance.
- .2 All Fibre and Cat 6 cabling should be 100% tested to current standards.
- .3 All call buttons and speakers to be tested individually.
- .4 As-Builts to include any newly installed or moved telephone systems, PA systems, network closets, and back bone cable runs.

1.12 MOBILE TECHNOLOGY CHARGING TOWERS

- .1 Purchase of Powergistics mobile charging tower is to be coordinated by Owner
- .2 Charging tower dimensions: 51.5" H X 10.75" W X 19.5" D (1308mm H X 273mm W X 495mm D)
- .3 Space of 355mm W must be available on wall for installation and door opening

- .4 Require a duplex receptacle on a separate circuit within 250mm of the charging tower

1.13 AUDIO-VISUAL EQUIPMENT

.1 Screens and Da-Lite Boards

- .1 Height of Da-Lite IDEA whiteboard installation to be confirmed by Owner under the guidelines shown in Figure 1 below.
- .2 No services including surface mounted conduit are to be run behind space where Da-Lite IDEA whiteboard is to be installed on teaching wall.
- .3 Da-Lite IDEA whiteboard to be installed on teaching wall between whiteboards/tack boards with a minimum 115mm gap between boards.

.2 Projectors and Speakers

- .1 Projector and speakers to be installed above Da-Lite IDEA screen +/- 203-254mm by Owner.
- .2 Allow 762mm X 406mm at centre line for projector mounting bracket.
- .3 Do not install any services including surface mounted conduit at this location.
- .4 Blocking required behind new drywall at location of projector install.
- .5 Blocking required over existing drywall at location of projector install.
- .6 Duplex receptacle and data for projector to be installed at high level to a maximum of 3048mm AFF and 500mm from centre of Da-Lite IDEA screen.
- .7 Speakers to be wall mounted above the Da-Lite IDEA screen by Owner.
- .8 Where existing conduit does not exist, cabling for projector and speakers to be surface mounted and run through channel between Da-Lite IDEA screen and adjoining whiteboard/tack board ending in surface mounted control box.
- .9 Per below drawing (Figure 1) IDEA screen to be installed at specific height AFF based on room use.
 - .1 Science and Shops @ 965mm

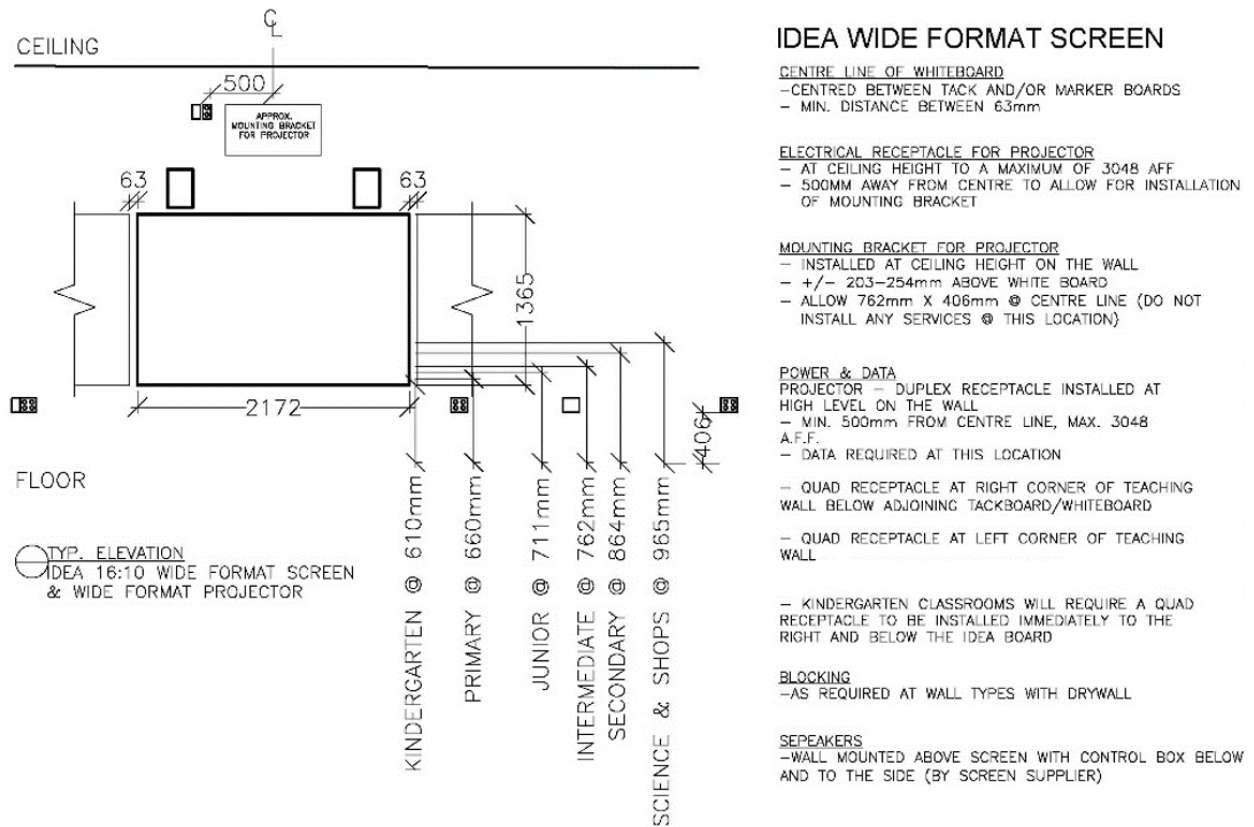


Figure 1: Idea Screen Installation

.3 Wellness Room and Shops

- .1 Da-Lite Screen to be installed at 965 mm to provide students with clear view of board above science/shop bench.
- .2 Projector to have conduit at 2" (51mm) from projector location to science/shop bench at side of shelving. The run for this conduit is not to exceed 30' (9144mm). Runs beyond the limit of 30' must be communicated to Owner to determine suitable alternative.

1.14 APPENDIX A – PANDUIT PARTS LIST

Although Panduit brand parts are only required for patch panels, this list of commonly used parts is available for convenience and reference of architects and contractors. If other manufacturers are chosen for these products, the contractor must ensure they are of the same quality.

Product Category	Part Number	Manufacturer	Part Description
Copper Cabling Products			
	PUP6C04BU-F	Panduit	Category 6 copper cable, 4-pair, 23AWG, U/UTP, CMP, Blue 1000 feet in a carton.
	CJ688TGBU	Panduit	The Category 6, RJ45, 8-position, 8-wire, UTP Mini-Com® universal jack module has TG-style termination and is blue.
	CPPL48FMWBLY	Panduit	Mini Com 48-port modular patch panel with faceplates in black, with label and label covers, (2RU).
	CPPL24FMWBLY	Panduit	Mini Com 24-port modular flush mount patch panel in black, (1RU).
	CFG2WH	Panduit	Mini Com rectangular adapter, mounts behind standard GFCI faceplates, accepts two Mini-Com® Module, White.
	CFG4WH	Panduit	Mini Com rectangular adapter, mounts behind standard GFCI faceplates, accepts two Mini-Com® Module, White.
	CFG6WH	Panduit	Mini Com rectangular adapter, mounts behind standard GFCI faceplates, accepts two Mini-Com® Module, White.
	CFPF12WH-2G	Panduit	Mini Com Classic Series double gang kit, includes faceplate frame and six flat inserts (two port each), accepts twelve Mini-Com® modules. White
	CBXQ2WH-A	Panduit	Mini-Com® surface mount box accepts two Mini-Com® modules. Includes quick release cover. Supplied with cable ties, adhesive backing, label and label cover. White.
	UTPSP7BUY	Panduit	Category 6, UTP patch cord with TX6™ PLUS Modular Plugs on each end. Blue, 7 ft. (Rack end)
	UTPSP10BUY	Panduit	Category 6, UTP patch cord with TX6™ PLUS Modular Plugs on each end, 10 ft. (Workstation end)

Product Category	Part Number	Manufacturer	Part Description
CAT 6A WAP DROPS			
	PUP6AV04BU-G	Panduit	Copper Cable, Cat 6A, Vari-MaTriX, 4-Pair, 23 AWG, UTP, CMP, Blue, 1000ft/305m
	CJ6X88TGYL	Panduit	Category 6A, RJ45, 10 Gb/s, 8-position, 8-wire universal module, Yellow.
	CBX1WH-A	Panduit	Mini-Com® surface mount box accepts one Mini-Com® Module. Supplied with adhesive backing. White.
	UTP28X1YL	Panduit	Category 6A Performance, 28AWG, UTP Patch Cord, CM/LSZH, Yellow, 1ft.
	UTP6ASD7YL	Panduit	Category 6A (SD), 10 Gb/s UTP patch cord with TX6A™ 10Gig™ Modular Plugs on each end. Yellow, 7 ft. (Rack End)
Voice Tie Cable Termination			
	DP245E88TGY	Panduit	DataPatch 24-port category 5e punchdown flat patch panel in black, (1 RU).
Fiber Cabling Products			
	FODPX06Y	Panduit	50um OM3 6 Fiber Indoor Distribution Cable, Plenum (OFNP), 900um Buffered Fibers.
	FODPX12Y	Panduit	50um OM3 12 Fiber Indoor Distribution Cable, Plenum (OFNP), 900um Buffered Fibers.
	FRME1U	Panduit	The Panduit® Opticom® Rack Mount Fiber Enclosure ensures network reliability by housing, organizing, managing and protecting up to 72 fiber optic cable, terminations, splices, connectors and patch cords using up to 3 FAP or FMP adapter panels or FOSM splice modules.
	FAP6WAQDLCZ	Panduit	LC 10Gig™ OM3/OM4 FAP loaded with six LC 10Gig™ Duplex Multimode Fiber Optic Adapters (Aqua) with zirconia ceramic split sleeves.

Product Category	Part Number	Manufacturer	Part Description
	FLCSMCXAQY	Panduit	The LC OptiCam® OM3/OM4 50/125µm multimode simplex connector in aqua with zirconia ceramic ferrules is intended for 900µm tight-buffered fiber installations which are outside the scope of the RoHS directive.
	FX2ERLNLNSNM002	Panduit	2 fiber OM3 LC duplex to LC duplex patch cord OFNR (riser) rated, 16mm jacketed cable Std IL 2 meters.
Racks, Cabinets, and Cable Management			
	R2P	Panduit	The Panduit Two-post Rack System provides a reliable foundation for mounting telecommunication and data center equipment. The modular rack can be used to manage high performance copper and fiber patch cables using Panduit horizontal and vertical cable managers and accessories, such as power outlet unit brackets. Aluminum, 45 RU, #12-24 Threaded Mounting Holes, Black, 1pc + hardware kit and paint piercing bonding kit.
	R4P	Panduit	The premium Panduit Four-post Rack System combines the stability of a cabinet with the accessibility of an open rack to provide the user with maximum flexibility when designing a data-center network layout. Four steel vertical posts and adjustable front and rear mounting rails provide the required strength and flexibility needed to work with various types of active equipment. Steel, 45 RU, 30in deep, #12-24 Threaded Mounting Holes, Black, 1pc + hardware kit and paint piercing bonding kit.
	WMPVF45E	Panduit	The Panduit® NetRunner® Vertical Cable Manager cost-effectively organizes, manages and protects cables on the front of the rack. Plus, bend radius control helps guard against kinks and snags. Single-sided, ABS Plastic, 45RU, Black, 1pc + Cover.
	WMPVHCF45E	Panduit	The Panduit® NetRunner® Vertical Cable Manager cost-effectively organizes, manages and protects cables on the front of the rack. Plus, bend radius control helps guard against kinks and snags. Single-sided, ABS Plastic, 45RU, Black, 1pc + Cover.

Product Category	Part Number	Manufacturer	Part Description
	NMF2	Panduit	The Panduit® NetManager® High Capacity Horizontal Cable Manager cost-effectively organizes and protects copper and fiber network cabling in any standard EIA 19in (483mm) rack or cabinet. Large front finger openings easily accommodate Category 6 and 10G cables, reducing installation time and maintenance costs. Hinged front cover only, ABS Plastic, 2RU, Black, 1pc.
Bonding and Grounding			
	GB2B0306TPI-1	Panduit	1/4" x 2" x 12" Telecommunications Grounding Busbars.
	RGRB19CN	Panduit	Grounding busbar; 19" (483mm) length; tin-plated; twenty holes arranged for flexibility in mounting with twenty #12-24 x 1/2" hex head screws installed; mounting hole sets have 5/8" (15.9mm) spacing; provided with two cage nut bonding studs and four #12-24 bonding nuts.
	HTCT250-2-1	Panduit	Copper Compression HTAP with code 250 kcmil - #2 AWG Run, code #2 - #6 AWG STR/SOL Tap 1 and code #8 - #14 AWG Tap 2 or flex 4/0 - #2 AWG Run, flex #2 - #8 AWG Tap 1 and flex #8 - #14 AWG Tap 2.
	RGCBNJ660P22	Panduit	#6 AWG (16mm ²) jumper, 60 (1.52m) length, 45° bent lug on grounding strip side, provided with .16 oz. (5cc) of antioxidant, two each #12-24 x 1/2, M6 x 12mm, #10-32 x 1/2 and M5 x 12mm thread-forming screws and a copper compression HTAP.
	RGEJ657PFY	Panduit	#6 AWG (16mm ²) jumper, 90° bent lug on grounding strip side, provided with .16 oz. (5cc) of antioxidant and two each #12-24 x 1/2, M6 x 12mm, #10-32 x 1/2 and M5 x 12mm thread-forming screws.
	CNBK	Panduit	Green bonding cage nut, includes 50 #12-24 bonding cage nuts (.06 – .11 thick panel) and 50 #12-24 x 1/2" bonding screws with #2 Phillips/slotted combo hex head (use 5/16" or 8mm socket).

Product Category	Part Number	Manufacturer	Part Description
	RGESD2B-1	Panduit	This two-hole ESD Port Kit with 5/8 spacing is a telecommunications grounding accessory that helps protect against electrostatic discharge to network equipment. It includes a .17 oz (5 cc) tube of antioxidant paste, 1 ESD protection sticker, two 12-24 HDW bonding studs, one M6 x 12mm thread-forming screw, two bonding cage nut HDWs, and one cleaning pad. Designed for flexibility and ease of installation, this kit reduces the risk of damage when a technician performs routine cable maintenance or accidentally touches an I/O port.
	RGESDWS	Panduit	This adjustable, fabric ESD wrist strap with 4mm snap is designed to ground a technician working on highly sensitive electronic equipment. This antistatic device reduces the buildup or discharge of static electricity. It connects to the ground via a 6' (1.8 m) coiled cable, banana plug, and 1 megohm resistor and helps protect the wearer from shock hazards.
Cable Pathways			
J Hooks – Ceiling Mount			
	JP131CMB-L20	Panduit	J-PRO Cable support system, with ceiling mount bracket that has one 3/16 (M5), 1/4 (M6), and 3/8 (M10) mounting hole, 1.31 (33.3mm) max. bundle capacity, nylon 6.6 with metal attachments, black, 50 pc. package quantity.
	JP2CMB-L20	Panduit	J-PRO Cable support system, with ceiling mount bracket that has one 3/16 (M5), 1/4 (M6), and 3/8 (M10) mounting hole, 2.00 (50.8mm) max. bundle capacity, nylon 6.6 with metal attachments, black, 50 pc. package quantity.
	JP4CMB-X20	Panduit	J-PRO Cable support system, with ceiling mount bracket that has one 3/16 (M5), 1/4 (M6), and 3/8 (M10) mounting hole, 4.00 (101.6mm) max. bundle capacity, nylon 6.6 with metal attachments, black, 10 pc. package quantity.
J Hooks – Wall Mount			

Product Category	Part Number	Manufacturer	Part Description
	JP131WP2B-L20	Panduit	J-PRO Cable support system, with ceiling mount bracket that has one 3/16 (M5), 1/4 (M6), and 3/8 (M10) mounting hole, 1.31 (33.3mm) max. bundle capacity, nylon 6.6 with metal attachments, black, 50 pc. package quantity.
	JP2WP2B-L20	Panduit	J-PRO Cable support system, for powder actuated installation on walls, one 5/32 (M4) mounting hole for user supplied fasteners, 2.00 (50.8mm) max. bundle capacity, nylon 6.6 with metal attachments, black, 50 pc. package quantity.
	JP4WP2B-X20	Panduit	J-PRO Cable support system, for powder actuated installation on walls, one 5/32 (M4) mounting hole for user supplied fasteners, 4.00 (101.6mm) max. bundle capacity, nylon 6.6 with metal attachments, black, 10 pc. package quantity.
Network Labeling			
	S100X150YAJ	Panduit	Laser/ink jet self-laminating label, 1" W x 1.50" L, Cat. 5e/Cat. 6 UTP/Cat. 6e UTP/Cat. 5e FTP/10 – 6 AWG, white print-on area, polyester, 7 labels/row, 42 labels/sheet, 2500 pc. package quantity. (cable wrap around labels for CAT 6 & CAT 6A laser jet labels)
	S100X150YAJ	Panduit	Laser/ink jet self-laminating label, 1" W x 1.50" L, Cat. 5e/Cat. 6 UTP/Cat. 6e UTP/Cat. 5e FTP/10 – 6 AWG, white print-on area, polyester, 7 labels/row, 42 labels/sheet, 2500 pc. package quantity. (cable wrap around labels for CAT 6 & CAT 6A LS8 Labels)
	C252X030FJJ	Panduit	Laser/ink jet network label, 2.52" W x 0.30" H, 4-port identifier, adhesive polyolefin, white, 3 labels/row, 75 labels/sheet, 1000 labels per package. (Modular patch panel labels laser jet labels)
	C252X030FJC	Panduit	Network label, P1 cassette, 2.52" W x 0.30" H, polyolefin, white, 125 labels/cassette, 1 pc. package quantity. (Modular Patch Panel LS8 Labels)

CHEMONG PUBLIC SCHOOL
PROJECT NO.: 21-000-040
DATE: MAY 03, 2021
ISSUED FOR: TENDER

SECTION 27 00 00
COMMUNICATIONS

18 OF 18

Product Category	Part Number	Manufacturer	Part Description
	C061X030FJJ	Panduit	Laser/ink jet network label, 0.61" W x 0.30" H, 1-port identifier, adhesive polyolefin, white, 13 label/row, 325 labels/sheet, 5000 labels per package. (2 ports Decora plate laser jet labels)

END OF SECTION

1	GENERAL	2
1.01	SUBMITTALS	2
1.02	REFERENCES	3
1.03	QUALITY ASSURANCE	4
1.04	MAINTENANCE PERIOD REQUIREMENTS	5
1.05	SOFTWARE REVISIONS	5
1.06	SYSTEM DESCRIPTION	5
2	PRODUCTS	6
2.01	SINGLE-STAGE FIRE ALARM SYSTEM COMPONENTS	6
2.02	ALARM CONTROL PANEL	9
2.03	NETWORK NODES OR TRANSPONDERS	11
2.04	PRINTER(S)	12
2.05	TROUBLE ALARM INITIATING DEVICES	12
2.06	FIRE ALARM INITIATING DEVICES	12
2.07	AUDIBLE ALARM SIGNALS (BELLS)	15
2.08	VISUAL ALARM SIGNALS	15
2.09	AUDIBLE ALARM SIGNALS (HORNS)	17
2.10	END-OF LINE RESISTORS	17
2.11	SHORT CIRCUIT ISOLATORS	18
2.12	WIRING	18
3	EXECUTION	19
3.01	INSTALLATION OF FIRE ALARM SYSTEM	19
3.02	SYSTEM PROGRAMMING	21
3.03	SYSTEM TESTING CERTIFICATION, AND VERIFICATION	21
3.04	LIABILITY INSURANCE POLICY	23
3.05	SOFTWARE CHANGES	24
3.06	SPARE PARTS INSTALLATION:	24
3.07	TRAINING	24
3.08	WORK IN EXISTING BUILDING SUBJECT	24

1 GENERAL

1.01 SUBMITTALS

- .1 Shop drawings/product data:** Submit shop drawings and product data sheets for the fire alarm system. Include the following:
 - .1 Identified wiring schematics with component identification and product/catalogue numbers for the central facility and all associated components.
 - .2 A complete, zoned block riser diagram identifying all components and circuits.
 - .3 A complete sequence of operation cross-referenced to the riser diagram.
 - .4 Single-line wiring diagrams complete with size and type of conductor, voltage drop for estimated loop and network wiring.
 - .5 Overall system riser wiring diagram identifying control equipment, initiating zones, signalling circuits; identifying terminations, terminal numbers, conductors, and raceways.
 - .6 Battery and load calculation for all components of the system, identify spare capacity of the system.
 - .7 A sample of graphic command centre screen displays.
 - .8 Detail assembly and internal wiring diagrams for control units and consoles or cabinets. Show all cabinet sizes.
- .2 Submittals to fire authority:** Submit to the local fire authority at the same time as submittal to the consultant, all items required by subparagraphs of paragraph .1 above.
- .3 System review and confirmation:** As specified in Part 3 of this Section, submit a letter from the system manufacturer/supplier which confirms that the system has been properly installed in accordance with issued installation instructions CAN/ULC-524, and an inspection and verification report in accordance with CAN/ULC-S537.
- .4 Panel/enclosure keys:** Submit a minimum of 3 identified keys for any panel or enclosure with a keyed lock door.

- .5 **Spare parts:** Prior to substantial performance, supply, in identified original packaging and hand to the owner at the site where directed, the following spare parts:
 - .1 Pull stations, 10% of the number installed, minimum three, and, if pull stations use glass rods, 20 glass rods
 - .2 Smoke detectors, 10% of the number installed for each type, minimum 2
 - .3 Thermal detectors, 5% of the number installed for each type, minimum 1
 - .4 control switches, 2 for each type used
 - .5 EVAC speaker assemblies, 5% of the number installed for each type, minimum 2
 - .6 Visible and audible signals other than speakers, 2 for each type used
 - .7 Isolators, 5
- .6 **As-built record drawing requirements:** In addition to all other “as-built” conditions, indicate on as-built record drawings the locations of all end-of-line resistors and all line isolation modules.
- .7 **Independent party testing and verification agency:** Submit the name, qualifications, and certification of the independent party testing and verification agency proposed for the project.
- .8 **Certificate of insurance:** As specified in part 3, submit a certificate of insurance covering testing and verification of the fire alarm system.
- .9 **Warranty:** Submit a signed extended warranty in the name of the owner covering the entire fire alarm system for a period of 1 year after the contract warranty expires. The terms of the extended warranty are to be full parts and on-site labour as for the contract warranty.

1.02 REFERENCES

- .1 Government of Canada
 - .1 NBC, National Building Code of Canada, latest edition
 - .2 TB OSH Chapter 3-3, Treasury Board of Canada, Occupational Safety and Health, Chapter 3-3, Fire Protection Standard for Electronic Data Processing Equipment

- .3 TB OSH Chapter 3-4, Treasury Board of Canada, Occupational Safety and Health, Chapter 3-4, Standard for Fire Alarm Systems
- .2 Underwriter's Laboratories of Canada (ULC)
 - .1 CAN/ULC-S524, Installation of Fire Alarm Systems
 - .2 ULC-S525, Audible Signal Appliances for Fire Alarm
 - .3 CAN/ULC-S526, Visual Signal Appliances, Fire Alarm
 - .4 CAN/ULC-S527, Control Units, Fire Alarm
 - .5 CAN/ULC-S528, Manual Pull Stations
 - .6 CAN/ULC-S529, Smoke Detectors, Fire Alarm
 - .7 CAN/ULC-S530, Heat Actuated Fire Detectors, Fire Alarm
 - .8 CAN/ULC-S536, Inspection and Testing of Fire Alarm Systems
 - .9 CAN/ULC-S537, Verification of Fire Alarm Systems
 - .10 CAN/ULC-S1001, Integrated System Testing

1.03 QUALITY ASSURANCE

- .1 The fire alarm system and its installation and testing are to be in accordance with requirements of all CSA and CAN/ULC Codes and Standards governing fire alarm system components, and installation and testing of the system.
- .2 In addition, the system must comply with requirements of CSA Z32, Electrical Safety and Essential Electrical Systems in Health Care Facilities.
- .3 **System Components:** All system components are to be ULC listed and labelled in accordance with standards listed above, and, unless otherwise specified, are to be supplied by a single manufacturer. All components must be suitable in all respects for conditions of the installation location.
- .4 **System Software:** System software is to be open protocol and full custom programmed with the system sequence of operation.

1.04 MAINTENANCE PERIOD REQUIREMENTS

- .1 Include for a 1 year no cost (to the Owner) maintenance period to commence at notification of Substantial Performance and which is to include 2 site inspections of the system with reports. Inspections are to be scheduled with the Owner and Consultant.
- .2 Where the work is phased and completed phases will be accepted and occupied by the Owner, include for requirements of paragraph .1 above for each such phase.

1.05 SOFTWARE REVISIONS

- .1 After successful testing, verification, and commissioning of the system, but prior to Substantial Performance, obtain a list of final room, area, and, if applicable, building names and revise system software to incorporate all required revisions.
- .2 Include for an additional software update to suit any requirements of governing authorities.
- .3 In addition to programming revisions specified above, include for, after Substantial Performance, another site visit to make any supplementary software revisions requested by the Owner.
- .4 Include for coordination meetings with Stakeholders and governing authorities to deliver a turnkey product, number of meetings as required to deliver the above required.

1.06 SYSTEM DESCRIPTION

- .1 Fire alarm system is existing to remain.
- .2 Fully supervised, microprocessor-based, field programmable, remote monitored fire alarm system, utilizing CPU, and on-board memory.
- .3 Zoned, non-coded single stage.
- .4 Modular in design to allow for future expansion.
- .5 Operation of system shall not require personnel with special computer skills.

2 PRODUCTS

2.01 SINGLE-STAGE FIRE ALARM SYSTEM COMPONENTS

- .1 **General Description:** Modular, central data communications and processing type, fully supervised, 1-stage, zoned, addressable, field programmable fire alarm system using digital techniques for data control and digital and multiplexing techniques for data transmission, designed such that each data communication link is limited to only 70% of its total capacity at initial installation and capable of supporting 100% of its designed capacity, The system is to be as indicated on the drawings and is to be complete with:
 - .1 a central alarm and control panel with power supply and standby batteries, central processor with microprocessor and logic interface, main system memory, input and output interfaces for alarm receiving, annunciation/display and program controls/signalling, and all required switches and controls
 - .2 remote annunciator(s)
 - .3 network nodes/transponders
 - .4 a manual control station for control of building services
 - .5 alarm initiating devices
 - .6 alarm signalling devices
 - .7 input output interface to other equipment
 - .8 door hold open/release hardware
 - .9 all required wiring including end-of-line resistors and addressable circuit isolators
 - .10 interconnections to other building systems
- .2 **Sequence of Operation – Trouble Alarm:** Trouble alarm initiating devices, other than circuit isolators and similar devices, will generally be supplied and installed as part of the mechanical work. The devices are as indicated on the drawings and include:
 - .1 fire protection system supervised shut-off valves,
 - .2 fire protection system piping mains pressure switches for low pressure indication,

- .3 fire protection pump trouble,
 - .4 fire protection pump not in auto,
 - .5 carbon monoxide detection
 - .6 dry sprinkler system air compressor loss of power indicated device,
 - .7 emergency power generator trouble,
 - .8 emergency power generator low fuel or gas valve closed,
 - .9 emergency generator ATS trouble/not in auto,
 - .10 emergency lighting systems,
 - .11 other fire alarm detection system,
 - .12 and fire pump start contact, Input from other fire alarm domains or separate fire detection system.
- .3 Unless otherwise specified, activation of a trouble alarm device is to initiate the following sequence of operation:**
- .1 audible and visual trouble alarm signals to be activated at the control panel
 - .2 audible and visual trouble alarm signals to be activated at all connected remote annunciators
 - .3 a trouble alarm signal to be sent to the Building Operations Department via SMS and Internet interface technology
 - .4 acknowledging the trouble alarm is to silence the audible alarm but visual trouble alarm signals are to remain illuminated until the trouble condition has cleared, and the system has been reset at the control panel
 - .5 a trouble alarm is to be suppressed during the course of a fire alarm
- .4 Sequence of Operation – Alarm:** Activation of any of the fire alarm devices indicated on the drawings, including fire protection system alarm valves and devices, is to initiate the following:
- .1 fire alarm signals to sound continuously and all visual signal to operate continuously at the control panel and throughout all zones until the alarms are manually silenced/stopped at the control panel, but only after the silence-inhibit timer has timed out

- .2 fire alarm system is to initiate trouble to all other domains of the system
 - .3 fire sign devices to illuminate
 - .4 the address and zone of the alarm to be registered at the control panel and all remote annunciators
 - .5 the outside monitoring company or the Fire Department (as connected) to be automatically notified
 - .6 the colour graphic to indicate the layout of the floor, the zone, and the device(s) in alarm
 - .7 smoke and fire doors with hold-open devices to release and close the doors
 - .8 the assigned message and activated control-by-event functions with time and date for the monitored point in alarm to be printed at the CPU printer
 - .9 locked doors equipped with electric locks to unlock and remain unlocked until the fire alarm system is reset
 - .10 interconnected mechanical equipment to shut down, all units serving multiple fire compartments of suites
 - .11 activate all assigned control points through control-by-event functions
 - .12 other campus style interconnected fire alarm panels to receive trouble signal
 - .13 domain style networked fire alarm digital gathering panels to show details of the fire alarm conditions on own LCD display
 - .14 music shut down relay to activate to shut down music or PA systems in the facility
 - .15 activation of all assigned control points through control-by-event functions
 - .16 elevator and escalator interface shall be programmed in accordance to elevator and escalator safety code
 - .17 fire shutters and/or smoke evacuation equipment shall be activated
- .5 **Sequence of Operation – Supervisory Alarm:** Activation of any system supervisory device is to cause an electronic latch to lock-in a supervisory state at the control panel and any connected node/transponder and initiate the following:

- .1 indicate the respective supervisory zone at the control panel and all remote annunciators
- .2 cause an alarm signal to sound at the control panel
- .3 activate a common supervisory circuit

2.02 ALARM CONTROL PANEL

- .1 The panel for control and monitoring of the system is to be a modular, programmable, shall contain a microprocessor based Central Processing Unit (CPU), configurable, and field expandable without the need for special tools, EPROM programmers, or PC based programmers, and replacement of memory IC's. The CPU shall communicate with and control slave microprocessor controlled modules which provide the interface to initiating device circuits, notification appliance circuits and building control relays. The panel is to support up to 20 logic equations including "and", "or" and "not", or time equations to be used for advanced programming, and logic equations are to require the use of a PC with a software utility designed for programming. The panel is to be equipped with Form C alarm, trouble, supervisory, and security relays rated at minimum 2 amperes at 30 volts DC, signal circuits programmable to be synchronized with the signals installed, and operator interface control and annunciation panel with a backlit LCD display, individual colour coded system status LED's, and an alphanumeric keypad with rubber keys for field programming and control of the system.
- .2 The panel is to be a wall mounting, dead front, NEMA/EEMAC 2 panel with piano hinged front door with lock and a minimum of 3 identified keys, and full door glazing. All controls and instructions are to be visible through the door window, and the door is to facilitate access to all operator controls. All electrical connections are to be front access by means of a removable inner protective cover.
- .3 The panel is to be capable of chronologically logging and storing a minimum of 300 events in an alarm log and a minimum of 300 events in a separate trouble log. The historical logs are to be stored in the CPU memory and protected with a lithium battery supervised for a low battery condition. Each log record is to indicate the time and date of the occurrence, and log reports are to be generated upon request.
- .4 The panel is to be complete with:
 - .1 the required number of addressable monitoring points and control/signal points plus a minimum of 20% spare capacity

- .2 priority reporting levels with fire alarm assigned the highest priority, supervisory and monitoring assigned a lower priority, and third part priority assigned the lowest priority, with the capability of assigning control priorities to control points in the system to guarantee operation or allow emergency override as required
- .3 an integral power supply, battery charger, and batteries as specified below
- .4 password protected field programmable basic life safety software stored in non-volatile CPU memory
- .5 circuitry to continuously monitor communications and data processing cycles of the microprocessor, and, upon failure, activate audible and visual trouble alarms
- .6 self-optimizing pre-alarm for advanced fire warning, which allows each detector to learn its particular environment and set its pre-alarm level to just above normal peaks
- .7 cross-zoning with the capability of counting, 2 detectors in alarm, 2 software zones in alarm, or 1 smoke detector and 1 thermal detector in alarm
- .8 circuitry to continuously supervise wiring between the control panel and any remote nodes/transponders, and, upon failure, activate audible and visual alarms at the control panel
- .9 hardware to support the required number of RS-232-CI/O ports for a remote printer, etc.
- .10 an 8 line, 21 character LED which is to continuously indicate all trouble and fire alarms
- .11 the ability to display system reports, and print system reports at a remote printer
- .12 the ability to communicate on a local area network (LAN), with a firmware package that utilizes a peer-to-peer inherently regenerative communication format and protocol
- .13 integrated web server interface for e-mail notification
- .14 integrated SMS text interface for notification via text messaging.

- .5 **Utility Power Supply Connection Facilities:** Suitable for a minimum of 6 amperes of 120 volt AC, 60 Hz power for the panel and peripheral devices, with provisions to permit audio-visual power to be increased as required by adding modular expansion audio-visual power supplies. The power supply connection facility is to continuously monitor all field wiring for earth ground conditions and is to be equipped with a Ground Fault LED, and AC Power Failure LED, and notification appliance circuit on LED (4).
- .6 **Field Power Supply:** Continuous duty, filtered and regulated 24 volt DC supply sized for present requirements plus a minimum of 20% future requirements, power limited within a range of from 20.4 to 32 volts DC, and with automatic "Brownout" transfer to standby batteries when the supply voltage falls below the set limit
- .7 **Standby Power:** Sufficient standby power is to be provided to operate the entire system in a normal supervisory mode for a minimum of 24 hours upon loss of normal utility power, and immediately followed by system operation under full power for a minimum of 2 hours. Batteries are to be sealed, maintenance free lead-acid, nickel-cadmium, or gel-cell batteries supervised such that a low battery power condition or disconnection of the batteries will activate an audible and visual trouble alarm at the central control facility. The batteries are to be complete with an automatic charger capable of re-charging the batteries to 70% of ultimate capacity within 12 hours, and a transient voltage surge protection device as recommended by the system supplier is to be provided.
 - .1 battery load calculation to be provided at time of shop drawing submission to confirm batteries sized for entire system capacity
 - .2 batteries to be sized to provide 100% power sized for maximum system applicable output
 - .3 provide battery calculation to identify battery output capacity related to the presently connected load

2.03 NETWORK NODES OR TRANSPONDERS

- .1 Generally, as specified above for the control panel but designed for remote mounting as a control panel and for interconnection to and interface with the control panel.

2.04 PRINTER(S)

- .1 Desktop, 120 volt, 60 Hz AC, thermal head, 80 column printer to provide a hard copy of fire alarm system event, capable of receiving English language text from the control panel in ASCII format via an EIA RS-232-C connection and other standard communications protocols. Each printer is to include the following features:
 - .1 the dates and time on all printed information
 - .2 180 characters per second
 - .3 3 kilobytes buffer capacity
 - .4 cartridge type ribbon
 - .5 friction feed for cut forms, tractor feed for continuous 240 mm (9 7/16") wide pin-to pin fanfold paper

2.05 TROUBLE ALARM INITIATING DEVICES

- .1 Generally, trouble alarm initiating devices other than those associated with fire alarm system equipment problems, will be supplied, and mounted as part of the mechanical work.

2.06 FIRE ALARM INITIATING DEVICES

- .1 Fire alarm initiating devices are to be as indicated on the drawings and as follows:
 - .1 **Manual Pull Station:** Addressable manual pull stations in accordance with requirements of CAN/ULC S528, semi-flush or surface mounted as required and/or shown, constructed of red polycarbonate material, designed with a push-in pull-down handle that activates the normally open alarm switch and displays yellow "ACTIVATED" lettering, with special key operated reset. Each station's address will be set at the time of installation, and stations are to be complete with:
 - .1 clearly visible bilingual (English-French) operating instructions on the cover and minimum 25 mm (1") high "FIRE" white identification
 - .2 a steel back box for surface mounting stations
 - .3 3 sets of 2 reset keys

- .4 auxiliary contact(s) as required to connect to items such as fire door release mechanisms
 - .5 where indicated or required, a ULC listed clear Lexan hinged cover with, if required by Code or local authorities, a tamper alarm (include for supply of 10 covers)
 - .6 for pull stations where indicated, explosion-proof facilities
- .1 **Sensor Bases:** Addressable analogue smoke and thermal detectors specified below are to be complete with a white, surface mounting base to which the sensor twist-lock mounts to provide digital transmission of analogue sensor values via 2-wire communicating wiring. The base electronics are to constantly monitor the status of the detachable sensor, and each sensor's output is to be digitized and transmitted to the fire alarm control panel every 4 seconds. Bases are to mount to a standard 100 mm (4") square or octagonal box and are to be complete with:
- .1 an address which remains with its programmed location
 - .2 automatic identification which provides default sensitivity if sensor types are substituted
 - .3 an integral red LED which pulses to indicate a normal condition and power on, and remains on to indicate an alarm or trouble
 - .4 a supervised LED relay which is activated when the base LED is on steady indicating local alarm or trouble, connected to a remote wall mounting LED alarm indicator with LED alarm and stainless steel faceplate
- .2 **Alarm Sensors:** Alarm sensors are to be sealed against rear air flow entry, are to twist-lock mount to any of the sensor bases and are to be complete with EMI/RFI shielded electronics. Alarm sensors are to be as follows:
- .1 **Heat Sensors:** Programmable self-restoring sensors with a rate compensating fixed temperature setting as indicated on the drawings
 - .2 **Photoelectric Smoke Sensors:** Stable, selectable sensitivity, 360° smoke entry design head with pulsed infrared LED light source and silicon photodiode receiver for constant and accurate low power smoke sensing, a 3 mesh insect screen, and, where indicated, and auxiliary contact for connection to an associated device

- .3 **Ionization Smoke Detector:** Selectable sensitivity, 360° smoke entry design head with single radioactive source with outer sampling ionization chamber and inner reference ionization chamber for stable operation under fluctuations in ambient temperature and humidity, designed such that the presence of particles of combustion cause a change in voltage ratio between chambers which is measured by the sensor electronics and digitally transmit to the control panel for processing, and equipped with 30 mesh insect screen, and, where indicated, an auxiliary contact for connection to an associated device
- .4 **Duct Mounted Smoke Detectors:** Addressable photoelectric type smoke detectors in an air-tight duct mounting housing and complete with:
 - .1 an air sampling tube of suitable length for insertion into the duct
 - .2 a test switch, or, for duct detectors in locations not easily accessible, a remote test station
 - .3 status LED's
 - .4 Form C auxiliary alarm relays
 - .5 a remote wall mounting alarm indicator with LED and stainless steel faceplate
 - .6 for detectors in ductwork as indicated on the drawings, and for air intake ductwork, a ULC listed and labelled weatherproof housing with electric heater, thermostat control, and low temperature trouble alarm contact
- .5 **Combined Fire-Smoke Detectors:** Multi-criteria sensors for twist-lock mounting to a sensor base as described above, complete with advanced algorithms to interpret and respond to the multiple inputs, 6 levels of sensitivity, twin LED indicators for 360° visibility and which can be control panel controlled to blink, latch-on, or latch-off, an integral test switch, and the following 4 separate sensing elements:
 - .1 electrochemical cell technology that monitors carbon monoxide produced by a smouldering fire
 - .2 infrared sensing to measure ambient light levels and flame signatures
 - .3 photoelectric smoke detection

.4 thermal detection for temperature monitoring

- .6 **Reflected Beam Smoke Detectors:** Equal to BEAM1224A(SA), ULC listed single-ended reflected design beam smoke detector with a 5 m to 100 m (16' to 330') protection range, $\pm 10^\circ$ horizontal and vertical adjustment angles with optical gun sight and integral signal strength indication with 2 digit display, 6 user selectable sensitivity levels, local red LED and remote alarm indication, local yellow LED and remote trouble alarm, local flashing green normal condition LED, integral sensitivity test filter, sensitivity filter, local alarm test switch, local alarm reset switch, remote test and reset switch with test station, and all required mounting and connecting accessories.

2.07 AUDIBLE ALARM SIGNALS (BELLS)

.1 In accordance with CAN/ULC-525 and as follows:

- .1 **Bells:** Minimum 200 mm (8") diameter, polarized, low operating current, under-dome design, synchronized, with the input polarized for standard reverse polarity supervision by the fire alarm system control panel, each complete with a low frequency aluminium shell, integrated RFI suppression, permanent magnet DC motor with steel striker, wiring screw terminals, and the following:
- .1 for surface mounting interior and exterior bells, a suitable red enamelled steel back-box
 - .2 for semi-flush mounting interior bells, a trim plate and a standard 100 mm (4") square box
 - .3 for flush mounted interior bells, a proper back-box, and a brushed stainless steel grille
- .2 **Exterior and Unfinished Area Horn Speakers:** Surface mounting red horns, weather-proof where required, with 2 sound levels of 90 and 95 dBA at 3 m (10') and equipped with a back-plate for mounting to an outlet box.

2.08 VISUAL ALARM SIGNALS

.1 In accordance with CAN/ULC-S526 and as follows:

-
- .1 **Strobe Lights:** Wall or ceiling mounting as indicated, low current design, synchronized, with the input polarized for standard reverse polarity supervision by the firm alarm control panel, complete with a universal mounting plate suitable for mounting on a standard 100 mm (4") square outlet box, and equipped with:
 - .1 a flash rate of 1 flash per second over the regulated voltage range, with a LED enclosed within a lens
 - .2 for installation in low ceilings a minimum of 4 field selectable strobe intensities of 15, 30, 75 and 110 candela, with tamper-proof selector switch
 - .3 for installation in high ceilings (higher than six (6) meters) a minimum of 4 field selectable strobe intensities of: 135, 150, 177 and 185 candela, with tamper-proof selector switch
 - .4 synchronization modules that will not permit the strobes to drift out of synchronization at any time during operation, and if the sync module fails to operate the strobe is to revert to non-synchronized flash rate
 - .5 a cover plate for strobes located in finished area, white or red selection applicable at no cost
 - .6 for strobe lights in non-climate controlled areas, a weatherproof back box and weatherproofing for the light assembly
 - .7 Listed for ceiling or wall mounting
 - .2 **Beacon Lights:** Surface mounting LED beacon light assemblies, each approximately 165 mm (6 ½") diameter by 150 mm (6") high and complete with a polycarbonate base, amber, red, or blue colour as selected by the Consultant, ten selectable "strobing" flash patterns which completely fill the lens, a synchronization or alternate flash feature, and a mounting plate and hardware to suit the application.
 - .3 **Fire Signs:** Illuminated, LED, flashing, 24 volt DC "FIRE DO NOT ENTER" sign with a black face and red letters which are not visible until the sign is energized. Each sign is to be complete with a satin finish aluminium housing, 2 rows of long life LEDs rated for minimum of 100,000 hours of life, a flasher, and Lexan guard. FIRE lettering is to be 50 mm (2") high. DO NOT ENTER lettering is to be 40 mm (1½") high.

2.09 AUDIBLE ALARM SIGNALS (HORNS)

.1 In accordance with CAN/ULC-S525 and as follows:

.1 **Horns:** Wall or ceiling mounting as indicated, low current design, automatic selection of 12- or 24-volt operation, horn tones, shall have three audibility options and an option to switch between a temporal three pattern and a non-temporal (continuous) pattern, and three volume options enable installers to easily adapt devices to meet requirements, complete with a universal mounting plate suitable for mounting on a standard 100 mm (4") square outlet box, and equipped with:

- .1 White or red selection applicable at no cost
- .2 Rotary switch for horn tone and three volume selections
- .3 Horn rated at 88+ dBA at 16 volts
- .4 Plug-in design with minimal intrusion into the back box
- .5 Tamper-resistant construction
- .6 Listed for ceiling or wall mounting
- .7 Nominal Voltage Regulated 12 DC/FWR or regulated 24 DC/FWR1
- .8 Operating Voltage Range 8 to 17.5 V (12 V nominal) or 16 to 33 V (24 V nominal)

.2 **Horn Strobe Combination:**

- .1 Shall comply with all provisions related to stand alone strobe and horn devices.
- .2 Where require, four-wire products shall be used to allow the strobe to be powered independently of the sounder. The horn or horn strobe models shall operate on a coded or non-coded power supply.

2.10 END-OF LINE RESISTORS

- .1 Sized to ensure correct supervisory current flows in alarm signal circuits and secured to a stainless steel plate for mounting to a single gang outlet box.

2.11 SHORT CIRCUIT ISOLATORS

- .1 Addressable short circuit isolator with input and output wiring terminals, designed to automatically isolate wire-to-wire short circuits on a SLC loop, send an address to the control panel, and only disconnect devices connected to the short circuit loop while all other devices connected to the isolator loops will remain in operation. Each isolator is to mount in a standard 100 mm (4") outlet box and is to be equipped with an identified stainless steel faceplate with LED that flashes when all circuits are normal and remains illuminated when a short circuit condition has been detected and isolated.

2.12 WIRING

- .1 In accordance with CSA C22.2 No. 208, CAN/ULC-S524, and governing Codes and Regulations, all electrically supervised, and as follows:
 - .1 **Power wiring to control panel and between panel and transponders, annunciators, etc.:** Tyco "Pyrontenax" type MI 2 hour fire rated, mineral insulated, copper sheathed, copper conductor cable
 - .2 **Risers between network transponders:** To include single #18 AWG twisted shielded cable for each riser, in Class A style 6/7 identified loops, in addition to other fire rated conductors
 - .3 **All other wiring unless otherwise specified:** Minimum 105° C (220° F) rated with copper conductors and colour coded insulation, and, unless otherwise shown or specified, sized in accordance with the fire alarm system manufacturer's instructions but, in any case minimum No. 16 AWG
 - .4 Fire alarm system shall be wired as class A for all initiating and signalling devices.
 - .5 Class "A" loop riser with class "B" connected field devices is applicable only when connecting field devices in an enclosed space (utility room) where End-Of-Line devices are terminated to a final equipment such as sprinkler switches, generator equipment elevator equipment and similar.
 - .6 If Class "A" loop riser with class "B" connected field devices wiring is used at a specific area fault line isolator shall be installed at entrance and exit of the noted area.

3 EXECUTION

3.01 INSTALLATION OF FIRE ALARM SYSTEM

- .1 Provide a complete fire alarm system in accordance with the Contract Documents, requirements of CAN/ULC-S524, and governing authorities.
- .2 Generally, install components where shown but confirm exact locations prior to roughing-in. In finished areas with suspended ceilings, refer to architectural reflected ceiling plans but do not support devices from the suspended ceiling. Ensure that all devices in “wet” non-climate controlled areas and all exterior devices are weatherproof.
- .3 **Power Connection Requirements:** Ensure that all system control panels, annunciators, and transponders are connected with fire rated power conductors sized for the application and extended from a dedicated fused disconnect circuit which is supervised such that any power failure will be audibly and visually alarmed at the transponder(s) and remote annunciator(s).
- .4 **“Head End” Equipment:** Locate the control panel, annunciators, displays, and other “head end” equipment where shown and carefully coordinate installation with adjacent work. Wall mount transponders so as to be accessible and ensure that each transponder is properly identified.
- .5 **Manual Pull Stations:** Install pull stations in standard outlet boxes, galvanized steel for recessed stations. “Condulet” type cast metal boxes for surface mounted stations. Comply with governing mounting height requirements, including barrier-free height requirements.
- .6 **Alarm Initiating Detectors:** Install the base for each alarm initiating detector to an outlet box, galvanized steel recessed type for devices in finished areas, surface mounted cast metal “Condulet” type boxes for devices in unfinished areas. Secure detector heads to the base.
- .7 **Duct Smoke Detectors:** Carefully coordinate installation of duct smoke detectors with the trade installing the ducts. The sheet metal trade will drill a hole for the sampling tube. Install the tube and secure the detector to the duct. Provide stand-off mounting for detectors on insulated ducts. Provide remote LED indicator assemblies for duct detectors which are not clearly visible from the floor.
- .8 **Patient Room/Area Detectors:** Interconnect patient room/area detectors with annunciator to the local Nurse’s Station and to the room/area nurse call dome light.

-
- .9 **Computer Room Detectors:** In the Computer Room(s) where shown and/or specified, cross-zone connect detectors and remote indicating devices as indicated.
 - .10 **Audible Alarm Signal Devices:** Audible device locations are indicated on the drawings; however, the exact quantity and locations of audible signal devices is to suit the results of a site audibility coverage test performed by the system supplier using approved instrumentation and experienced test personnel. Relocate audible signal devices and/or provide additional audible signal devices as required by results of the test.
 - .11 **Visual Alarm Signal Devices:** Visual alarm signal device locations are indicated on the drawings. Unless otherwise indicated, locate wall mounted devices 2.4 m (8') above the floor and ceiling mounted devices 300 mm (12") below the finished ceiling. Provide a minimum of 2 circuits per floor and connect the devices in an alternating scheme.
 - .12 **Fire Signs:** Confirm exact location of fire signs prior to roughing-in and connect such that activation of the fire alarm system illuminates the sign, and, when the fire alarm system is reset, the sign is de-energized.
 - .13 **Door Hardware:** Carefully coordinate wiring connections to door hold-open hardware or electrical door locks with the installation of the hardware such that hold-open devices release the doors and electric locks are de-energized upon fire alarm system activation as specified.
 - .14 **Wiring Connections to Other Building Systems and Equipment:** Provide supervised wiring connections from fire alarm system components to building systems as shown and/or specified on the drawings.
 - .15 **Wiring Requirements:** Do all system wiring. Except for fire rated cable, install wiring in minimum 20 mm (¾") conduit. Conform to the following requirements:
 - .1 connect all wiring to colour code, identified and numbered terminal strips in junction boxes or at equipment
 - .2 ensure that colour coding is consistent for the entire length of each run
 - .3 provide all wiring in accordance with requirement of governing Codes and Regulations
 - .4 install alarm indicating circuits and alarm receiving circuits in separate conduit
 - .5 provide end-of-line resistors to electrically supervise all wiring

- .6 ground and bond all system cabinets and other work to the building grounding system

3.02 SYSTEM PROGRAMMING

- .1 Arrange for all required system programming to be done by the system manufacturer's technical representatives.

3.03 SYSTEM TESTING CERTIFICATION, AND VERIFICATION

- .1 The system manufacturer or an independent third party testing company are to test and verify the completed system. The third party testing company or manufacturer is to have primary responsibility for testing and verification.
- .1 **System Manufacturer's Testing and Verification:** Accompanied by qualified personnel of the system manufacturer, visually inspect the system for completeness, then test system operation, including all alarm initiating devices, signal devices, and all other system operation and functions. When the system manufacturer confirms that the system is operating as intended, obtain from manufacturer, and submit copies of signed test and inspection sheets, and a signed letter from the system manufacturer certifying that the system has been checked, tested, operated, adjusted, and is operating as intended, all as per CAN/ULC-S536. Qualified personnel system manufacturer's personnel are also to be available on-site to accompany independent third party personnel testing and verification.
- .2 **System Testing and Verification:** Accompanied by qualified personnel of the system manufacturer, visually inspect the system for completeness, then test system operation, including all alarm initiating devices, signal devices, and all other system operation and functions. Check wiring for fault, open circuit and ground condition, check conductor size, type of conductor, insulation and shielding where applied and necessary. When the system manufacturer confirms that the system is operating as intended, obtain from manufacturer, and submit copies of signed tests and inspection sheets. Provide signed letter certifying that system has been verified, checked, tested, operated, adjusted, and is operating as intended. Obtain record of wiring and performance verification documentation as governed by ULC.

- .3 Retain and pay all cost for testing and verification of the system in accordance with CAN/ULC S537 and CAN/ULC S1001. The fire alarm system provider testing agency is to be a qualified and experienced testing agency with personnel trained in accordance with the Fire Alarm Technology Program of the Canadian Fire Protection Association, or Certified Fire Alarm Electricians certified by the Electrical Contractors Association of Ontario. All such personnel are to carry identification cards at all times while on-site.
- .4 Include in contract and be responsible for all aspects of testing and verification of the fire alarm system, all required coordination with owner, governing authorities, and other trades and:
 - .1 coordinating attendance at the site of all required fire inspection personnel so as to obtain their approval of testing and verifying work
 - .2 coordinating attendance at the site of system manufacturer's technical personnel to advise as required
 - .3 written confirmation that all alarm initiating devices, signals, paging, telephone, and all other components have been tested and operate properly
 - .4 written confirmation that all supervised wiring is properly installed and operating and is in accordance with all applicable requirements
 - .5 written confirmation that the overall system and sequences of operation, including operation of communication equipment, mechanical equipment, elevators, similar equipment as specified, battery power and charging have been tested and are in accordance with all requirements and meet with the approval of local governing authorities
 - .6 submittal of signed test report sheets and a signed Verification Certificate and approval documentation issued by the local Fire Authorities

- .5 **Independent Fourth Party System Testing and Verification:** After the verification of the fire alarm system is complete, the Contractor shall engage the services of an independent testing organization to verify the fire alarm. Retain and pay all cost for independent fourth party testing and verification of the system. The independent fourth party is to be a qualified and experienced testing agency with personnel trained in accordance with the Fire Alarm Technology Program of the Canadian Fire Protection Association, or Certified Fire Alarm Electricians certified by the Electrical Contractors Association of Ontario. All such personnel are to carry identification cards at all times while on-site.
- .1 Provide independent written report equivalent to the report provided by the fire alarm system provider. Report shall follow ULC guidelines per CAN/ULC S537.
- .2 The fourth party report shall be seal/stamp signed and dated by a Professional Engineer licensed to practice in the Province
- .3 Independent fourth party testing agency may not be affiliated with the system manufacturer.

3.04 LIABILITY INSURANCE POLICY

- .1 Within 15 days of written notification of award on contract, submit a Certificate of Insurance for a Commercial General Liability Insurance Policy from an insurer licensed to do business in the Province of the work and signed by an officer of the insurer covering public liability and property damage in a minimum amount of 2 million dollars inclusive in Canadian funds and insuring all services, operations, products, and fire alarm system work. The policy is to be extended to include bodily injury, property damage, personal and advertising injury, products and completed operations, contractual liability, Owners and Contractors protective liability and to a limit of not less than 2 million dollars Canadian per occurrence.
- .2 The policy is to:
- .1 include a cross liability clause and be endorsed to include the Owner
- .2 include non-owned automobile insurance to a limit of not less than 2 million dollars Canadian
- .3 include automobile insurance (OAP1) for both owned and leased vehicles with inclusive limits of 2 million dollars Canadian

- .4 be non-contributing with and will apply only as primary and not excess to any other insurance of self-insurance available to the Owner
- .5 contain and undertaking by the insurers to notify the Owner in writing not less than 30 days before and material change in coverage or cancellation of coverage

3.05 SOFTWARE CHANGES

- .1 Provide all software and programming changes as may be required by the Property Management or Authorities having Jurisdiction, at no additional cost to the Owner. Coordinate names of all devices with Property Management and Sprinkler Contractor, and Authorities Having Jurisdiction before final handover.

3.06 SPARE PARTS INSTALLATION:

- .1 Include in tender all inclusive labour and material, including, installation, coordination, task management, testing and verification required to install the spare parts identified in the General requirements of this specification

3.07 TRAINING

- .1 Allow to fully train the Property Management, Security and Maintenance Staff and the Local Authority with the operating of the system.
- .2 Allow for at least 3, four-hour training sessions.

3.08 WORK IN EXISTING BUILDING SUBJECT

- .1 Interface with existing building.
- .2 The expansion/renovation shall be tied into the existing building fire alarm.
- .3 Due to the phased nature of this project, include for a fully operational and verified fire alarm installation for the separate phase one construction. Include a temporary annunciator at a location to be approved by governing authorities.
- .4 The manufacturer shall supply to the contractor reasonable amounts of technical assistance with respect to any changes necessary to conform, the work to paragraphs above. During the period of inspection by the manufactures electricians, they shall check that the system is installed as designed by the manufacturer.

- .5 After the verification of the system is complete, the Contractor shall engage the services of an independent organization to verify the fire alarm. Every new device shall be checked for correct operation, address, and display. This verification shall be sealed by a registered Professional Engineer. The selection of the fourth party verifier is subject to prior approval by the Consultant.
- .6 Due to the phase nature of the project, carry out a total ULC S536 inspection at the end of the project

END OF SECTION