

**SHERIDAN COLLEGE –
BWING VET LAB RENOVATIONS**

7899 McLaughlin Road
Brampton, ON

Architectural | Mechanical | Electrical Specifications

Issued for Permits and Tender
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Project No. 2512

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Consulting Engineers

Mechanical / Electrical Consultant
JDX Advance Service Inc.

- .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 HC – Denotes documents prepared by Hardware Consultant
 - .3 M - Denotes documents prepared by Mechanical Engineer.
 - .4 E - Denotes documents prepared by Electrical Engineer.
 - .5 O - Denotes documents prepared by Owner.

DIVISION 00 – PROCUREMENT AND CONTRACTING REQUIREMENTS

Document	Title	Discipline	Pages
00 01 10	Table of Contents	A	3
00 31 00	Information Available to Bidders	A	1
	- Hazardous Building Materials Letter	O	1

DIVISION 01 - GENERAL REQUIREMENT

Document	Title	Discipline	Pages
01 10 10	General Requirements	A	52

DIVISION 02 - EXISTING CONDITIONS

Document	Title	Discipline	Pages
02 40 00	Demolition and Removals	A	8
02 80 00	Management of Designated Substances	A	3

DIVISION 05 – METALS

Document	Title	Discipline	Pages
05 25 23	Stainless Steel Casework	A	11
05 50 00	Miscellaneous and Metal Fabrications	A	6

DIVISION 06 – WOOD, PLASTICS, AND COMPOSITES

Document	Title	Discipline	Pages
06 10 00	Rough Carpentry	A	5

DIVISION 07 - THERMAL AND MOISTURE PROTECTION

Document	Title	Discipline	Pages
07 85 00	Firestopping and Smoke Seals	A	6
07 91 00	Sealants	A	8

DIVISION 08 – OPENINGS

Document	Title	Discipline	Pages
08 11 13	Metal Frames	A	5
08 14 00	Wood Doors	A	5
08 70 00	Finish Hardware	A	4
	-Hardware Groups	HC	3
08 70 01	Door and Lock Hardware	O	1
08 80 00	Glazing	A	6
08 88 60	Spandrel Panel Replacement	A	4

DIVISION 09 - FINISHES

Document	Title	Discipline	Pages
09 21 16	Gypsum Board	A	9
09 30 00	Tile	A	9
09 51 10	Healthcare Acoustical Panels	A	6
09 65 16	Resilient Sheet Flooring	A	9
09 91 00	Painting	A	13

DIVISION 11 - EQUIPMENT

Document	Title	Discipline	Pages
11 06 05	Laboratory Fittings	A	5

DIVISION 22 – PLUMBING

Document	Title	Discipline	Pages
	See attached Mechanical & Electrical Table of Contents	M	18

DIVISION 23 – HEATING, VENTILATING, AND AIR CONDITIONING (HVAC)

Document	Title	Discipline	Pages
	See attached Mechanical & Electrical Table of Contents	M	46

DIVISION 25 – INTEGRATED AUTOMATION

Document	Title	Discipline	Pages
	See attached Mechanical & Electrical Table of Contents.	M	11

DIVISION 26 – ELECTRICAL

Document	Title	Discipline	Pages
	See attached Mechanical & Electrical Table of Contents.	E	31

DIVISION 27 – COMMUNICATIONS

Document	Title	Discipline	Pages
	See attached Mechanical & Electrical Table of Contents.	E	2

DIVISION 28 – ELECTRONIC SAFETY AND SECURITY

Document	Title	Discipline	Pages
	See attached Electrical Table of Contents.	E	5

APPENDICES

Document	Title	Discipline	Pages
Appendix ME1	Sheridan College Infrastructure Guidelines	O	75
Appendix ME2	Sheridan College BAS Design Standard	O	42

END OF DOCUMENT

REPORT(S)

- 1.1 A copy of the following report(s) are appended under separate cover:
Revised Hazardous Building Materials Assessment Letter
Prepared by Pinchin
Davis Campus, 7899 McLaughlin Road, Brampton, Ontario
- 1.2 The report(s), by their nature, cannot reveal all conditions that exist or can occur on the site. Should conditions be found to vary substantially from the report, immediately notify Consultant in writing and await instructions.
- 1.3 Contractor shall not be entitled to extra payment or extension of Contract Time for work which is required and which is reasonably inferable in the report(s) as being necessary.

END OF SECTION

Asbestos														
	Paint	Lead Products	Mercury	PCB	ODS	Mould	Water	IAQ	Confined Space					
System	Component	Material	Item	Covering	A*	V*	AP*	Good	Fair	Poor	Unit	Sample	Hazard	Friable
Ceiling		Fibreglass			C	Y						V00001	None	
Ceiling	N/a	N/A	Not Applicable	N/A	NA	NA		0	0	0	%	V00001	None	
Ceiling 1		Ceiling Tiles (lay-in)			C	Y		36			SF	V00001	None	
Duct	Supply Air	Not Insulated	Not Applicable	N/A	C	Y		0	0	0	%	V00001	None	
Floor		Concrete (poured)			A	Y								
Piping	Drain	Cement Product 2			A	Y		10(7)			LF	V90001	Confirmed Asbestos	NF*
Piping	Domestic Water (hot And Cold)	Fibreglass 2	Straight	Paper	C	Y		1	2	3	LF	V00001	None	
Piping	Domestic Water (hot And Cold)	Fibreglass	Fitting	Polyvinyl chloride (PVC)	C	Y		0	0	0	%	V00001	None	
Structure	N/a	Concrete (poured)	Not Applicable	N/A	C	Y		0	0	0	%	V00001	None	
Wall		Drywall and joint compound			A	Y		100(7)			%	V95001	Presumed Asbestos	NF*
Wall		Drywall and joint compound			A	Y		100			%	S0147C1	None	
Wall		Drywall and joint compound			A	Y		100			%	S0147C1	None	
Wall		Paint			A	Y		100(7)			%	S0148A1	Confirmed Asbestos	NF*
Wall		Paint			A	Y		100(7)			%	S0148A1	Confirmed Asbestos	NF*
Wall		Paint			A	Y						S0148C1	Confirmed Asbestos	NF*
Wall	N/a	Masonry	Not Applicable	N/A	NA	NA		0	0	0	%	V00001	None	

Showing 1 to 16 of 16 entries

***Legend:**
A - Access; V - Visible; AP - Air Plenum; F - Friable material; NF - Non Friable material; PF - Potentially Friable material

1 GENERAL

- 1.1 The requirements of the Articles of Agreement, Conditions of the Contract, Division 1 apply to and form all Sections of the Contract Documents and the Work.
- 1.2 Work in this Specification is divided into descriptive sections which are not intended to identify absolute contractual limits between Subcontractors, nor between the Contractor and their Subcontractors. The Contractor is responsible for organizing division of labour and supply of materials essential to complete the Contract. The Consultant assumes no liability to act as an arbiter to establish subcontract limits between Sections or Divisions of Work.
- 1.3 It is intended that Work supplied under these Contract Documents shall be complete and fully operational in every detail for the purpose required. Provide all items, articles, materials, services and incidentals, whether or not expressly specified or shown on Drawings, to make finished Work complete and fully operational, consistent with the intent of the Contract Documents.
- 1.4 Work designated as “N.I.C.” is not included in this Contract.
- 1.5 Specifications, Schedules and Drawings are complementary and items mentioned or indicated on one may not be mentioned or indicated on the others.
- 1.6 Contractors finding discrepancies or ambiguities in, or omissions from the Drawings, Specifications or other Contract Documents, or having doubt as to the meaning and intent of any part thereof shall contact the Consultant for clarification. If the Consultant is not contacted for clarification, execute the Work in accordance with the most stringent requirements.
- 1.7 Mention in the specifications or indication on the drawings of materials, products, operations, or methods, requires that the Contractor provide each item mentioned or indicated of the quality or subject to the qualifications noted; perform according to the conditions stated in each operation prescribed; and provide labour, materials, Products, equipment and services to complete the Work.
- 1.8 Where the singular or masculine is used in the Contract Documents, it shall be read and construed as if the plural, feminine or neuter had been used when the context or the statement so requires and as required to complete the Work, and the rest of the sentence, clause, paragraph, or Article shall be construed as if all changes in grammar, gender or terminology thereby rendered necessary had been made.
- 1.9 The terms “approved”, “review”, “reviewed”, “accepted”, “acceptance”, “acceptable”, “satisfactory”, “selected”, “directed”, “instructed”, “required”, “submit”, “permitted” or similar words or phrases are used in standards or elsewhere in Contract Documents, it shall be understood, that words “by (to) the Consultant” follow, unless context provides otherwise.
- 1.10 Where the words 'submit', 'acceptable' and 'satisfactory' are used in the Contract Documents, they shall be considered to be followed by the words 'to the Consultant' unless the context provides otherwise.
- 1.11 The terms “exposed” or “exposed to view” refers to surfaces that are within the line of vision of persons from any accessible viewpoint, both within and without the building. Where any part of a surface is exposed to view, all other portions of that surface shall also be considered as exposed to view.

- 1.12 Contractor to add The Sheridan College and Cherie Ng Architect Inc. as Additional Insured Names in the Contractor's Commercial General Liability insurance policy.
- 1.13 Contractor to forward a copy of their Commercial General Liability Insurance Certificate of Insurance with the Additional Insured Names to the architect at the Pre-Construction Meeting.

2 EXISTING SITE CONDITIONS

- 2.1 Make a careful examination of the site, and investigate and be satisfied as to all matters relating to the nature of the Work to be undertaken, as to the means of access and egress thereto and therefrom, as to the obstacles to be met with, as to the extent of the Work to be performed, any limitations under which the work has to be executed, and any and all matters which are referred to in the Contract Documents.
- 2.2 Report any inconsistencies, ambiguities, discrepancies, omissions, and errors between Site conditions and Contract Documents to the Consultant prior to the commencement of Work. If inconsistencies, ambiguities, discrepancies, omissions, and errors are not reported and clarified, the most stringent requirement shall govern, as determined by the Consultant. Ensure that each Subcontractor performing work related to the site conditions has examined it so that all are fully informed on all particulars which affect the Work thereon in order that construction proceeds competently and expeditiously.
- 2.3 Before commencing the Work of any Section or trade, carefully examine the Work of other Sections and trades upon which it may depend, examine substrate surfaces, and report in writing to the Consultant, defects which might affect new Work. Commencement of Work shall constitute acceptance of conditions and Work of other sections, trades, and Other Contractors upon which the new Work depends. If repair of surfaces is required after commencement of specific work it shall be included in the work of the trade providing the specific system or finish.

3 CONTINUITY OF EXISTING SERVICES

- 3.1 Shutdowns and planning of operations that may affect Owner's use of services shall be coordinated with and in accordance with the Owner's written directions. Provide notice for all required interruptions to utility, heating, cooling, mechanical, electrical, and life safety systems.
- 3.2 Make written requests for shutdown at least 5 working days in advance, unless specifically stated herein or as otherwise instructed by the Owner.
- 3.3 Shutdowns shall be scheduled in advance with Owner and shutdown period shall be minimized to Owner's convenience. Facilities in existing adjacent areas will be occupied during the Work.
- 3.4 Major shutdowns shall take place on weekends or at night by prior arrangement with and at no additional cost to the Owner.
- 3.5 Minimize disruption, vibration, noise and dust to the function of existing building.

- 3.6 These requirements are for security reasons and for the consideration of the Owner. Requirements shall not be construed as cause for elimination or restriction of Contractor's working schedule, claims for delay or work, nor additional cost.

4 ACCESS / PROPERTY CONSTRAINTS

- 4.1 Provide and maintain access facilities as may be required for access to the Work.
- 4.2 Minimize disruption, noise and dust to the functions of existing operational areas of existing buildings. Times of entry, routes of access and time required to complete the Work shall be arranged and scheduled in cooperation with the Owner.
- 4.3 Confine Work and operations of employees to limits indicated by the Contract Documents. Do not unreasonably encumber the premises with products.
- 4.4 Organize delivery of materials/equipment to and removal of debris and equipment from place of Work to permit continual progress of work and suitable for restricted site conditions.
- 4.5 Determine and make arrangement as required for loading and unloading of equipment and Products at times that will not affect public traffic flow and that will be permitted by the Sheridan College. Conform to City by-laws with regard to parking restrictions and other conditions.
- 4.6 Make provisions and arrangements and provide allowances if times for loading and unloading allowed by the Sheridan College are other than regular working hours.
- 4.7 All Products, materials and equipment required on Site shall be portable and/or size suitable for access and movement on Site and without causing damage to buildings.
- 4.8 Workers shall not enter existing building beyond construction areas except where required for connection or modification to existing services or other such work. Arrange such requirements with Owner prior to entering existing occupied areas.
- 4.9 Provide locked doors in barriers, permit access by Owner and Consultant to Work areas and to areas Contractor is responsible for.

5 SETTING OUT

- 5.1 Before commencing work, verify lines, levels and dimensions shown on the drawing and report discrepancies in levels or dimensions to the Consultant. Be responsible for work done prior to the receipt of the Consultant's decision regarding reported discrepancies

6 PARKING

- 6.1 Parking may be permitted on Site provided it does not disrupt the performance of Work, Site safety or the movement of vehicular or pedestrian traffic and is acceptable to the Consultant and permitted by the Sheridan College.

7 COORDINATION

- 7.1 Coordination of the Work of all Sections of the specifications as required to complete the Project is the responsibility of the Contractor.
- 7.2 Coordinate with removals/installations specified in other Divisions and Other Contracts.
- 7.3 Ensure that Subcontractors and trades cooperate with other subcontractors and trades whose work attaches to or is affected by their own work. Ensure that minor adjustments are made to make adjustable work fit fixed work.
- 7.4 Allow access of Owner's Other Contractors on site and to areas of Work. Cooperate and coordinate with such Other Contractors. Schedule work to complement work of such Other Contractors.
- 7.5 Entry by the Owner's own forces and by Other Contractors shall not mean acceptance of the Work and shall not relieve the Contractor of their responsibility to complete the Contract.
- 7.6 Existing equipment shall remain in present locations unless designated otherwise. Protect from damage. Remove, store and reinstall existing fixed equipment, fixtures and components which interfere with construction and which are scheduled for relocation.
- 7.7 Placing, installation, application and connection of work by the Owner's own forces or by Other Contractors on and to the Contractor's Work shall not relieve the Contractor of his responsibility to provide and maintain the specified warranties.
- 7.8 Pay particular attention to types of ceiling construction and clearances throughout, especially where recessed fixtures are required. Coordinate work with Other Contractors and Subcontractors wherever ventilation ducts or piping installations occur to ensure that conflicts are avoided.
- 7.9 Install ceiling mounted components in accordance with final ceiling plans. Inform Consultant of conflicting installations. Install as directed.
- 7.10 Install and arrange ducts, piping, tubing, conduit, equipment, fixtures, materials and products to conserve headroom and space with minimum interference and in neat, orderly and tidy arrangement. Run pipes, ducts, tubing and conduit, vertical, horizontal and square with building grid unless otherwise indicated. Install piping, ducts, and conduit as close to underside of structure as possible unless shown otherwise.
- 7.11 Make provision for unrestricted relocation of light fixtures to replace ceiling panels at grid spaces of the same size, without interference or restriction by items located within the ceiling space.
- 7.12 Where supports or openings are to be left for the installation of various parts of the Work furnish the necessary information to those concerned in ample time so that proper provision can be made for such items. Cutting, drilling and the subsequent patching required for failing to comply with this requirement shall be performed at a later date at no additional Cost to Owner.
- 7.13 Ensure that setting drawings, templates, and all other information necessary for the location and installation of materials, fixtures, equipment, holes, sleeves, inserts, anchors, accessories, fastenings, connections, and access panels are provided by each Section whose work requires cooperative location and installation by other

Sections, and that such information is communicated to the applicable installer. Cutting, fixing and 'making good' of the work of other Contractors, Subcontractors and trades and making up of lost time involved in failing to comply with this requirement shall be performed at no additional Cost to Owner.

- 7.14 Be responsible for coordinating products supplied in metric (SI) and imperial units into the overall layout.
- 7.15 Properly coordinate the work of the various Sections and trades, taking into account the existing installations to assure the best arrangement of pipes, conduits, ducts and refrigeration, mechanical, electrical and other equipment, in the available space. Under no circumstances will any extra payment be allowed due to the failure by the Contractor to coordinate the Work. If required, in critical locations, prepare interference and/or installation drawings showing the work of the various Sections as well as the existing installation, and submit these drawings to the Consultant for review before the commencement of Work.
- 7.16 Protect from damage. Remove, store and reinstall existing fixed equipment, fixtures and components which interfere with construction and which are scheduled for relocation.
- 7.17 Coordinate with structural, refrigeration, mechanical and electrical trades to ensure protecting, supporting, disconnecting, cutting off, capping, diverting, relocating or removing of existing services in areas of Work before commencement of alteration work.
- 7.18 In case of damage to active services or utilities, notify Consultant and respective authorities immediately and make all required repairs under direction of Consultant and respective authorities. Carry out repairs to such damaged services and utilities continuously to completion, including working beyond regular working hours.

8 METRIC DIMENSIONS

- 8.1 Measurements in this specification are expressed in metric (SI) units and depending on the progress made in the various sectors of the industry are either hard or soft converted units.
- 8.2 All metric units specified shall be taken to be the minimum acceptable unless otherwise noted.
- 8.3 It is the Contractor's responsibility to check and verify with manufacturers and suppliers on the availability of materials and products in either metric or imperial sizes. Be responsible for coordinating products supplied in metric (SI) and imperial units into the overall layout.
- 8.4 Where both metric and imperial sizes or dimensions are shown, the metric size or dimension shall govern.

9 BUILDING DIMENSIONS

- 9.1 Take necessary job dimensions for the proper execution of the work. Assume complete responsibility for the accuracy and completeness of such dimensions, and for coordination.

- 9.2 Verify that 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 Drawings, and ensure that work installed in error is rectified before construction resumes.
- 9.3 Check and verify dimensions referring to the work and the interfacing of services.
- 9.4 Do not scale directly from the Drawings. If there is ambiguity or lack of information, immediately inform the Consultant. Changes required through the disregarding of this clause shall be the responsibility of the Contractor.
- 9.5 All details and measurements of any work which is to fit or to conform with work installed shall be taken at the building.
- 9.6 Advise Consultant of discrepancies and if there are omissions on Drawings, particularly reflected ceiling plans and jointing patterns for surfaces finishes, which affect aesthetics, or which interfere with services, equipment or surfaces. Do not proceed with work affected by such items without direction from the Consultant.
- 9.7 Provide written requirements for site conditions and surfaces necessary for the execution of respective work, and provide setting drawings, templates and all other information necessary for the location and installation of material, holes, sleeves, inserts, anchors, accessories, fastenings, connections and access panels. Inform respective contractors whose work is affected by these requirements and preparatory work.

10 INTERFERENCE AND COORDINATION DRAWINGS

- 10.1 Coordinate placement of equipment to ensure that components will be properly accommodated within the spaces provided prior to commencement of work.
- 10.2 Prepare interference and equipment placing drawings to ensure that all components will be properly accommodated within the spaces provided.
- 10.3 Prepare drawings to indicate coordination and methods of installation of a system with other systems where their relationship is critical. Ensure that all details of equipment apparatus, and connections are coordinated.
- 10.4 Take complete responsibility for any remedial work that results from failure to coordinate any aspect of the Work prior to its fabrication/installation.
- 10.5 Ensure that accesses and clearance required by jurisdictional authorities and/or for easy maintenance of equipment are provided in the layout of equipment and services.

11 CUTTING AND PATCHING

- 11.1 Execute Work to avoid damage to other Work.
- 11.2 Execute cutting, fitting and patching including excavation and fill to complete the Work.
- 11.3 Employ appropriate trades with skilled labour to perform cutting Work.
- 11.4 Fit Work segments together, to integrate with penetrations through surfaces and with other Work.

- 11.5 Remove and replace defective and non-conforming Work.
- 11.6 Do any drilling, cutting, fitting, patching and finishing that may be required to make the various classes and kinds of other Work fit together in a professional and finished manner. Make watertight connections with adjoining structures
- 11.7 Provide openings in non-structural elements of Work for penetrations of mechanical and electrical Work.
- 11.8 Execute Work by methods to avoid damage to other Work and which will provide proper surfaces to receive patching and finishing.
- 11.9 Cut Products using proper equipment and methods. On rigid materials, use a masonry saw or core drill. Pneumatic or impact tools are not allowed on masonry work without prior approval.
- 11.10 Where new Work connects with existing structures, cut, patch and make good existing work to match original condition.
- 11.11 Be responsible for correct formation and bridging of openings in masonry and structural walls as required.
- 11.12 Ensure compatibility between installed Products and ensure security of installation.
- 11.13 Restore Work with new Products in accordance with requirements of the Contract Documents.
- 11.14 Fit Work airtight to pipes, sleeves, ducts, conduits and other penetrations through surfaces.
- 11.15 Properly prepare surfaces to receive patching and finishing.
- 11.16 Refinish surfaces to match adjacent finishes; for continuous surfaces refinish to nearest intersection; for an assembly, refinish entire unit.

12 FIRE RATINGS

- 12.1 Where a material, component or assembly is required to be fire rated, the fire rating shall be as determined or listed by one of the following testing authorities acceptable to the authorities having jurisdiction:
- 12.2 Underwriters' Laboratories of Canada.
 - .1 Underwriters' Laboratories Inc.
 - .2 Factory Mutual Laboratories.
 - .3 The National Research Council of Canada.
 - .4 The National Board of Fire Underwriters.
 - .5 Intertek Testing Services.
- 12.3 Where reference is made to only one testing authority an equivalent fire rating as determined or listed by another of the aforementioned testing authorities is acceptable if approved by authorities having jurisdiction. Obtain and submit such approval of authorities, in writing when requesting acceptance of a proposed equivalent rating or test design.

13 FIRE SEPARATIONS

- 13.1 Conform to following requirements to maintain continuity of fire separations whether or not shown on the Contract Drawings.
- 13.2 Fire separations may be pierced by openings for electrical and similar service outlets provided such boxes are non-combustible and are tightly fitted and sealed with a ULC approved sealant for the assembly being sealed.
- 13.3 Construction that abuts on or is supported by a non-combustible fire separation shall be constructed so that its collapse under fire conditions will not cause the collapse of the fire separation.
- 13.4 At penetration through fire rated walls, ceilings or floors, completely seal voids with ULC approved firestopping material; full thickness of the construction element. In locations that require a smoke seal, provide appropriate ULC approved system installed in accordance with the manufacturer's recommendations.

14 CODES

- 14.1 Reference is made to standards in the specifications to establish minimum acceptable standards of materials, products and workmanship. Ensure that materials, products and workmanship meet or exceed requirements of the reference standards specified.
- 14.2 In the event of conflict between documents specified herein, execute the Work in accordance with the most stringent requirements.

15 STANDARDS

- 15.1 Where a material or product is specified in conjunction with a referenced standard, do not supply the material or product if it does not meet the requirements of the standard. Supply another specified material or product, or an acceptable material or product of other approved manufacture which does meet the requirements of the standard, at no additional cost to the Owner.
- 15.2 Where no standard is referred to, provide materials, products and workmanship which meet requirements of the applicable standards of the Canadian Standards Association, and Canadian General Standards Board.
- 15.3 If there is question as to whether a material, product or system is in conformance with applicable standards, the Consultant reserves the right to have such materials, products or systems tested to prove or disprove conformance. The cost for such testing will be paid by the Owner in the event of conformance with contract Documents or by the Contractor in the event of non-conformance.
- 15.4 Where application, installation and workmanship standards are cited, it is intended that referenced standards form the basis for minimum requirements of the specified item and specifications supplement the standards unless specified otherwise.
- 15.5 Matters may be dealt with in part by these specifications which are also dealt with, under the same or similar headings in cited standard. It is not intended that these

specifications take the place of the standards but supplement them, unless specified otherwise.

- 15.6 Where reference is made to manufacturer's directions, instructions or specifications they shall include full information on storing, handling, preparing, mixing, installing, erecting, applying, or other matters concerning the materials pertinent to their use and their relationship to materials with which they are incorporated.

16 PRE-CONSTRUCTION MEETING

- 16.1 Attend a pre-construction meeting, arranged and conducted by the Consultant.
- 16.2 Co-ordinate and organize attendance by representatives of major Subcontractors and parties in contract with the Contractor.
- 16.3 Consultant will arrange attendance of other interested parties not responsible to the Contractor.
- 16.4 Consultant will distribute copies of Agenda prior to meeting.
- 16.5 Be prepared to provide specific information relative to agenda items as they are pertinent to the Contract.
- 16.6 Record minutes of meeting and distribute type written copies to all participants and other interested parties, within one week of meeting date.

17 PROGRESS MEETINGS

- 17.1 Attend regularly scheduled progress meetings to be held on Site at times and dates that are mutually agreed to by the Owner, Consultant, and Contractor.
- 17.2 Co-ordinate and organize attendance of individual Subcontractors and material suppliers when requested. Relationships and discussions between Subcontractor participants are not the responsibility of the Consultant and do not form part of the meetings content.
- 17.3 Ensure that Contractor representatives in attendance at meetings have required authority to commit Contractor to actions agreed upon. Assign same persons to attend such meetings throughout the contract period.\
- 17.4 Inform the Consultant in advance of meetings regarding all items to be added to the agenda.
- 17.5 Consultant will distribute copies of Agenda prior to meeting.
- 17.6 Be prepared to provide specific information relative to agenda items at each meeting as they are pertinent to the Contract.
- 17.7 Agenda will include but not be limited to the following topics as are pertinent to the Contract.
- .1 Review and agreement of previous minutes.
 - .2 Construction safety.
 - .3 Status of submittals.
 - .4 Quality control.
 - .5 Co-ordination.

- .6 Contract Schedule.
 - .7 Work plan up to next scheduled meetings.
 - .8 Requests for information/clarification.
 - .9 Contemplated changes.
- 17.8 Record minutes of meeting and distribute type written copies to all participants and other interested parties, within one week of meeting date.
- 18 PRODUCT DATA**
- 18.1 Before delivery of Products to the Site, submit Product data as specified in each section or as requested by the Consultant.
- 18.2 Submit manufacturer's Product data for systems, materials, and methods of installation proposed for use. Such literature shall identify systems, each component, and shall certify compliance of each component with applicable standards
- 19 SAMPLES**
- 19.1 Before delivery of Products to the Site, submit samples of Products as specified or as requested by the Consultant. Label samples as to origin and intended use in the Work and in accordance with the requirements of the Specification Sections. Samples must represent physical examples to illustrate materials, equipment or work quality and to establish standards by which completed Work is judged.
- 19.2 Ensure samples are of sufficient size and quantity, if not already specified, to illustrate:
- .1 The quality and functional characteristics of Products, with integrally related parts and attachment devices.
 - .2 Full range of colours available.
- 19.3 Notify the Consultant in writing, at time of submission, of any deviations in samples from requirements of the Contract Documents, and state the reasons for such deviations.
- 19.4 Identify samples with Project name, Contract number, date, Contractor's name, number and description.
- 19.5 If samples are not acceptable, both samples will be returned. If samples are acceptable, one sample will be so indicated and returned. Be responsible for the cost of samples that are not accepted and for resubmission of samples.
- 19.6 Acceptable samples shall serve as a model against which the products incorporated in the work shall be judged.
- 19.7 Each Product incorporated in the Work shall be precisely the same in all details as the acceptable sample.
- 19.8 Should there be any change from the accepted sample, submit in writing for approval of the revised characteristics and resubmit samples of the Product for approval if requested.
- 19.9 When samples are very large, require assembly, or require evaluation at the Site, they may be delivered to the Site, but only with approval and as directed.

20 SHOP DRAWINGS

- 20.1 Arrange for the preparation of shop drawings as called for in the Contract Documents or as may be reasonably requested by the Consultant. The Contractor and each Subcontractor shall operate as experts in their respective fields and all shop drawings and samples shall conform to the requirements of the Contract Documents.
- 20.2 The term “shop drawings” means drawings, diagrams, schematics, illustrations, schedules, performance charts, brochures and other data which are required to illustrate details of the Work.
- 20.3 In addition to shop drawings specified in the specification sections, submit shop drawings required by jurisdictional authorities in accordance with their requirements.
- 20.4 Shop drawings shall indicate the following minimum criteria and any additional criteria indicated in the individual specification sections requiring shop drawings:
- .1 Clear and obvious notes of any proposed changes from the Contract Documents.
 - .2 Fabrication and erection dimension.
 - .3 Provisions for allowable construction tolerances and deflections provided for live loading.
 - .4 Details to indicate construction arrangements of the parts and their connections, and interconnections with other work.
 - .5 Location and type of anchors and exposed fastenings.
 - .6 Materials, physical dimensions including thicknesses, and finishes.
 - .7 Descriptive names of equipment.
 - .8 Information to verify that superimposed loads will not affect function, appearance, and safety of the work detailed as well as of interconnection work.
 - .9 Assumed design loadings, and dimensions and material specifications for loadbearing members.
- 20.5 Include in shop drawing submissions detailed information, templates, and installation instructions required for incorporation and connection of the Work.
- 20.6 Before submitting to the Consultant, review all shop drawings to verify that the Products illustrated therein conform to the Contract Documents. By this review, the Contractor agrees that it has determined and verified all field dimensions, field construction criteria, materials, catalogue numbers and similar data and that it has checked and coordinated each shop drawing with the requirements of the Work and of the Contract Documents. The Contractor's review of each shop drawing shall be indicated by stamp, date and signature of a qualified and responsible person possessing the appropriate authorization.
- 20.7 Be responsible for dimensions to be confirmed and correlated at the Site, for information that pertains solely to fabrication processes or to techniques of construction and installation and for coordination of the Work of all subtrades.
- 20.8 Submit shop drawings for the Consultant's review with reasonable promptness and in orderly sequence so as to cause no delay in the Work nor in the work of Other Contractors. At the time of submission, notify the Consultant in writing of any deviations in the shop drawings from the requirements of the Contract Documents. The Contractor will be held responsible for changes made from the Contract

Documents which are not indicated or otherwise communicated in writing with the submission.

- 20.9 Drawings submitted by the Contractor as required herein are the property of the Owner who may use and duplicate such drawings where required in association with the Work.
- 20.10 Submit shop drawings, as indicated in each section of the Work, signed and sealed by a licensed Professional Engineer registered in the place of the Work.
- 20.11 Shop drawings shall have distinct, uniform letters, numerals and line thicknesses that will ensure the production of clear legible prints and also facilitate reduced reproduction.
- 20.12 Shop drawings shall contain the following identification:
- .1 Project name and Contract number.
 - .2 Applicable 6-digit Contract Specification number describing the item.
 - .3 Location (unit, level, room number, etc.).
 - .4 Name of equipment or Product.
 - .5 Name of Subcontractor or supplier.
 - .6 Signature of Contractor certifying that Shop drawing is in conformance with Contract Documents.
 - .7 On submissions subsequent to the first, the following additional identification:
 - .1 The revision number.
 - .2 Identification of the item(s) revised.
- 20.13 Dimensions and designations of elements shall be shown in the same system of measurement used on the applicable Contract Drawings.
- 20.14 Consultant reserves the right to refuse acceptance of drawing submissions not meeting the above requirements.
- 20.15 Consultant's review will be for conformity to the design concept and for general arrangement only and such review shall not relieve the Contractor of responsibility for errors or omissions in the shop drawings or of responsibility for meeting all requirements of the Contract Documents unless a deviation on the shop drawings has been approved in writing by the Consultant. Review does not mean that Consultant approves detail inherent in shop drawings, responsibility which shall remain with Contractor submitting same.
- 20.16 Contractor shall make any changes in shop drawings which the Consultant may require consistent with the Contract Documents and re-submit unless otherwise directed by the Consultant. When re-submitting the shop drawings, the Contractor shall notify the Consultant in writing of any revisions other than those requested by the Consultant.
- 20.17 Only drawings noted for revision and resubmission need be resubmitted.
- 20.18 File one copy of each submitted shop drawing at the Site.
- 20.19 Allow two weeks for the Consultant's review of each submission.

21 CERTIFICATES

- 21.1 Submit certificates that are required by authorities having jurisdiction or that are requested in the specification sections.
- 21.2 Clearly show on each certification the name and location of the Work, name and address of Contractor, quantity and date of shipment and delivery and name of certifying company.
- 21.3 Certificates shall verify that Products and/or methods meet the specified requirements and shall include test reports of acceptable testing laboratories to validate certificates.
- 21.4 Submit certificates in duplicate and signed by an authorized representative of the certifying company

22 CERTIFICATION OF TRADESPERSON

- 23 Provide certificates, at the request of the Consultant, to establish qualifications of personnel employed on the Work where such certification is required by authorities having jurisdiction, by the Consultant or by the Contract Documents.

24 EXTENDED WARRANTIES

- 24.1 Submit extended warranties as requested in sections of the Specifications showing title and address of Contract, warranty commencement date and duration of warranty.
- 24.2 Extended warranties shall commence on termination of the standard warranty specified in the conditions of the contract and shall be an extension of these provisions. Clearly indicate what is being warranted and what remedial action is to be taken under the warranty. Ensure warranty bears the signature and seal of the Contractor.
- 24.3 Submit each extended warranty on a form that is acceptable to the Owner and Consultant.

25 SAFETY

- 25.1 For the purposes of the Contract, the term "Constructor", as defined in the Occupational Health and Safety Act, shall mean the Contractor who shall be responsible for ensuring that the provisions of the statutes, regulations and by-laws pertaining to the safe performance of the Work are to be observed. The "Constructor" shall submit the Notice of Project.
- 25.2 In the event of conflict between any of the provisions of Statutes, Regulations and Bylaws, and other requirements of authorities, the most stringent provision applies.
- 25.3 The Contractor's representative shall be responsible for ensuring that the provisions of statutes, regulations and by-laws pertaining to safe performance of the Work and the work of Other Contractors and Owner's own forces working on the Site are observed and that the methods of performing the Work do not endanger the personnel employed thereon nor the general public, and are in accordance with the latest edition of the Occupational Health and Safety Act. Include on the Joint Health and Safety Committee representatives of Other Contractors working on Site.

25.4 Prior to the Contractor's representative being absent from the Site for an extended period during execution of the Work, the Contractor's representative will name, in writing to the Consultant, another person who is competent to assume these responsibilities. The Contractor shall advise the Consultant of change of the individual identified as the Contractor's representative.

25.5 At the discretion of the Consultant, the "Constructor" designation may be transferred to/from a Contractor at any time at no additional cost to the Owner.

26 PROJECT RESPONSIBILITIES

26.1 The Contractor's representative shall ensure that:

26.2 All measures and procedures prescribed by the following Acts and Regulations are carried out on Site:

- .1 The Occupational Health and Safety Act;
- .2 The Regulations for Construction Projects;
- .3 WHMIS Regulations;
- .4 The Environmental Protection Act and regulations,
- .5 COVID-19 Construction Practice
- .6 All other legislation, regulations and standards as applicable.

26.3 Every employer and every worker performing Work on the Site must comply with the requirements referred to above.

26.4 Ensure that the health and safety of workers, employees of the Owner and the general public are protected in relation to the Work performed on the Site.

27 WORKPLACE HAZARDOUS MATERIALS INFORMATION SYSTEM (WHMIS)

27.1 Be familiar with and comply with WHMIS regulations.

27.2 Properly label controlled products. Provide proper warning labels and training at the Site.

27.3 Maintain on site for duration of Contract a hazardous materials log containing all required MSDS. Log shall be open for inspection by Owner, Consultant and all personnel on Site.

27.4 Provide copies of material safety data sheets (MSDS) for any controlled products prior to delivery to the Site.

27.5 Be responsible for all applicable requirements of the regulations.

27.6 Before commencing any Work on Site, attend the pre-construction meeting and provide the Consultant with a proposal as to how hazardous materials will be stored and dispensed on Site. In addition, specifically outline the measures which will be undertaken to prevent damage or injury in the event of an accidental spill.

27.7 Provide "Handling Procedure for Hazardous Materials".

28 JOINT HEALTH AND SAFETY COMMITTEE

- 28.1 The Contractor shall be responsible for the establishment and operation of the Joint Health and Safety Committee as required by the Occupational Health and Safety Act.

29 SAFETY DELIVERABLES

- 29.1 The Contractor shall deliver to the Consultant:
- .1 The Contractor's Occupational Health and Safety Policy.
 - .2 The Contractor's safety program to implement the Occupational Health and Safety Policy for the Contract, which will effectively prevent and control accidents for the Contract.
 - .3 A copy of all communications with, and including all orders by, the Ministry of Labour or other occupational health and safety enforcement authority.
 - .4 A copy of all accident/injury investigation reports, not just the WSIB Form 7 Employer's Report of Injury Disease. Each report must contain a statement of actions that will be taken to prevent a recurrence.
 - .5 A copy of all inspection reports made by the Contractor in compliance with the employer's responsibility under the Occupational Health and Safety Act.
 - .6 A copy of all safety information pertaining to the Contract made and furnished by the Contractor's own "Safety Personnel" or outside consultants/advisers engaged for the purpose of inspecting the workplace for occupational health and safety.
 - .7 A verification that all workers in the employ of the Contractor on Site, have had a WHMIS training or refresher course within the last twelve months.
 - .8 A verification that all workers in the employ of the Contractor have had "Explosive Activated Tool Training" on the type of tools being used.
 - .9 A verification that the instruction manuals are on Site for all tools and equipment being used.
 - .10 A copy of the most recent workers compensation experience rating account, i.e. CAD-7, NEER, and/or an insurance carrier's experience rating account.
 - .11 Statistical information for the purpose of determining injury frequency and severity rates (hours worked, first-aid injuries, medical aid injuries, lost time injuries, restricted workday injuries, near-miss accident/incident and significant occurrence data), in a timely manner as required by the Consultant.
 - .12 The immediate reporting to the Consultant of all instances that are defined in the Occupational Health and Safety Act as "Notices of Injuries" and "Occurrences" and any occasion that a worker exercises their "Right to Refuse Unsafe Work".
 - .13 The Consultant reserves the right to require additional or amended deliverables pertaining to safety during the duration of the Work at no additional cost to the Owner.
 - .14 Items specified above shall be delivered to the Consultant prior to the Contractor commencing Work on the Site.

30 DUE DILIGENCE

- 30.1 The Contractor acknowledges that it has read and understands the measures and procedures relating to occupational health and safety as prescribed above. The Contractor acknowledges and understands its duties as therein set out and hereby

expressly undertakes and agrees to comply with all such requirements and standards in their entirety and at the Contractor's expense.

- 30.2 The Contractor further agrees to fully cooperate with all health and safety requirements, rules, regulations, standards and criteria set out in the Contract Documents, which agreement is in furtherance of the Contractor's duties and responsibilities under occupational health and safety legislation.
- 30.3 The Contractor agrees that if, in the opinion of the Consultant or Owner, the health and safety of a person or persons is endangered or the effective operation of the system put in place to ensure the health and safety of workers on the Site is not being implemented, the Consultant or Owner may take such action as it deems necessary and appropriate in the circumstances, including, without limitation, the following:
 - 30.4 Require the Contractor to remedy the condition forthwith at its own expense;
 - 30.5 Require that the Site be shut down in whole or in part until such time as the condition has been remedied;
 - 30.6 Remedy the problem and the Owner shall back-charge the Contractor for the cost of such remedial work, together with an appropriate overhead factor as determined by the Owner in its sole discretion; and
 - 30.7 Terminate the Contract without further liability in the event the Contractor fails to comply with these provisions.
- 30.8 If a lien is registered, in respect to any monies held back, back-charged or assessed in accordance with these paragraphs, the Contractor shall consent to an order vacating such registration and shall indemnify the Owner for any and all loss, whereby direct or consequential which the Owner may sustain as a consequence of such registration.

31 SITE SAFETY PERSONNEL

- 31.1 In the event the Consultant deems it necessary, because of the Work, the Contractor shall assign a "Competent Safety Person" to assist the Contractor's representative in the discharging of safety responsibility, at no additional cost to the Owner.

32 PROGRESS PHOTOGRAPHS

- 32.1 Concurrently with monthly application for payment submit digital pictures by online cloud storage illustrating the progress of the Work as follows:
 - .1 A minimum of 20 pictures that best illustrate the progress on the site.
 - .2 Pictures shall be in focus and properly illuminated; view shall be unobstructed.
 - .3 Pictures shall be taken with a minimum 5 megapixel camera or better such that quality and details can be discerned from photo.
 - .4 The Pictures shall either have an accurate date-stamp present in the photo, or be numbered and dated in the digital filename.
 - .5 The photo's shall be labeled with the following information: The project name, the period the pictures are taken in, the monthly application number which the pictures are associated with.

33 SCHEDULES

33.1 Be responsible for planning and scheduling of the Work. As a minimum, prepare and update the following schedules:

- .1 Contract Schedule.
- .2 Detailed Construction Schedule.

33.2 Be responsible for ensuring that Subcontractors plan and schedule their respective portions of the Work. Subcontractor's schedules shall form part of the above mentioned schedules.

33.3 Contract Schedule:

- .1 Prepare and submit the Contract Schedule within two weeks following award of Contract. This schedule, once it is reviewed by the Consultant and if it meets the Consultant's project requirements, will become contractual.
- .2 The Contract Schedule shall be developed using a logic network technique for planning and scheduling.
- .3 The Contract Schedule shall be submitted for approval in its optimum levelled form. This presentation may be in either a time scaled network or a bar chart form. It shall be subdivided into either work areas or systems as applicable.
- .4 The Contract Schedule shall include the following information:
 - .1 Starting and ending dates of each activity including the float periods;
 - .2 Manpower requirements for each activity;
 - .3 Interdependency with activities of other Contractors;
 - .4 Dates specified in the Contract Documents;
 - .5 Dates on which specific data will be required for submittal, i.e., Vendor data, drawings for review, etc.
- .5 This schedule shall be reviewed and updated monthly by the Contractor so as to reflect any Contract changes as well as major changes to the schedule

33.4 Detailed Construction Schedule:

- .1 Prepare and submit a detailed construction schedule within two weeks of final review and acceptance of the Contract Schedule. This schedule, once it is reviewed and accepted by the Consultant, will be updated and submitted monthly with the Contract Schedule and weekly once the Contractor starts on Site.
- .2 This schedule shall cover the construction period. It will show, in detail, activities on a daily basis indicating durations, manpower and constraints. The activities shown on this schedule shall further clarify or detail the activities shown on the Contract Schedule.
- .3 The detailed construction schedule shall be presented in a bar chart form.

34 INSPECTION AND TESTING BY THE OWNER

34.1 The Consultant, on behalf of the Owner may appoint an independent inspection and testing company to carry out inspection and testing of the Work for conformance to the Contract Documents. Such costs for inspection and testing will be paid by the Owner.

However, any additional inspection and testing due to non-conformance to the Contract Documents shall be at the Contractor's expense.

34.2 Inspections and testing by the independent inspection and testing company will be promptly made. Uncover for examination any Work covered up prior to inspection or without approval of the Consultant. Make good such Work at no cost to the Owner.

34.3 The Owner may inspect and test Products during manufacture, fabrication, shop testing, installation, construction and testing phases of the Contract. The Consultant will ascertain the quantity and quality of testing to be performed. Inspection and testing may be performed at the place of manufacture/fabrication, storage, or at the Site as designated by the Consultant. Where inspection and testing is done either during manufacture, fabrication, or at Site, ensure that proper facilities and assistance are provided.

35 INSPECTION AND TESTING

35.1 Source and Field Quality Control specified in Other Sections:

- .1 This Section includes requirements for performance of inspection and testing specified under Source Quality Control and Field Quality Control in other Sections of the specifications.
- .2 Do not include in work of this Section responsibilities and procedures that relate solely to an inspection and testing company's functions that are specified in another Section which is paid for directly by the Owner. Such information is included in this Section for Contractor's information only.

36 QUALIFICATIONS OF INSPECTION AND TESTING COMPANIES

36.1 Inspection and testing companies to be certified by the Standards Council of Canada (SCC) or Canadian Council of Independent Laboratories (CCIL).

36.2 Companies engaged for inspection and testing shall provide equipment, methods of recoding and evaluation, and knowledgeable personnel to conduct tests precisely as specified in reference standards.

36.3 If requested, submit affidavits and copies of certificates of calibration made by an accredited calibrator to verify that testing equipment was calibrated and its accuracy ensured within the previous twelve months.

37 RESPONSIBILITIES OF THE CONTRACTOR DURING INSPECTION AND TESTING PROCEDURES

37.1 Be responsible for quality control methods and procedures to ensure performance of the work in accordance with the Contract Documents.

38 RESPONSIBILITIES OF INSPECTION AND TESTING COMPANIES

- 38.1 Determine from specifications and Drawings the extent of inspection and testing required for Work of the Contract. Subcontractors shall notify Consultant of any omissions or discrepancies in the work inspected and/or tested.
- 38.2 Perform applicable inspection and testing described in the Specifications and as may be additionally directed.
- 38.3 Provide competent inspection and testing personnel when notified by the Contractor that applicable work is proceeding. Inspection personnel shall cooperate with the Consultant and Contractor to expedite the Work.
- 38.4 Subcontractors shall notify the Consultant and Contractor of deficiencies and irregularities in the Work immediately when they are observed in the course of inspection and testing.
- 38.5 Inspection and testing companies shall not perform or supervise any of the Contractor's work, and shall not authorize:
- 38.6 Performance of work that is not in strict accordance with the Contract Documents.
- 38.7 Approval or acceptance of any part of the Work.

39 INSPECTION AND TESTING PROCEDURES

- 39.1 Perform specified inspection and testing only in accordance with specified reference standards, or as otherwise approved.
- 39.2 Observe and report on compliance of the Work to requirements of Contract Documents.
- 39.3 Ensure that inspectors are on site or at fabricator's operations for full duration of critical operations, and as otherwise required to determine that the Work is being performed in accordance with the contract Documents.
- 39.4 Identify samples and sources of materials.
- 39.5 Review and report on progress of the work. Report on count of units fabricated and inspected at fabricator's operations.
- 39.6 Observe and report on conditions of significance to work in progress at time of inspection or at fabricator's operations. Include where applicable and if critical to the work in progress:
 - .1 Time and date of inspection.
 - .2 Temperature of air, materials, and adjacent surfaces.
 - .3 Humidity of air, and moisture content of materials and adjacent materials.
 - .4 Presence of sunlight, wind, rain, snow and other weather conditions.
 - .5 Include in reports all information critical to inspection and testing.
 - .6 Ensure that only materials from the work and intended for use therein are tested.
 - .7 Determine locations for work to be tested.

40 TOLERANCES FOR INSTALLATION OF WORK

- 40.1 Unless specifically indicated otherwise, Work shall be installed plumb, level, square and straight.

- 40.2 Unless acceptable tolerances are otherwise specified in specification sections or are otherwise required for proper functioning of equipment, site services, and mechanical and electrical systems:
- .1 "Plumb and level" shall mean plumb or level within 1 mm in 1 m.
 - .2 "Square" shall mean not in excess of 10 seconds lesser or greater than 90 degrees.
 - .3 "Straight" shall mean within 1 mm under a 1 m long straightedge.
 - .4 "Flush" shall mean within:
 - .1 6 mm for exterior concrete, masonry, and paving materials.
 - .2 1 mm for interior concrete, masonry, tile and similar surfaces.
 - .3 0.05 mm for other interior surfaces.
- 40.3 Allowable tolerances shall not be cumulative.

41 DEFECTS

- 41.1 Defective products, materials and workmanship found at any time prior to Contract Completion will be rejected regardless of previous inspections, testing, and reviews of the Work. Inspections, testing, and reviews shall not relieve the Contractor from their responsibility, but are a precaution against oversight or error. Remove and replace defective and rejected products, materials, systems, and workmanship. Be responsible for delays and expenses caused by rejection.

42 DOCUMENTS ON SITE

- 42.1 Maintain at job site, one copy of each of the following:
- .1 Contract Documents including Drawings, Specifications, Addenda, and other modifications to the Contract.
 - .2 'Reviewed' or 'Reviewed as Modified' Shop Drawing
 - .3 Project Construction and Shop Drawing Schedules. Site Instructions and Change Orders.
 - .4 Field Test Reports.
 - .5 Reports by Authorities having Jurisdiction. Building and other applicable permits.
 - .6 Daily log including:
 - .1 Weather conditions.
 - .2 Excavation conditions
 - .3 Start and finish date of each Trade Contractor.
 - .4 Erection and removal dates of formwork.
 - .5 Date, quantities and particulars of each concrete pour.
 - .6 Dates and quantities and particulars of roofing and waterproofing work. Visits to the Site by Owner, Consultants, Jurisdictional Authorities, Testing and Inspection companies, and material and equipment supplier representatives.
 - .7 Material Safety Data Sheet pursuant to WHMIS (Occupational Health & Safety Act).

- .8 As-built drawings recording as-built conditions, instructions, changes for structure, equipment, wiring, plumbing, etc., prior to being concealed.
- .9 Copies of applicable codes.
- .10 The above material shall be made available to the Consultant at their request.

43 DRAINAGE

- 43.1 Layout and construct work to ensure that positive drainage is provided to floor drains, ditches, site drains and catch basins, as set in their final position, preventing undrained areas and ponding.
- 43.2 Ensure that allowable construction tolerances and structural deflection do not cause ponding of water.
- 43.3 Report to Consultant in writing prior to executing work affected, in case adequate drainage cannot be provided.

44 REGULATORY REQUIREMENTS

- 44.1 The Building Code - Ontario Regulation 332/12, including all amendments, shall govern the construction of the Work.
- 44.2 The CSA B52 Standard – Mechanical Refrigeration Code
- 44.3 Comply with all By-Laws and regulations of authorities having jurisdiction. These codes and regulations constitute an integral part of the Contract Documents.
- 44.4 Owner shall apply and pay for Municipal Building Permit, and Contractor shall obtain and pay for all other permits, licenses, deposits, and certificates of inspection as part of the Contract Price as per Conditions of the Contract. Ensure that permits, licenses, deposits, and certificates included under specific Sections are provided as specified.
- 44.5 If required, pay for construction damage deposit required by authorities having jurisdiction.
- 44.6 Where permits, licences, and inspection fees are required by authorities having jurisdiction for specific trade functions, they shall be obtained by particular subtrade responsible for that work.
- 44.7 Arrange for inspection, testing of Work and acceptance required by the authorities having jurisdiction. Be responsible for necessary preparations, provisions and pay all associated costs.
- 44.8 Be responsible for ensuring that no work is undertaken which is conditional on permits, approvals, reviews, licences, fees, until all applicable conditions are met. No time extension will be allowed for delay in obtaining necessary permits.
- 44.9 Any additional work or changes to the materials due to Work not complying with the Ontario Building Code and Regulations as indicated by the Building Inspector shall be changed. All costs involved shall be borne by Contractor.
- 44.10 Obtain permit required to work on Municipal rights of way. Provide damage deposits for sidewalks, roads and services work, as applicable.

- 44.11 Give notice of completion of project prior to occupancy, as required by applicable legislation.

45 EXISTING PUBLIC SERVICE LINES

- 45.1 Where existing public services are indicated to be removed and/or relocated, perform Work in compliance with authorities having jurisdiction.
- 45.2 Make good public roads, walkways and curbs soiled or damaged due to construction to the requirements of local authorities.

46 CODES

- 46.1 Reference is made to standards in the specifications to establish minimum acceptable standards of materials, products and workmanship. Ensure that materials, products and workmanship meet or exceed requirements of the reference standards specified.
- 46.2 In the event of conflict between documents specified herein, execute the Work in accordance with the most stringent requirements.

47 STANDARDS

- 47.1 Where a material or product is specified in conjunction with a referenced standard, do not supply the material or product if it does not meet the requirements of the standard. Supply another specified material or product, or an acceptable material or product of other approved manufacture which does meet the requirements of the standard, at no additional cost to the Owner.
- 47.2 Where no standard is referred to, provide materials, products and workmanship which meet requirements of the applicable standards of the Canadian Standards Association, Canadian General Standards Board, Ontario Provincial standard specifications (OPSS), Ontario Provincial Standard Drawings (OPSD) and the applicable building code. References to "Measurement for Payment" and "Basis of Payment" in OPSS standard documents are not applicable to this Contract.
- 47.3 If there is question as to whether a material, product or system is in conformance with applicable standards, the Consultant reserves the right to have such materials, products or systems tested to prove or disprove conformance. The cost for such testing will be paid by the Owner in the event of conformance with contract Documents or by the Contractor in the event of non-conformance.
- 47.4 Where application, installation and workmanship standards are cited, it is intended that referenced standards form the basis for minimum requirements of the specified item and specifications supplement the standards unless specified otherwise.
- 47.5 Matters may be dealt with in part by these specifications which are also dealt with, under the same or similar headings in cited standard. It is not intended that these specifications take the place of the standards but supplement them, unless specified otherwise.
- 47.6 Where reference is made to manufacturer's directions, instructions or specifications they shall include full information on storing, handling, preparing, mixing, installing,

erecting, applying, or other matters concerning the materials pertinent to their use and their relationship to materials with which they are incorporated.

47.7 Where standards, specifications, associations, and regulatory bodies are listed in the Specifications by their abbreviated designations. These are but not limited to the following:

- .1 The Aluminium Association
- .2 Architectural Aluminium Manufacturers Association
- .3 American Association of State Highway and Transportation Officials
- .4 American Concrete Institute
- .5 Anti-Friction Bearing Manufacturer's Association
- .6 American Institute of Electrical Engineers
- .7 American Iron and Steel Institute
- .8 Air Movement and Control Association
- .9 Association of Municipal Electric Utilities
- .10 American National Standards Institute
- .11 Air-Conditioning and Refrigeration Institute
- .12 American Standards Association
- .13 American Society of Heating, Refrigeration and Air Conditioning Engineers
- .14 American Society of Mechanical Engineers
- .15 American Society of Testing and Materials
- .16 Architectural Woodwork Manufacturers Association of Canada American Water Works Association
- .17 Canadian Electrical Manufacturer's Association
- .18 Canadian Gas Association
- .19 Canadian General Standards Board
- .20 Canadian Institute of Steel Construction
- .21 Canadian Mortgage and Housing Corporation
- .22 Canadian Paint Manufacturers Association
- .23 Council of Forest Industries of British Columbia
- .24 Canadian Roofing Contractors Association
- .25 Canadian Standards Association
- .26 Canadian Sheet Steel Building Institute
- .27 Canadian Welding Bureau
- .28 Canadian Wood Council
- .29 Electrical and Electronic Manufacturers Association Canada Factory Mutual
- .30 Institute of Electrical and Electronic Engineers
- .31 Maple Flooring Manufacturers Association
- .32 Military Standards
- .33 Manufacturer's Standardization Society
- .34 Ministry of Transportation Ontario
- .35 National Association of Architectural Metal Manufacturers National Fire Protection Association
- .36 National Electrical Manufacturer's Association (U.S.A.) National Lumber Grades Authority
- .37 National Research Council of Canada
- .38 Ontario Concrete Block Association
- .39 Ontario Hydro Electrical Safety Code
- .40 Ontario Provincial Standard Specification
- .41 Porcelain Enamel Institute

- .42 Plumbing Drainage Institute
- .43 Public Health Act
- .44 Sheet Metal and Air Conditioning Contractors National Association
- .45 Steel Structures Painting Council
- .46 Tubular Exchange Manufacturer's Association
- .47 Terrazzo, Tile and Marble Association of Canada Underwriters Laboratories Inc. (U.S.)
- .48 Underwriters Laboratories of Canada

48 FIRE RATINGS, ASSEMBLIES AND SEPARATIONS

- 48.1 Where a material, component, assembly, or separation is required to be fire rated, the fire rating shall be as determined or listed by one of the following testing authorities acceptable to the authorities having jurisdiction:
- .1 Underwriters' Laboratories of Canada.
 - .2 Underwriters' Laboratories Inc.
 - .3 Factory Mutual Laboratories.
 - .4 The National Research Council of Canada.
 - .5 The National Board of Fire Underwriters.
 - .6 Intertek Testing Services.
- 48.2 Where reference is made to only one testing authority an equivalent fire rating as determined or listed by another of the aforementioned testing authorities is acceptable if approved by authorities having jurisdiction. Obtain and submit such approval of authorities, in writing when requesting acceptance of a proposed equivalent rating or test design.
- 48.3 Fire rated door assemblies shall include doors, frame, anchors, and hardware and shall bear label of fire rating authority showing opening classification and rating.
- 48.4 Material having a fire hazard classification shall be applied or installed in accordance with fire rating authorities printed instructions.
- 48.5 Fire rated assemblies shall be constructed in accordance with applicable fire test report information issued by fire rating authority. Deviation from fire test report will not be allowed.
- 48.6 Construct fire separations as continuous, uninterrupted elements except for permitted openings. Extend fire rated walls and partitions from floor to underside of structural deck above.
- 48.7 Fire separations may be pierced by openings for electrical and similar service outlets provided such boxes are non-combustible and are tightly fitted and sealed with a ULC approved sealant for the assembly being sealed.
- 48.8 Construction that abuts on or is supported by a non-combustible fire separation shall be constructed so that its collapse under fire conditions will not cause the collapse of the fire separation.
- 48.9 Do not use combustible members, fastenings, attachments and similar items to anchor electrical, mechanical or other fixtures to fire separations.
- 48.10 At penetration through fire rated walls, ceilings or floors, completely seal voids with ULC approved firestopping material; full thickness of the construction element. In

locations that require a smoke seal, provide appropriate ULC approved system installed in accordance with the manufacturer's recommendations.

49 TEMPORARY CONTROLS

- 49.1 Hoarding, fencing and barriers:
- .1 Before commencing operations, supply, erect and maintain hoarding, fencing, and barriers around work area. Paint outside of hoarding in a colour selected by the Consultant and mark with "POST NO BILLS" signs.
 - .2 Provide temporary enclosures as required to protect the building in its entirety or in its parts, against the elements, to maintain environmental conditions required for work within the enclosure, and to prevent damage to materials stored within.
 - .3 Provide lockable gates through hoarding, fencing, and barriers for access to Site by workers and vehicles.
- 49.2 Prevent unauthorized entry to the Site. Barricade, guard or lock access points to the satisfaction of the Consultant and post "NO TRESPASSING" signs.
- 49.3 Install signs for movement of people around Work Site as required and directed by the Consultant.
- 49.4 Provide secure, rigid guide rails and barricades around open shafts, open edges of floors and roofs as required for protection of Work, workers, and the public.
- 49.5 Remove hoarding, fencing, barriers, building enclosures, guide rails and barricades upon Contract Completion unless otherwise noted on the Contract Drawings or as directed by the Consultant.

50 SERVICE AND UTILITY SYSTEMS

- 50.1 Consult with utility companies and other authorities having jurisdiction to ascertain the locations of existing services on or adjacent to site.
- 50.2 Information as to the location of existing services, if shown on the Drawings, does not relieve the Contractor of his responsibility to determine the exact number and location of existing services.
- 50.3 Give proper notices for new services as may be required. Make arrangements with authorities and utilities for service connections required.
- 50.4 Pay any charges levied by utilities or authorities for work carried out by them in connection with this Contract, unless specified otherwise.
- 50.5 Operate and maintain all utility systems affected by work of this Contract, until the building or specific portions thereof have been accepted by the Owner.
- 50.6 Report existing unknown services encountered during excavation to Consultant for instructions; cut back and cap or plug unused services. Be responsible for the protection of all active services encountered and for repair of such services if damaged.

50.7 SCAFFOLDING, HOISTS AND CRANES

Select, operate, and maintain scaffolding, hoisting equipment and cranes as may be required.

- .1 Do not erect or operate equipment that will endanger existing structures, local municipalities hydro installations, or traffic signals.
- .2 Design and construct scaffolding in accordance with CAN/CSA S269.2-M.

50.8 **TEMPORARY WORKS**

- .1 Installation and Removal: Provide temporary utilities, facilities and controls in order to execute the Work expeditiously. Remove from Site all such Work after use.
- .2 Arrange for connections with Owner and pay all costs for installation, maintenance and removal.
- .3 Be responsible for the careful and reasonable use of Owner supplied water and power.
- .4 Temporary power and lighting systems:
- .5 Supply, install and maintain electrical power and necessary electrical equipment including overhead and underground feeders, transformers, motors, starters, panels, protective devices and equipment. Connections will be made available to any part of the Work within distance of a 30 m extension.
- .6 Provide temporary lighting inside and outside structure of adequate intensity to illuminate construction activities. Provide temporary pedestrian lighting for sidewalk areas affected by the Work.
- .7 Supply and install the type and quantity of minimum lighting equipment in each location to ensure adequate, continual illumination 24 hours per day, 7 days per week for the following:
 - .1 Emergency evacuation, safety and security throughout the Project at intensity levels required by jurisdictional authorities.
 - .2 General lighting for performance of the Work throughout the Project, evenly distributed, and at intensities to ensure that proper installations and applications are achieved.
 - .3 Performance of finishing trades in area as required evenly distributed, and of an intensity of at least 50 Lux.
- .8 In locations approved by the Consultant. install and support the electrical plant, distribution and temporary lighting systems including service equipment and local hydro authority meter energized by the local hydro circuits. Installations shall be approved by the Consultant and shall be carried out in a neat manner to avoid interference with the application of finish material and to facilitate removal when the installed permanent lighting system is in operation.
- .9 Make all necessary arrangements for and pay all costs for a temporary electrical service of sufficient capacity to supply temporary lighting, operation of power tools, cranes and equipment for all construction, implementation, and inspection and testing purposes. Supply and install necessary temporary cables and other electrical equipment and make all temporary connections as required.

- .10 Temporary power distribution wiring shall comply with Ontario Hydro Electrical Safety Code. Obtain inspection certificates for temporary electrical work.
- .11 Maintain the lighting systems in operation during the life of the Contract. Replace burned or missing lamps immediately.
- .12 Upon Contract Completion, remove electrical plant and temporary lighting from the Site.
- .13 Water Supply:
 - .1 Provide and pay for a continuous supply of potable water for construction use. Provide as a minimum one water connection on each floor level.
 - .2 Provide and maintain all temporary lines, extensions and hoses as required. Remove all temporary connections and lines on completion of the Work and make good any damage.
- .14 Temporary Heating:
 - .1 Provide temporary heating required during construction period, including attendance, maintenance and fuel.
 - .2 Construction heaters used inside buildings must be vented to the outside or be flame less type. Solid fuel salamanders are not permitted.
 - .3 Maintain temperatures of minimum 10oC in areas where construction is in progress unless otherwise indicated in the Contract Documents. Protect exposed and adjacent services from freezing. Repair at no cost to the Owner any such services, buildings or other utilities disrupted by freezing.
 - .4 Ventilate heated areas and keep structures free from exhaust combustion gases.
 - .5 The permanent heating system of the building or portions thereof may be used when available only upon written permission by Consultant. If permission to use heating system is obtained:
 - .1 Before using air handling systems, ensure that dust/debris is removed from the premises and install temporary filters to prevent construction dust/debris from entering via return air or intake openings. keep unused ducts sealed to prevent entry of dust/debris. Replace filters frequently during construction.
 - .2 On completion of work remove temporary filters and install new filters in accordance with Division 23. After temporary use of air handling system is complete and before turning over system to Owner, vacuum internally to ensure all dust/debris is removed.
 - .6 Elevators: Elevators may be used by construction personnel as permitted by the Owner.
 - .7 Temporary Telephone and Data: Provide and pay for separate telephones and Data services, for local call only, as required for own use and use of the Consultant and Owner. Long distance call shall be paid by party making call.

- .8 Sanitary Facilities: Provide sanitary facilities in accordance with occupational health and safety requirements in the place of the Work. Use of Owner's existing sanitary facilities or new sanitary facilities is not allowed.

51 SITE SECURITY

- 51.1 Provide and pay for security personnel to guard the Site and contents of the Site after working hours and during holidays as established by the Owner. Control of access shall be through hoarding and barricades during times work is in progress, and by locking hardware otherwise.
- 51.2 Any security service provided by the Owner is for the protection of the Owner's interest in the Work on the Site and shall not relieve the Contractor of the responsibility to protect the Site and the Work of the Contract.

52 PROTECTION

- 52.1 Protection of Public Area: Protect surrounding private and public property from damage during performance of the Work.
- 52.2 Take all necessary precautions to prevent damage to work affected by temperature, water, weather and other environmental conditions.
- 52.3 Protection of Building Finishes and Equipment:
 - .1 Provide protection for existing structure, finished and partially finished building finishes, waterproofing systems, and equipment during performance of the Work.
 - .2 Cover Owner's equipment and plant within the Site with 6 mil PVC sheet, or equal, taped to make it dust-tight. Equipment and existing work moved or altered to facilitate construction, movement of Products or equipment shall be stored, protected with dust-tight covers and subsequently returned to its original location.
 - .3 Obtain approval from the Consultant prior to the installation of temporary supporting devices into existing roof, ceiling, or wall members for the erecting of equipment or machinery. Repair roof, ceiling, and wall members used for this purpose to the satisfaction of the Consultant.
 - .4 Provide necessary screens, covers and hoarding as required.
 - .5 Any Products or equipment damaged while carrying out the Work shall be restored with new Products or equipment matching the original equipment. Damage shall include harm resulting from all construction work, such as falling objects, wheel and foot traffic, failure to remove debris, operation of machinery and equipment, and scaffolding and hoisting operations.
- 52.4 Fire Protection:
 - .1 Take precautions to prevent fires. Provide and maintain temporary fire protection equipment of a type appropriate to the hazard anticipated in accordance with authorities having jurisdiction, governing codes, regulations, by-laws and to the satisfaction of the Consultant and insurance authorities.

- .2 Excessive storage of flammable liquids and other hazardous materials is not allowed on Site. Flammable liquids must be handled in approved containers. Remove combustible wastes frequently.
- .3 Inspect temporary wiring, drop cords, extension cables for defective insulation or connections frequently.
- .4 Open burning of rubbish is not permitted on the Site.
- .5 Handle, transport, store, use and dispose of gasoline, benzine or other flammable materials with good and safe practice as required by authorities having jurisdiction.
- .6 Provide fire extinguishers of the non-freezing chemical type in each temporary building, enclosure and trailer. Use only fire-proofed tarpaulins.
- .7 A fire watch shall be required for each of the following activities regardless of the number, duration or size of the activity in operation:
 - .1 any open flame activities (e.g., soldering and welding);
 - .2 shutdown of fire detection system;
 - .3 shutdown of sprinkler system.
- 52.5 Maintain adequate cover over services as required by Utility Authorities.
- 52.6 Report any discharge of a contaminant to the Authorities having jurisdiction.

53 PEST CONTROL

- 53.1 Be responsible to provide control measures, restraining procedures, and treatments to prevent infestation and spread of insects, rodents and other pests deemed to be present at Site and/or noticed during course of the Work. Carry out fumigation, pest control procedure, and posting of warning signs, notices including contents of such notices in accordance with requirements of Pesticides Act and any other authorities having jurisdictions. Pesticides used shall be in accordance with Canada Pest Control Products Act, and provincial and municipal regulations.

54 FIRST-AID FACILITIES

- 54.1 Provide site equipment and medical facilities necessary to supply first-aid service to injured personnel in accordance with regulations of the Workmen's Compensation Act. Maintain facilities for duration of Contract.

55 USE OF NEW PERMANENT SERVICE & EQUIPMENT

- 55.1 Do not use any new permanent service or equipment without Owner's written approval.
- 55.2 Where permission is granted to use permanent services and equipment provide competent persons to operate services and equipment; inspect frequently and maintain facilities in proper operating condition at all times.
- 55.3 Permanent services and equipment shall be turned over to Owner in "as new" and perfect operating condition.

- 55.4 Use of permanent systems and equipment as temporary facilities shall not affect the warranty conditions and warranty period for such systems and equipment. Make due allowance to ensure that Owner will receive full benefits of equipment manufacturers warranty after project takeover.

56 PROJECT IDENTIFICATION

- 56.1 If required, obtain approvals from jurisdictional authorities for temporary signs.
- 56.2 Do not display signs without the Consultant's and Owners written consent.
- 56.3 Maintain signs in good condition for the duration of Contract.

57 SITE MAINTENANCE

- 57.1 Maintain the Site and adjacent premises in a clean and orderly condition, free from debris and other objectionable matter. Immediately remove rubbish and surplus Products, equipment and structures from the Site. If the Site is not cleaned (within 48 hours after the Contractor has been instructed to do so), the Consultant may clean the Site and retain the cost from monies due, or to become due, to the Contractor.
- 57.2 When the Work is substantially performed, remove surplus Products, tools, construction machinery and equipment not required for the performance of the remaining Work

58 SITE STORAGE AND OVER LOADING

- 58.1 Confine the Work and operations of employees to limits indicated by the Contract Documents. Do not unreasonably encumber the Site with Products.
- 58.2 Products shall be stored only in areas designated or approved by the Consultant, and shall not be left lying on streets, sidewalks, boulevards or elsewhere within public view. Products which the Consultant may permit to be stored elsewhere than in the Contractor's storage areas shall be neatly stacked or otherwise disposed and shall be so maintained.
- 58.3 Fabrication shops shall not be set up within the structure except as directed by or with the permission of the Consultant.
- 58.4 Do not load or permit to be loaded any part of the Work with a weight or force that it is calculated to bear safely. Be solely responsible and liable for damages resulting from violation of this requirement. Provide temporary supports as strong as permanent support.
- 58.5 Do not cut, drill or sleeve load bearing members unless shown on drawings or otherwise approved by the Consultant in writing for each location.
- 58.6 Site storage and loading requirements to be in accordance with the Ontario Occupational Health and Safety Act and Regulations for Construction Projects.

59 PUBLIC CONVENIENCE AND SAFETY

- 59.1 Maintain sidewalks at and adjacent to the Site in a safe condition throughout the Contract. Promptly remove ice and snow.
- 59.2 Keep haul routes free at all times from Products spilled on highway or street surfaces and clean highways and streets of deposits due to performance of the Work to the satisfaction of the Consultant and the highway and street authorities. Clean highways and streets within 24 hours of Consultant's instruction.
- 59.3 The Consultant may inspect haul routes, the Site and adjacent premises daily and may halt operations, withhold payment or carry out such additional operations as necessary, deducting the cost from monies due, or to become due, to the Contractor.

60 ACCESS AND EGRESS TO SITE

- 60.1 Where construction requirements demand, construct access roads capable of withstanding construction equipment and haul traffic. Maintain access roads in good condition at all times. Remove access roads prior to completion of the Work unless otherwise noted and restore area as shown on the Contract Drawings.

61 PUBLIC TRAFFIC FLOW

- 61.1 Provide and maintain flag persons, Police Officers, traffic signals, barricades and illumination as required by Authorities having jurisdiction and/or as necessary to perform the Work and protect the public.
- 61.2 **PUBLIC UTILITIES AND SERVICES**
- 61.3 Verify limitations imposed on project work by presence of utilities and services, and ensure no damage occurs to them.
- 61.4 Notify service authorities concerned so that they protect, remove, relocate, or discontinue them, as they may require.
- 61.5 Make arrangements and pay for connection charges for services required for project work.
- 61.6 Locate poles, pipes, conduit, wires, fill pipes, vents, regulators, meters, and sanitary services work in inconspicuous locations. If not shown on Drawings, verify location of service work with Consultant before commencing installation.

62 ROADS, CURBS, GUTTERS, AND WALKS

- 62.1 Include all curb cuts and making good of existing curbs, walks and paving on Municipal property to provide fully paved and finished approaches to requirements of authorities having jurisdiction.

63 CONSTRUCTION PARKING

- 63.1 Parking will be permitted on Site provided it does not disrupt the performance of Work, Site safety or the movement of vehicular or pedestrian traffic and is acceptable to the Consultant.

64 SITE VISITORS

- 64.1 During the progress of the Work, afford access to visitors duly authorized by the Consultant and facilitate inspections or tests they may desire to make. Record site visitors in log book maintained on site.
- 64.2 Ensure Site visitors wear appropriate safety apparel.

65 EROSION AND SEDIMENTATION CONTROL

- 65.1 Control drainage on site to prevent flooding, erosion and run-off onto adjacent properties as a result of construction operations.
- 65.2 Dispose of water containing silt in suspension in accordance with requirements of jurisdictional authorities.
- 65.3 Conform to sedimentation and erosion control requirements of the conservation and/or municipal authority having jurisdiction. Provide and maintain until completion of work or until directed by Consultant to be removed, sediment control devices at catch basins, drainage courses and at other locations on site as directed. Comply with requirements of the local Conservation Authority.
- 65.4 Provide storm drain inlet protection consisting of a sediment control barrier or an excavated ponding area around storm drain inlet or curb inlet; add bracing where necessary to withstand high flow volumes and depth. Inspect inlet protection after each rainfall and repair damage. Sweep up accumulated sediment and dispose of in a controlled area. Remove inlet protection after area has been stabilized with permanent vegetation.
- 65.5 Prevent tracking of mud and dirt from site onto paved roads. Provide stabilized vehicle access/egress points, constructed of coarse granular material. Place additional granular material as required to maintain access/egress points in proper working order. Clean mud and dirt from paved roads at end of each day by shovelling or sweeping and subsequent washing. Dispose of mud dirt in a controlled disposal area.

66 TEMPORARY DRAINAGE AND DEWATERING

- 66.1 Drainage lines and gutters shall be kept open at all times. No flow of water shall be directed across or over pavements except through pipes or properly constructed troughs. Keep all portions of Work properly and efficiently drained during construction and until completion. Be responsible for all disturbances, dirt and damage which may be caused by or result from water backing up or flowing over, through, from or along any part of Work, or due to operations which may cause water to flow elsewhere.
- 66.2 Keep trenches and other excavations free of water at all times. Employ adequate means to remove water in a manner that will prevent loss of soil, and maintain the stability of excavation.

- 66.3 Dispose of such water in a manner that will not be dangerous to public health, private property or to any portion of Work completed or under construction, nor which causes an impediment to the use of streets by the public.
- 66.4 Drainage of trenches or other excavation through newly laid storm drainage pipe will be allowed only with the express permission of the authority having jurisdiction.
- 66.5 When drainage is directed to existing catch basins, regularly inspect and clean such catch basins of debris and sediment.

67 SNOW REMOVAL

- 67.1 Allow no accumulation of ice and snow on Site, and on roof deck when roofing operations are scheduled to take place.
- 67.2 Remove snow from road, Site circulation paths and elsewhere as required to permit access to Work, parking and uninterrupted construction progress.

68 POLLUTION (DUST, DEBRIS, AND NOISE) CONTROL

- 68.1 Cover or wet down dry materials and rubbish to prevent blowing dust and debris. Provide dust control for temporary roads.
- 68.2 Keep premises free of waste material.
- 68.3 Arrange and pay for removal of all waste generated by the work in manner acceptable to authorities having jurisdiction.
- 68.4 Limit noise levels in accordance with requirements of authorities having jurisdiction.
- 68.5 Maintain temporary erosion and pollution control features installed under this contract.
- 68.6 Control emissions from equipment and plant to local authorities emission requirements.
- 68.7 Prevent abrasive-blasting and other extraneous materials from contaminating air beyond application area, by providing temporary enclosures.

69 TREE PROTECTIONS

- 69.1 All trees are to be protected in accordance with the City of Brampton, Urban Forestry, Tree Protection Policy.
- 69.2 Within Contractor's assigned work and storage areas and adjacent to designated access routes, protect existing trees and other plants scheduled to remain. Provide approved barrier consisting of snow fencing or plywood around Tree Protection Zone (TPZ).
- 69.3 Leave protection areas undisturbed; do not use areas for storage, stockpiling or any other purpose. Do not dump or flush any contaminants in areas of tree feeder roots.
- 69.4 Where limbs, roots or portions of plants are required to be removed to accommodate new work, they shall be removed with the approval of Urban Forestry and under the supervision of an experienced arborist.

- 69.5 Where root systems of protected trees adjacent to construction are exposed or damaged, they shall be neatly trimmed and the area backfilled with suitable material to prevent desiccation.
- 69.6 Where necessary give plants an overall pruning to restore the balance between roots and top growth and/or to restore appearance.
- 69.7 Except at locations where specific procedures are included in Contract Documents do not alter grades around existing trees/plants without first obtaining Consultant's consent and directions.

70 SUBSTITUTIONS

- 70.1 Requests for substitutions will not be accepted prior to the Notification of Award. Substitutions will be considered by the Consultant provided that:
- .1 The proposed substitutions have been investigated and complete data are submitted in accordance with the Specifications.
 - .2 Data relating to changes in the Contract Schedule, if any, and relation to other Work have been submitted.
 - .3 Same warranty is given for the substitution as for the original Product specified.
 - .4 All claims are waived for additional costs related to the substitution which may subsequently arise.
 - .5 Installation of the accepted substitution is co-ordinated into the Work and that full responsibility is assumed when substitutions affect other work. Make any necessary changes required to complete the Work. Revisions to the drawings for incorporation of the substitutions shall be made by the Consultant and all costs associated with the revisions shall be borne by the Contractor.
- 70.2 Substitutions to methods or process described in the Specifications or drawings, may be proposed for the consideration of the Consultant. Ensure that such substitutions are in accordance with the following requirements:
- .1 Time spent by the Consultant in evaluating the substitution shall not be the basis for a claim by the Contractor for extensions to the Contract Time.
 - .2 Clearly indicate how the proposed substitutions would be advantageous to the Owner or in the opinion of the Contractor would improve the operation of the installation.
 - .3 Be responsible for substitutions to methods or processes concerning such Work and ensure that the warranty covering all parts of the Work will not be affected.
 - .4 The cost of all changes in the work of Other Contractors, necessitated by the substituted methods or processes, if accepted, is borne by the Contractor.
 - .5 The substituted methods or processes fit into space allotted for the specified methods or processes. Revisions to the drawings for incorporation of the substitutions shall be made by the Consultant and all costs associated with the revisions shall be borne by the Contractor.
- 70.3 Substitutions will not be considered if:

- .1 They are indicated or implied on shop drawings or Product data without formal request.
- .2 Acceptance will require substantial revision of the Specifications and Drawings.
- 70.4 Do not substitute Products or methods or processes into the Work unless such substitutions have been specifically approved for the Work by the Consultant.
- 70.5 Approved substituted Products shall be subject to the Consultant's inspection and testing procedures. Approved substituted Products shall only be installed after receipt of the Consultant's written approval.
- 70.6 The Contract Price will be adjusted accordingly to any and all credits arising from the substitutions mentioned above.

71 APPROVAL OF PRODUCTS AND INSTALLATION METHODS

- 71.1 Wherever in the Specifications it is specified that Products and installation methods shall meet approval of Authorities having Jurisdiction, underwriters, the Consultant, or others, such approval shall be in writing.

72 PRODUCT DELIVERY CONTROL

- 72.1 It is the responsibility of the Contractor to ensure that the supplier or distributor of materials specified or alternatives accepted, which he intends to use, has materials on the site when required. The Contractor shall obtain confirmed delivery dates from the supplier.
- 72.2 The Contractor shall contact the Consultant immediately upon receipt of information indicating that any material or item, will not be available on time, in accordance with the original schedule, and similarly it shall be the responsibility of all subcontractors and suppliers to so inform the Contractor.
- 72.3 The Consultant reserves the right to receive from the Contractor at any time, upon request, copies of actual purchase or work orders of any material or products to be supplied for the work.
- 72.4 If materials and products have not been placed on order, the Consultant may instruct such items to be placed on order, if direct communication in writing from the manufacturer or prime suppliers is not available indicating that delivery of said material will be made in sufficient time for the orderly completion of the Work.
- 72.5 The Consultant's review of purchase orders or other related documentation shall in no way release the Contractor, or his subcontractors and suppliers from their responsibility for ensuring the timely ordering of all materials and items required, including the necessary expediting, to complete the work as scheduled in accordance with the Contract Documents.
- 72.6 In the event of failure to notify the Consultant at commencement of Work and should it subsequently appear that Work may be delayed for such reason, the Consultant reserves the right to direct the Contractor to take the following measures at no increase in Contract Price:
 - .1 Substitute more readily available Products of similar or better quality and character, or

- .2 Temporarily install another Product until such time as the specified Product becomes available, at which time the temporarily installed product shall be removed and the specified Product installed.

73 TRADEMARKS AND LABELS

- 73.1 Permanent labels, trademarks and nameplates on Products are not acceptable in the finished Work, except where required by authorities having jurisdiction, for operating instructions, or when located in service rooms.
- 73.2 Remove trademarks and labels by grinding, if necessary, painting out where the particular surface is being painted, or if on plated parts, replace with new plain plated or non-ferrous metal parts.

74 DELIVERY, STORAGE, HANDLING AND PROTECTION

- 74.1 Be responsible for handling and delivery of Products. Protect Products from damage during handling, storage and installation. Deliver store and handle items in accordance with manufacturer's instructions and as specified. Be responsible for all costs of delivery, loading and off-loading, and for transportation back to its origin for correction, if required, due to damage or defect. Reject materials and Products delivered to the Site which are damaged.
- 74.2 Manufacture, pack, ship, deliver, and handle Products so that no damage occurs to structural qualities and finish appearance, nor in any other way which is detrimental to their function and appearance.
- 74.3 Ensure that Products, while transported, are not exposed to an environment which would increase their moisture content beyond the maximum specified.
- 74.4 Organize delivery of materials, Products and equipment to, and removal of debris and equipment from, the site and surrounding property.
- 74.5 Schedule early delivery of Products to enable Work to be executed without delay. Before delivery, arrange for receiving at the Place of the Work.
- 74.6 Coordinate mechanical and electrical equipment and apparatus deliveries with the manufacturer's and suppliers such that equipment and apparatus is delivered to the site when it is required, or so that it can be stored within the building and protected from the elements.
- 74.7 Shop assemble work for delivery to site in size easily handled and to ensure passage through building openings.
- 74.8 Deliver packaged Products, in original unopened wrapping or containers, with manufacturer's seals and labels intact.
- 74.9 Label packaged products to describe contents, quantity, and other information as specified.
- 74.10 Labels attesting that materials conform to specified reference standards will be acceptable as verification that contents meet specified requirements. In the absence of labels, submit affidavits to validate conformance of Product to reference standards, as requested by the Consultant.

- 74.11 Label fire-rated Products to indicate Underwriters' Laboratories approval.
- 74.12 Handle and store materials and products in such a manner that no damage is caused to the materials and products, the Work, the site and surrounding property.
- 74.13 Do not obstruct or disrupt local traffic flow during construction period.
- 74.14 Allocate an area within the limits of the Work acceptable to the Owner for storage of Products brought to the site by all trades. Keep storage area tidy at all times and do not use other parts of the property for storage. Arrange and pay for off-site storage when required.
- 74.15 Locate products on site in a manner to cause minimal interference with the Work and building activities.
- 74.16 Store Products off the ground, in a manner to prevent damage, adulteration, deterioration and soiling to the Products, other building components, assemblies, other products, the structure, the site and surrounding property, and in accordance with manufacturer's instructions when applicable.
- 74.17 Store packaged or bundled Products in original and undamaged condition complete with written application instructions. Keep manufacturer's seals and labels intact. Do not remove from packaging or bundling until required in the Work.
- 74.18 Do not place or store materials and Products in corridors, public areas, streets, lanes, passageways or similar locations.
- 74.19 Store Products so as not to create any overloading conditions to any part of the building, structure, falsework, form work and scaffolding.
- 74.20 Store Products subject to damage from weather in weatherproof enclosures.
- 74.21 Store cementitious Products clear of earth or concrete floors, and away from walls.
- 74.22 Keep sand, when used for grout or mortar materials, clean and dry. Store sand on wooden platforms and cover with waterproof tarpaulins during inclement weather.
- 74.23 Store sheet materials and lumber on flat, solid supports and keep clear of ground. Slope to shed moisture.
- 74.24 Store and handle flammable liquids and other hazardous materials in approved safety containers and as otherwise prescribed by safety authorities. Store no flammable liquids or other hazardous material in bulk within the Work.
- 74.25 Store and mix paints in a heated and ventilated room or area assigned for this purpose. Keep this room or area locked when unattended. Remove oily rags and other combustible debris from the Place of the Work daily. Take every precaution necessary to prevent spontaneous combustion.
- 74.26 Protect prefinished metal surfaces by protective coatings or wrappings until time of final cleanup. Protection shall be easily removable under work of without damage to finishes. Do not permit strippable tape or coatings to become baked on surfaces which they protect.
- 74.27 Touch-up damaged factory finished surfaces to Consultant's satisfaction. Use primer and paint to match original.

- 74.28 Protect glass and other finishes against heat, slag and weld splatter by provision of adequate shielding. Do not apply Visible markings to surfaces exposed to view in finished state or that receive transparent finishes.
- 74.29 Protect surfaces of completed work exposed to view from staining, disfigurement and all other damage by restriction of access or by use of physical means suitable of the material and surface location.
- 74.30 Adequately protect trowelled concrete floors from damage. Take special measure when moving heavy loads or equipment on them.
- 74.31 Keep finished concrete floors free from oils, grease or other material likely to damage or discolour them or affect bond of applied finishes. Once building is enclosed, keep floors as dry as possible after curing.
- 74.32 Protect finished flooring from pedestrian traffic with reinforced kraft paper as a minimum, secured in place and with joints sealed by reinforced pressure sensitive tape. Maintain protection in place until contract completion.
- 74.33 Protect finished flooring from continuing construction work and delivery of products with plywood panels of minimum 6 mm thickness with joints between panels sealed with reinforced pressure sensitive tape. Maintain protection in place until work and deliveries are complete.
- 74.34 Make good or replace damaged materials to the satisfaction of the Consultant.
- 74.35 Hazardous Materials Information:
- .1 Comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling, storage, and disposal of hazardous materials; and regarding labelling and provision of material safety data sheets (MSDS) in accordance with jurisdictional authorities.
 - .2 Deliver copies of Material Safety Data Sheets (MSDS) to the Consultant on all Products intended for use in the Work and designated as a "controlled product."
- 75 AVAILABILITY**
- 75.1 If delays in supply of Products are foreseeable, notify the Consultant of such, in order that remedial action may be authorized in ample time to prevent delay in performance of Work.
- 75.2 In the event of failure to notify the Consultant at commencement of Work and should it subsequently appear that Work may be delayed for such reason, the Consultant reserves the right to direct the Contractor to take the following measures at no increase in Contract Price:
- .1 Substitute more readily available Products of similar or better quality and character, or
 - .2 Temporarily install another Product until such time as the specified Product becomes available, at which time the temporarily installed product shall be removed and the specified Product installed.

76 MANUFACTURER'S INSTRUCTIONS

- 76.1 Unless otherwise indicated in the Specifications, fabricate, install, apply, connect, install, erect, use, clean, and condition Products in accordance with manufacturer's instructions except where more stringent requirements are specified. Do not rely on labels or enclosures provided with Products. Obtain written instructions directly from manufacturers.
- 76.2 Notify the Consultant in writing, of conflicts between the Specifications and manufacturer's instructions, so that the Consultant may establish the course of action. If requested, make a copy of those instructions available at the Site.
- 76.3 In cases of improper installation or erection of Products, due to failure in complying with these requirements, the Consultant may direct removal and re-installation at no increase in Contract Price.

77 WORKMANSHIP

- 77.1 Workmanship shall be the best quality, executed by workers experienced and skilled in the respective duties for which they are employed. Immediately notify the Consultant if required Work is such as to make it impractical to produce required results.
- 77.2 Do not employ any unfit person or anyone unskilled in their required duties. The Consultant reserves the right to require the dismissal from the Place of the Work, workers deemed incompetent, careless, insubordinate or otherwise objectionable.
- 77.3 Decisions as to the quality or fitness of workmanship in cases of dispute rest solely with the Consultant, whose decision is final.
- 77.4 Give particular attention to finished dimensions and elevations of the Work. Make finished Work fit indicated spaces accurately. Make finished Work flush, plumb, true to lines and levels and accurate in all respects.
- 77.5 In finished areas, conceal pipes, ducts, conduit and wiring in floors, walls, ceilings, chases, or behind furring except where indicated otherwise.
- 77.6 Ensure that service poles, fill-pipes, vents, regulators, metres and similar service installations are located in inconspicuous locations. If not indicated on drawings, verify location of service installations with Consultant prior to commencing installation.
- 77.7 Ensure that integrity of fire separations is maintained where they are penetrated.
- 77.8 Finish access panels and doors to match adjacent wall and/or ceiling finish unless otherwise specified or indicated.
- 77.9 Keep surfaces, on which finished materials will be applied, free from grease, oil, and other contamination which would be detrimental in any way to the application of finish materials.
- 77.10 Enforce fire prevention methods at site. Do not permit fires, open flame heating devices or accumulation or debris. Use flammable materials only if all safety precautions are taken. Provide and maintain in working order ULC labelled fire extinguishers of types suitable for fire hazard in each case, and locate them in prominent location and to approval of jurisdictional authorities.

- 77.11 Where flammable materials are being applied, ensure that adequate ventilation is provided, spark-proof equipment is used, and smoking and open flames are prohibited.

78 DIMENSIONS

- 78.1 Check all dimensions at the Site before fabrication and installation commences and report discrepancies to the Consultant.
- 78.2 Where dimensions are not available before fabrication commences, ensure that dimensions required are agreed upon between the parties concerned.
- 78.3 Prior to commencing work, ensure that clearances required by jurisdictional authorities can be maintained
- 78.4 Wall thicknesses and openings shown on the drawings may be nominal only; ascertain actual sizes at the Site.
- 78.5 Verify dimensions of shop fabricated portions of the Work at the Site before shop drawings and fabrications are commenced. The Owner will not accept claims for extra expense by reason of non-compliance with this requirement.
- 78.6 Fabricate and erect manufactured items, shop fabricated items, and items fabricated on or off site, to suit site dimensions and site conditions.
- 78.7 In areas where equipment is to be installed, check dimensional data on equipment to ensure that area and equipment dimensions are compatible with necessary access and clearance provided. Ensure that equipment supplied is dimensionally suitable for space provided.
- 78.8 Leave areas clear where space is indicated to be reserved for future equipment, including access to such future equipment.
- 78.9 Whether shown on the Drawings or not, leave adequate space and provision for servicing of equipment and removal and reinstallation of replaceable items such as motors, coils and tubes.

79 RELOCATION OF MECHANICAL AND ELECTRICAL ITEMS

- 79.1 The Owner and the Consultant reserve the right to relocate outlets at a later date, but prior to installation, without additional cost to Owner, assuming that the relocation per outlet does not exceed 3000 mm from the original location. No credits will be anticipated where relocation per outlet of up to and including 3000 mm reduces materials, products and labour.
- 79.2 Should relocations per outlet exceed 3000 mm from the original location the Contract Price will be adjusted in accordance with the provisions for changes in the Contract Documents.
- 79.3 Alter the location of pipes and other equipment, without additional cost to the Owner, if approved, provided the change is made before installation.
- 79.4 Make necessary changes, due to lack of coordination, as required and when approved, at no additional cost, to accommodate structural and building conditions.

80 EXPANSION, CONTRACTION, AND DEFLECTION

- 80.1 Conform to manufacturer's recommended installation temperatures. If items, components, assemblies, systems, and finishes are installed at temperatures different from operation or service temperatures, make provisions for expansion and contraction in service as acceptable to manufacturer and consultant. Repair all resulting damage should expansion provisions provide inadequate.
- 80.2 Make provisions for expansion and contraction due to temperature changes within components, Products and assemblies, and between adjacent components, Products and assemblies, and due to building movements including but not limited to creep, column shortening, deflection, sway and twist. Ensure provisions for expansion, contraction and building movements prevent damages from occurring to and within components, Products and assemblies.
- 80.3 Make adequate allowance at wall and partition heads for deflection of the structure above. Determine requirements from Consultant where additional information is required. Where partitions butt to underside of floor assembly, or structural framing, the clearance shall be based on the span of the members supporting the floor or structural framing. In making such allowance use methods which maintain the integrity of the wall or partition as a sound, and/or fire barrier.
- 80.4 Make provisions in pipes, plenums, ducts and vessels containing air and fluids as is necessary to prevent damage due to fluid and air induced pressure, surges and vibrations, to pipes, plenums, ducts and vessels and to adjacent components, assemblies and construction to which pipes, ducts, plenums and vessels are attached or pass through.

81 DIELECTRIC SEPARATION

- 81.1 Ensure that a dielectric separator is provided in a permanent manner over entire contact surfaces to prevent electrolytic action (galvanic corrosion) between dissimilar materials. Similarly, prevent corrosion to aluminum in contact with alkaline materials such as contained in cementitious materials.

82 FASTENINGS

- 82.1 Include in the work of each section necessary fastenings, anchors, inserts, attachment accessories, and adhesives. Where installation of devices is in work or other sections, deliver and locate devices in ample time for installation.
- 82.2 Do not install fibre, plastic or wood plugs or blocking for fastenings in masonry, concrete, or metal construction, unless specified or indicated on drawings.
- 82.3 Install work with fastenings or adhesives in sufficient quantity to ensure permanent secure anchorage of materials, construction, components and equipment under static conditions, and to resist building thermal movement, creep and vibration.
- 82.4 Provide metal fastenings and accessories in same material, texture, colour, sheen and finish as metal on which they occur, unless indicated otherwise.
- 82.5 Prevent electrolytic action between dissimilar metals and materials.

- 82.6 Use non-corrosive hot dip galvanized steel fasteners and anchors for securing exterior Work, and where attached to, or contained within, exterior walls and slabs, unless stainless steel or other material is specified. Leave steel anchors bare where cast in concrete.
- 82.7 Space anchors within their load limit or shear capacity and ensure they provide positive permanent anchorage. Wood, or any other organic material plugs are not acceptable.
- 82.8 Conceal fasteners where indicated. Keep exposed fastenings to a minimum, space evenly and in an organized symmetrical pattern.
- 82.9 Fastenings which cause spalling or cracking of material to which anchorage is made are not acceptable.

83 ADJUSTING

- 83.1 Ensure that all components of assemblies fit snugly, accurately and in true planes, and that moving parts operate positively and freely, without binding and scraping.
- 83.2 Verify that work functions properly and adjust it accordingly to ensure satisfactory operation. Lubricate Products as recommended by manufacturer.

84 DEMONSTRATION AND INSPECTION OF PRODUCTS AND SYSTEMS

- 84.1 Arrange for a demonstration of systems and operating Products upon the 100% completion of their installation and prior to certification for Substantial Performance.
- 84.2 Include in the arrangements for the attendance of the Consultant, Owner, jurisdictional authorities, and personnel assigned by the Owner for the operation of the systems and/or Products.
- 84.3 Demonstrations shall be conducted by the Subcontractor responsible for the installation of the systems and/or Product, assisted by representatives of the manufacturer or supplier. All personnel conducting the demonstration shall be completely knowledgeable of all conditions of the operating, functioning and maintenance of the systems and/or Products.
- 84.4 Owner's representative will acknowledge the successful completion of each demonstration on a form provided by the Contractor. The form shall be agreed to by the Owner, Consultant and Contractor prior to demonstration and testing.
- 84.5 Submit copies of letters from manufacturers of Systems and/or Products before making application for certificate of Substantial Performance to verify that the Products has been installed and connected correctly, and that it is operating in a satisfactory manner. The certification shall be based upon inspection and testing of the Products by competent technical personnel. Include in letter of certification the names of personnel conducting the testing and inspection, the methods of inspection utilized, and the location in the building of the Products certified.
- 84.6 Following submission of letters of certification and their acceptance by the Owner, the owner shall have the right to use the Products on a trial basis and for instructing their personnel in its use.

85 FINAL INSPECTIONS AND CLOSE OUT

- 85.1 Submit proposed closeout procedures and schedule of inspection to Consultant for approval before final demonstrations and inspections commence.
- 85.2 Arrange for, conduct and document final demonstrations, inspections, close-out and take-over at completion of the Work in accordance with procedures described in OAA/OGCA TAKE-OVER PROCEDURES, OAA/OGCA Document No. 100. Where "Architect" is referred to in Document No. 100 it shall mean Consultant.

86 CERTIFICATE OF COMPLIANCE

- 86.1 Submit Certificate of Compliance, prior to the application for Substantial Performance, for each of the following items.
- .1 An affidavit relative to the use of lead-free solder for all domestic water lines, regardless of location.
 - .2 Products for which Material Safety Data Sheets have been submitted and accepted.
 - .3 Other Work/Products identified in the Contract Documents as requiring a Certificate of Compliance.
- 86.2 Each Certificate of Compliance shall indicated names and addresses of the project, the Owner, the date of issue, product description including name, number, manufacturer, with a statement verifying that the Work/Product installed meets specified requirements and, if applicable, complies with the submitted and accepted Material Safety Data Sheets.
- 86.3 Each Certificate of compliance shall be issued on the subcontractor's letterhead, properly executed, under whose work the prospective Work/Product has been provided.
- 86.4 Each Certificate of Compliance shall be endorsed by the Contractor with his authorized stamp/signature. Ensure that submissions are made to allow sufficient time for review without delaying progress of scheduled completion.

87 GARBAGE DISPOSAL AND CLEANUP

- 87.1 Provide waste containers for the disposal of all waste materials resulting from performance of their work.
- 87.2 No hazardous or contaminated waste material shall be placed in Owner's waste containers and Subtrades shall make their own arrangements for the disposal off site of any such material resulting from performance of their work.
- 87.3 Remove all regular waste material and debris from their work areas and deposit in the waste containers at the end of each working day. Any clean up work not performed as requested will be carried out by the Owner with all resultant costs being charged to the Subtrade. Remove all waste from the Sheridan College Campus.

88 CLEANING

88.1 Progress cleaning:

- .1 Remove from finish work, spatters, droppings, labels, and debris, before they set up.
- .2 Ensure that only cleaning materials are used which are recommended for the purpose by both the manufacturer of the surface to be cleaned and of the cleaning material.
- .3 Maintain building work areas "broom clean" at least on a daily basis, but cleaning shall also be done immediately before finishing work.
- .4 No waste material may be burned or buried at site. Remove waste as often as required to avoid accumulation, no less than, at the end of each working day.
- .5 Remove packaging materials and debris from the site immediately after product and equipment is unwrapped or uncrated.
- .6 Ensure that volatile fluid wastes are not disposed of in storm or sanitary sewers, in open drain courses, or anywhere on site.
- .7 Do not allow waste material and debris to accumulate in an unsightly or hazardous manner. Sprinkle dusty accumulations with water. Provide containers in which to collect waste material and debris. Dispose of hazardous products in accordance with requirements of jurisdictional authorities.
- .8 Ensure that cleaning operations are scheduled to avoid deposits of dust or other foreign matter on surfaces during finishing work and until wet or tacky surfaces are cured.
- .9 Provide instructions for final cleaning of finishing work, and for inclusion in Maintenance and Operating Manuals.

88.2 Final cleaning:

- .1 Before final inspection, replace glass and mirrors broken, damaged, and etched during construction, or which are otherwise defective.
- .2 In addition to requirements for progress cleaning, Work shall include final cleaning by skilled cleaning specialists on completion of construction.
- .3 Remove temporary protections and make good defects before commencement of final cleaning.
- .4 Final cleaning shall remove dust, stains, paint spots, soil, grease, fingerprints, and accumulations of construction materials, interior and exterior to the building for all new work throughout new and existing Building. Work shall be done in accordance with manufacturer's instructions for each material.
- .5 Maintain cleaning until Owner has taken possession of building or portions thereof.

89 PROGRESS RECORDS

- 89.1** Maintain on site, permanent written records of daily progress of the Work. Records shall be open to review by Consultant and Owner at all times and a copy shall be furnished to Consultant on a weekly basis.

- 89.2 Records shall show dates of commencement, progress and completion of various trades and items of work. Particulars pertaining to number of employees of various trades and type and quantity of equipment employed daily, temperature, protection methods and other such data shall be noted.

90 RECORD DRAWINGS

- 90.1 Complete appended Electronic File Release Agreement and submit complete with required fee. Final record drawings to be submitted in both CAD and PDF format.
- 90.2 Authorized deviations from drawings shall be marked in red accurately on one set of drawing prints in a neat, legibly printed manner and shall be dated. Prior to final inspection, neatly transfer the recorded information to a second set of drawing prints of the most recent revision to the drawings and submit both sets to the Consultant.
- 90.3 Maintain record drawings up to date as Work progresses. Status of maintained record drawings may be considered as a condition for validation of applications for payment.
- 90.4 Identify each record drawing as "Contract Record Copy" and maintain the record drawings in good condition. Make record drawings available to the Consultant at all times.
- 90.5 Record drawings shall include accurate dimensioned record of deviations and changes in Work from drawings.
- 90.6 Record drawings shall be signed and dated by Contractor.
- 90.7 Submit record drawing to Consultant for review and make corrections as directed by Consultant.
- 90.8 Record accurately all deviations in the Work.
- 90.9 Accurately record locations of concealed structure, mechanical and electrical services and similar Work not clearly in view, the location of which is required for maintenance, alteration Work and future additions. Do not conceal such Work until the location has been recorded.
- 90.10 Accurately record locations of equipment bases, anchors, concrete pads and roof curbs, sleeves, piping, conduits, ducts, maintenance holes and valves, etc. located either below, outside or within structure.
- 90.11 Where piping, conduits and ducts are underground, underfloor, embedded in concrete or otherwise in unaccessible locations, accurately record with respect to structure column lines or walls and elevations with respect to finished floor levels or grades referenced to the centre line of components.
- 90.12 Accurately record any components which will be in inaccessible locations for Consultant's review before the component is covered, or buried, or made inaccessible.

91 OPERATION AND MAINTENANCE MANUALS

- 91.1 Hand over to the Consultant two (2) copies of a comprehensive operations and maintenance manual and material suitable for the Owner's maintenance employees. Manuals shall cover all Products supplied and installed under the Contract.
- 91.2 Submit draft of the operation and maintenance manuals for the Consultant's review at least 15 days before testing systems and equipment. Incorporate alterations and additions, as found to be necessary during testing, and prepare the final version of the manual from the corrected draft.
- 91.3 Submit final version of operation and maintenance manuals prior to Contract Completion.
- 91.4 Testing of systems and equipment will not be deemed to be complete until the requisite number of copies of the final version of the manuals has been handed over to the Consultant.
- 91.5 If standard literature is incorporated into the operations and maintenance manual, any irrelevant information shall be deleted, or suitably noted.
- 91.6 The manuals shall have sufficient detail in order that the Owner can totally maintain the equipment without outside help.
- 91.7 Submit all material in English.
- 91.8 Operation and maintenance manuals shall contain the following minimum information and data:
 - 91.9 Table of contents: Provide title of Contract; names, addresses, and telephone numbers of Consultants and Contractor with name of responsible parties; schedule of Products and systems, indexed to content of the volume.
 - 91.10 For each Product or system: List names, addresses and telephone numbers of Subcontractors, suppliers and service representatives, including local source of replacement supplies and parts including telephone numbers.
 - 91.11 Warranties: Warranties are between the Contractor and Owner. Warranties shall include, as a minimum:
 - .1 Description of warranty coverage.
 - .2 Date warranty starts (being date of Contract Completion).
 - .3 Date warranty expires.
 - .4 Contact name, address and phone number (the Contractor shall also be responsible for advising the Owner of changes in contact information during the warranty period).
 - .5 Equipment and components performance curves.
 - .6 Hydro certificates.
 - 91.12 Reports: For each Product or system provide the following:
 - .1 Manufacturer's certified reports
 - .2 Factory test reports.
 - .3 Field testing reports.
 - 91.13 Details of design, construction and/or fabrication features, component function and maintenance requirements, to permit effective start-up, operation, maintenance, repair, modification, extension and expansion of any portion or feature of the installation.

- 91.14 Technical data, Product data, supplemented by bulletins, component illustrations, detailed views, technical descriptions of items and parts lists.
 - 91.15 Schematics, interconnection lists: Manuals shall be complete with schematic and wiring diagrams, wiring interconnection lists and diagrams fully cross referenced and coordinated, printed circuit board layouts including the component identification, component parts list with electronic substitution equivalent. Provide cross referenced components lists and sequence of operations.
 - 91.16 Trouble shooting and fault location guide: Instructions to facilitate quick return of malfunctioning equipment to operation.
 - 91.17 Routine servicing and preventative maintenance schedule for Products and/or estimated hours required for routine servicing and preventative maintenance tasks.
 - 91.18 List of recommended spare parts and recommended quantity of each item to be stocked based on spare part availability and re-order time.
 - 91.19 Complete set of reviewed shop drawings.
 - 91.20 Product data: Mark each sheet to clearly identify specific Products and component parts, and data applicable to installation; delete inapplicable information.
 - 91.21 Drawings: Supplement Product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams and as required in the Specifications.
 - 91.22 Typed text: As required to supplement Product data. Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions and as required in the Specification.
- 92 AS-BUILT DRAWINGS**
- 92.1 Prepare all required drawings on CAD (.dwg), using CAD Version 2010 or higher.
 - 92.2 Prepare CAD drawings to meet the requirements of the Owners or Consultant's CAD Standards and Procedures.
 - 92.3 Supply and hand over to the Consultant one CD of drawings for each final drawing prepared under this Contract, including but not limited to circuit drawings, equipment layout drawings, and shop drawings.
 - 92.4 The final size of drawings shall be 560 mm x 860 mm. Half size reproductions (280 mm x 430 mm) shall also be provided.
 - 92.5 Prior to Contract Completion, supply and hand over to the Consultant, one complete set of .dwg Drawing Files in CAD format on storage media acceptable to Consultant for each final drawing prepared under this Contract, including but not limited to circuit drawings, equipment layout drawings, and shop drawings.
 - 92.6 Text files shall be written in word processing program acceptable to Owner.

- 92.7 Authorized deviations from drawings shall be marked in red accurately on one set of drawing prints in a neat, legibly printed manner and shall be dated. Prior to final inspection, neatly transfer the recorded information to a second set of drawing prints of the most recent revision to the drawings and submit both sets to the Consultant.
- 92.8 Maintain as-built drawings up to date as Work progresses. Status of maintained as-built drawings may be considered as a condition for validation of applications for payment.
- 92.9 Identify each as-built drawing as "As-Built Copy" and maintain the as-built drawings in good condition. Make as-built drawings available to the Consultant at all times.
- 92.10 As-built drawings shall include accurate dimensioned record of deviations and changes in Work from drawings.
- 92.11 As-built drawings shall be signed and dated by Contractor.
- 92.12 Submit as-built drawing to Consultant for review and make corrections as directed by Consultant.
- 92.13 Record accurately all deviations in the Work.
- 92.14 Accurately record locations of concealed structure, mechanical and electrical services and similar Work not clearly in view, the location of which is required for maintenance, alteration Work and future additions. Do not conceal such Work until the location has been recorded.
- 92.15 Accurately record locations of equipment bases, anchors, concrete pads and roof curbs, sleeves, piping, conduits, ducts, maintenance holes and valves, etc. located either below, outside or within structure.
- 92.16 Where piping, conduits and ducts are underground, underfloor, embedded in concrete or otherwise in inaccessible locations, accurately record with respect to structure column lines or walls and elevations with respect to finished floor levels or grades referenced to the centre line of components.
- 92.17 Accurately record any components which will be in inaccessible locations for Consultant's review before the component is covered, or buried, or made inaccessible.
- 92.18 CAD drawings of Contract Drawings can be obtained from Consultant at a cost of \$750.00 plus HST per sheet drawing and with a signed CAD Wavier.
- 92.19 Clearly and prominently mark each drawing "AS-BUILT DRAWING prepared by _____ (name of Contractor)"

93 TRANSMITTAL

- 93.1 Transmittal shall contain the list of file names contained on the storage media.

93.2 Data forwarded to the Owner shall contain the following files in addition to the design information:

- .1 Library parts/cells used in the design
- .2 Level convention used for each design file.
- .3 Plotting instructions used to prepare hard copies including colour tables, pen tables and plot scale.
- .4 Working units of the design files.
- .5 Font library, if the standard is not used.

94 PHASED CONSTRUCTION

- 94.1 The Work shall be conducted in multiple phases, with each phase focusing on a single room.
- 94.2 Construction activities shall be planned and executed in phases, with each phase focusing on a single room.
- 94.3 No subsequent phase shall commence until the current room is fully completed and returned to service.
- 94.4 The Contractor shall submit a detailed construction schedule indicating the start and completion dates for each room.
- 94.5 The schedule must be approved by the Consultant and the Owner before any work commences.
- 94.6 The Contractor shall coordinate with the facility management to ensure that only one room is out of commission at any given time.
- 94.7 The Contractor shall ensure that access to and from rooms not under construction remains unobstructed.
- 94.8 Construction materials and debris must be confined to the room under construction and shall not impede the operation of adjacent areas.
- 94.9 The room will be considered complete when all punch list items are resolved and the room is fully operational.
- 94.10 Once a room is approved and back in commission, the contractor may commence work on the next room as per the approved schedule.

95 MOVING, STORING, AND REINSTALLING EXISTING FURNITURE AND EQUIPMENT

- 95.1 **Furniture:** Includes all movable articles within the room such as desks, chairs, tables, cabinets, etc.
- 95.2 **College Equipment**

- 95.3 Contractor shall coordinate with the Owner to schedule the moving and reinstallation activities to minimize disruption.
- 95.4 Work shall be conducted in phases, ensuring that each room's furniture and equipment are handled separately.
- 95.5 No room shall have furniture or fitness equipment moved, stored, or reinstalled without prior approval from the Owner.
- 95.6 Prior to moving, all furniture and equipment shall be inventoried and documented, including photographs and descriptions.
- 95.7 Contractor shall be responsible for the unloading of all furniture and equipment supplied to the work site. The Contractor shall be responsible for any damage occurring during these operations.
- 95.8 Any existing damage shall be noted, documented by photographs and communicated to the Consultant and Owner.
- 95.9 Furniture and equipment shall be carefully disassembled, if necessary, and moved using appropriate equipment to prevent damage.
- 95.10 Items shall be labeled clearly to ensure correct reinstallation.
- 95.11 Contractor is responsible for providing all secured storage containers required for the furniture and equipment.
- 95.12 A secure, dry, clean and secure storage area shall be designated for the temporary storage of furniture, equipment and stored on the site of the work in a manner satisfactory to the Owner.
- 95.13 Items shall be stored in an organized manner, with protective coverings to prevent dust and damage.
- 95.14 Stored items shall be protected from environmental conditions and potential impacts.
- 95.15 Regular inspections shall be conducted to ensure the integrity of stored items.
- 95.16 After painting is completed and fully cured, the room shall be prepared for reinstallation.
- 95.17 Contractor shall verify that the room is clean and free of any debris or dust.
- 95.18 Furniture and equipment shall be carefully moved back into the room and reassembled as necessary.
- 95.19 Items shall be positioned according to the original layout unless otherwise directed by the Owner.

- 95.20 Once reinstallation is complete, the contractor shall conduct a final inspection with the Owner.
- 95.21 Any issues or discrepancies shall be addressed promptly.
- 95.22 Upon completion of each phase, a final inspection shall be conducted to ensure all furniture and equipment are properly reinstalled and the room is ready for use.
- 95.23 Contractor shall provide a final inventory and condition report of all moved items.
- 95.24 Any damage or issues noted during the process shall be documented and remedied at the Contractor's expense.
- 95.25 Store all materials and equipment in a secure and protected manner, which will not overload the structure and shall prevent vandalism or unauthorized use.
- 95.26 Be responsible for the security of all materials and equipment. Make no claims for theft or damage to the Owner.

96 OCCUPIED BUILDING

- 96.1 This is an occupied building and normal building routine will have to carry on while this work is being done. All work shall be performed after regular college working hours (after hours) or on weekends. This will not constitute an extra fee.
- 96.2 Take proper care to avoid unnecessary noise, clutter or obstruction in pedestrian areas, and arrange for storage of materials and tools where they will cause minimum inconvenience.
- 96.3 Where excessive noise or obstruction is in certain cases unavoidable, advise the Owner ahead of time and make suitable arrangements.
- 96.4 The Owner will allow access to the building and to the work site at times designated by the Owner.
- 96.5 The Owner will not assign storage space, for materials and tools. Contactor shall provide secure storage containers on site on designated parking lot space or stored in a location acceptable to the building Owner.
- 96.6 Perform work which interferes with the public comfort at the times specified by the Owner.
- 96.7 The Owner to be notified up to 2 weeks in advance of deliveries of any major equipment and materials arriving on site.

97 TEMPORARY ENCLOSURE AND PROTECTION

- 97.1 Provide and maintain, signs, guardrails, barrier, warning lights and other protection as required by authorises having jurisdiction for safety of the Place of the Work. Be responsible for adequacy of protection.
- 97.2 Plant, Machinery and Scaffolding:
- .1 Provide formwork, scaffolding, equipment, tools, machinery 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.
- 97.3 Maintain temporary barriers and enclosures in good condition for the duration of the Work.
- 97.4 Remove temporary barriers and enclosures from Place of the Work when no longer required.
- 97.5 **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 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.
- 97.6 Fire Routes
- .1 Maintain fire access routes, including overhead clearances, for use by emergency response vehicles

END OF SECTION

1 General

1.1 SECTION INCLUDES

- .1 Labour, Products, equipment and services necessary for demolition and removals Work in accordance with the Contract Documents.
- .2 Work included: Requirements for demolishing, salvaging and removing wholly or in part the various items designated on the drawings or required to be removed or partially removed for the receipt of the Work of this Contract, including not necessarily limited to:
 - .1 Alteration and renovations to existing building.
 - .2 Cutting and removing of walls, floors, ceilings, doors and frames, in the existing buildings as indicated on Drawings.
 - .3 Patching, making good openings and chases in walls, floors, ceilings, including the supply and installation of lintels, channels and finishes.
 - .4 Removal of rubbish, debris, demolished fixtures, fittings and items not scheduled to remain the Owner's property, resulting from the demolition and preparatory work.
 - .5 Remove abandoned services such as conduits, pipes, wiring, ducts, fixtures, equipment, etc. where required for the work or indicated on the drawings.
 - .6 Removal of all mechanical items including plumbing fixtures, services etc. where required for the work or indicated on drawings and or where not required to be relocated.
 - .7 Removal of existing electrical items including fixtures, etc. where required for the work or indicated on the drawings and not required to be relocated.
 - .8 Dust control during the operations of the work of this Section.
 - .9 Removal shall mean removal from site and safe disposal in a legal manner

1.2 REFERENCES

- .1 CSA S350-M, Code of Practice for Safety in Demolition of Structures.
- .2 OPSS, Ontario Provincial Standard Specification.

1.3 SUBMITTALS

- .1 Where required by Authorities having jurisdiction, submit a Fire Plan to local fire department for review and approval.
- .2 Submit shop drawings, diagrams and details in accordance with Section 01 10 10.
- .3 30 calendar days prior to start of demolition and removals work, submit for review, drawings, diagrams or details showing sequence of disassembly work and shoring of supporting structures in accordance with authorities having jurisdiction.
- .4 Submit for approval, a plan showing impacts, interruptions and delays to Owners operations
- .5 Submit Dust Control Plan conforming to requirements of Sheridan College Public Health Services.

- .6 Have submissions signed and sealed by Professional Engineer licensed in Province of Ontario.
- .7 Submit to Consultant, details of where rubble, debris and other materials are to be disposed or reused. Include each disposal/reuse site location, operator's name and business address, type of license under which site operates, and criteria used by site to assess suitability of rubble, debris and other materials for disposal.
- .8 Give notice to Utility Authorities controlling services and appurtenances which will be affected by demolition work.

1.4 QUALITY ASSURANCE

- .1 Prepare waste audits, waste reduction workplans, source separation programs and recycling programs as required by jurisdictional authorities and update programs and implement such programs as required.
- .2 Perform the work of this section in accordance with the 'Environmental Protection Act' including Ontario Regulation 102 and the 'Environmental Assessment Act' including Ontario Regulation 103.
- .3 Conform to Fire Code, Regulation under the Fire Marshals Act.
- .4 The demolition contractor must engage a registered professional engineer who holds a certificate of authorization and an appropriate level of liability insurance to prepare demolition procedures.
- .5 As part of the contract requirements, the engineer for the demolition contractor should be required to sign the general review commitment required by city building departments.

1.5 SITE CONDITIONS

- .1 Interruptions to Owners operations will not be permitted.
- .2 Perform operations, machine and equipment movements, deliveries and removals at time or times that will permit uninterrupted operations in and around structures, including parking, deliveries, and Site access and egress.
- .3 Take over structures to be demolished based on condition on date that Tenders close.
- .4 Contractor shall photo document all existing conditions prior to demolition and make such material available to Cons

2 Products

2.1 MATERIALS

- .1 All materials requiring removal shall become the Contractor's property and shall be removed and disposed of from the site, as the work progresses, unless indicated otherwise.
- .2 Salvaged material:
 - .1 Salvage and stockpile Products, materials, and equipment as specified herein, indicated on Site or indicated on drawings.
 - .2 Coordinate items to be salvaged with Owner. Dispose of items Owner deems to be of no further use.

- .3 Salvaged materials shall not be chipped, cracked, split, stained or damaged.
- .4 Store items off of moist surfaces.

3 Execution

3.1 GENERAL

- .1 Schedule skylight removal work to coincide with commencement of new roofing system installation.
- .2 Clean up rubble and debris, resulting from work promptly and dispose at end of day or place in waste disposal bins. Empty bins on regular basis.
- .3 Stockpiling of rubble, debris, and surplus Products on Site will not be permitted.
- .4 Remove, handle and transport Products indicated to be salvaged and stored for future use. Transport Products to storage area(s) designated by Consultant. Perform work to prevent any damage to Products during removal and in storage. Products damaged during removal, will be inspected by Consultant. Consultant will determine extent of damage and accept or refuse Products.
- .5 List and description of items to be removed and stored or reused:
 - .1 Items as indicated on the drawings or by the Consultant.
- .6 Tag and log all items to be salvaged to the satisfaction of the Consultant. Ensure identification tags do not damage items to be salvaged and are non-permanent, removable and durable.
- .7 Communicate Dust Control Plan procedures to all appropriate personnel on site and their head offices and due diligence measures to be maintained to control all fugitive emissions.
- .8 Take precautions to guard against movement, settlement or collapse of adjacent services, sidewalks, driveways, or trees. Be liable for such movement, settlement or collapse caused by failure to take necessary precautions. Repair promptly such damage when ordered.

3.2 EXAMINATION

- .1 Verify condition and dimensions of previously installed Work upon which this Section depends. Report defects to Consultant. Commencement of work of this Section means acceptance of existing conditions.
- .2 Examine adjacent structures and other installations prior to commencement of demolition and removals work.

3.3 PRESERVATION OF REFERENCES

- .1 Record location and designation of survey markers and monuments located within demolition area, prior to removal. Store and restore markers and monuments upon completion of Work or relocate as directed by Consultant.

3.4 PROTECTION

- .1 Prevent movement or damage of adjacent structures, services, walks, paving, trees, landscaping, adjacent grades, and parts of existing structure to remain. Supply and

- install bracing and shoring as required. Make good damage caused by demolition to acceptance of Consultant.
- .2 Protect adjacent structures and property against damage which might occur from falling debris or other causes. Repair or replace damage caused from work of this Section to acceptance of Consultant.
 - .3 Do not interfere with use of adjacent structures and Work areas. Maintain free, safe passage to and from adjacent structures and Work areas.
 - .4 Take precautions to support affected structures. If safety of structure being demolished, adjacent structures or services are endangered, cease demolition operations and take necessary action to support endangered item. Immediately inform Consultant. Do not resume demolition until reasons for endangering have been determined and corrected and action taken to prevent further endangering.
 - .5 If movement or settlement occurs, install additional bracing and shoring as necessary and make good damage to acceptance of Consultant.
 - .6 Hang tarpaulins where debris and other materials are lowered. Build in around openings with wood and plywood at locations used for removal of debris and materials.
 - .7 Prevent debris from blocking surface drainage system, elevators, mechanical, and electrical systems which are required to remain in operation.
 - .8 Pay particular attention to prevention of fire and elimination of fire hazards which would endanger Work or adjacent structures and premises.
 - .9 Supply and install adequate protection for materials to be re-used, set on ground and prevent moisture pick-up. Cover stockpiles of materials with tarpaulins.
 - .10 Close off access to areas where demolition is proceeding by barricades and post warning signs.
 - .11 Supply, install and maintain legal and necessary barricades, guards, railings, lights, warning signs, security personnel and other safety measures, and fully protect persons and property.
 - .12 Dust/weather partitions:
 - .1 Prior to demolition work proceeding in existing structures, temporarily enclose Work areas, access and supply and install dustproof and weatherproof partitions. Design partitions to prevent dust and dirt infiltration into adjoining areas, prevent ingress of water, and to resist loads due to wind.
 - .2 Prevent dust, dirt and water from demolition operations entering operational areas.
 - .3 Adjust and relocate partitions as required for various operations of work.
 - .4 Upon completion of work, remove and dispose of partitions from Site.
 - .13 Dust protection:
 - .1 Perform dust control procedures in accordance with approved Dust Control Plan and work of this Section.

- .2 Clean water to be applied to hard and soft surfaces and on open excavation faces on Site daily to eliminate dust.
 - .3 Roadways and sidewalks to be cleaned daily or as required.
 - .4 A designated truck loading area on granular material or existing asphalt to be used to mitigate tracking of potentially contaminated soil and demolition debris off Site. Contaminated loading points to be cleaned or re-established.
 - .14 Removed skylights:
 - .1 Provide temporary protective sheeting over removed skylights.
 - .2 Turn sheeting up and over parapets and curbing. Retain sheeting in position with weights or temporary fasteners.
 - .3 Provide for surface drainage from sheeting to roof drains.
 - .4 Do not permit traffic over unprotected or repaired deck surface.
 - .15 Blasting is not permitted
- 3.5 **PREPARATION**
- .1 Disconnect and/or re-route electrical data, communication and telephone service lines entering structures to be demolished. Remove abandoned lines as indicated on Contract Drawings. Post warning signs on electrical lines and equipment which is required to remain energized.
 - .2 Disconnect and cap designated mechanical services:
 - .1 Natural gas supply lines: As indicated on drawings, to be removed by qualified workers in accordance with gas company instructions.
 - .2 Sewer and water lines: Remove and dispose of as indicated on Contract Drawings.
 - .3 Other underground services: Remove and dispose of as indicated on Contract Drawings.
 - .3 Disassemble and remove mechanical equipment, ductwork and piping complete with supports and associated components.
 - .4 Do not disrupt active or energized utilities designated to remain undisturbed
 - .5 Perform rodent and vermin control to comply with health regulations
- 3.6 **DEMOLITION**
- .1 Perform demolition with extreme care. Confine effects of demolition to those parts which are to be demolished.
 - .2 Perform work and prevent inconvenience to persons outside those parts which are to be demolished.
 - .3 Carry out demolition in accordance with the requirements of CSA S350-M.
 - .4 Demolish parts of structure to permit remedial work as indicated
 - .5 Demolition shall proceed safely in systematic manner from roof to grade and as necessary to accommodate remedial work indicated. Work on each floor level shall be

complete before commencing work on supporting structure and safety of its supports are impaired. Parts of building which would otherwise collapse prematurely shall be securely shored. Walls and piers shall not be undermined.

- .6 Do not overload floor or wall with accumulations of material or debris or by other loads.
- .7 Perform work to minimize dusting. Keep work area wetted down with fog sprays to prevent dust and dirt rising. Supply and install temporary water lines and connections that may be required. Upon completion, remove installed temporary water lines. Use covered chutes, water down.
- .8 Do not sell or burn materials on Site.
- .9 Remove existing equipment, services, and obstacles where required for refinishing or making good of existing surfaces, and replace as Work progresses.
- .10 At end of day's work, leave Work in safe condition with no part in danger of toppling or falling. Protect interiors of parts not to be demolished from exterior elements.
- .11 Drainage and sewer system protection:
 - .1 Ensure that no dust, debris or slurry enters drainage and sewer system on Site.
 - .2 Remove and dispose of debris and slurry promptly from Site.
 - .3 Comply with City of Brampton Sewer Use By-Law.
- .12 Concrete:
 - .1 Demolish concrete by methods which avoid impact loads on items which are not to be demolished.
 - .2 Where only part or parts of a concrete floor, wall, or other items are to be demolished, use saw cuts to isolate areas which are to be demolished except where existing reinforcing steel is to be left in place. Prior to such isolating, install suitable support to prevent premature movement of area(s) being isolated and undesirable transfer of loads as cutting progresses. If necessary, remove area(s) to be demolished by successively isolating small sections.
 - .3 Where reinforcing steel is to be left in place, use saw cuts from surface of concrete around perimeter(s) of area(s) to be demolished, chip concrete without damaging reinforcing steel. Retouch damaged epoxy coating of existing reinforcing steel.
- .13 Steel: Where only part or parts of structure is to be demolished, dismantle and maintain structure stable. Do not place excessive loads on components. Install adequate temporary guys and supports to ensure stability and to prevent excessive loading. Support each component being disconnected from structure, and lower, do not drop, component after it is disconnected.
- .14 Cut openings through existing walls, partitions and floors. Establish exact location of steel reinforcing in existing concrete slabs or walls before cutting. Be responsible for damage to existing steel reinforcing and be liable for structural failure. Make good surfaces disturbed with materials to match existing.
- .15 Where doors are scheduled to be removed, include removal of door frames and door hardware.

- .16 Remove interior partitions, fittings, fixtures and accessories as indicated on drawings. Partitions and walls shall be removed full height to structure above.
- .17 Remove interior finishes, such as ceiling and floor finishes, where new finishes are indicated on Contract Drawings.
- .18 Removal of existing ceilings shall include complete removal including bulkheads and suspension system.
- .19 Removal of adhesive applied finishes shall include complete removal to substrate including adhesive. Take adequate care to prevent damage to substrate.
- .20 Remove existing floor finishes, include mortar bed, underlayment or other cleavage membranes, underpad, base, floor moulding and transition strips.
- .21 Demolish all other items indicated or required.
- .22 Cut openings through existing walls, partitions, roofs and floors. Establish exact location of steel reinforcing in existing concrete slabs or walls before cutting. Be responsible for damage to existing steel reinforcing and be liable for structural failure. Make good surfaces disturbed with materials to match existing.
- .23 Where doors are scheduled to be removed, include:
 - .1 Removal in re-usable condition of door hardware.
 - .2 Removal of doors and door frames.
- .24 Remove interior partitions, fittings, fixtures and accessories as indicated on drawings. Partitions and walls shall be removed full height to structure above.
- .25 Remove interior finishes, such as ceiling and floor finishes, where new finishes are indicated on Room Finish Schedule.
 - .1 Removal of existing ceilings shall include complete removal including bulkheads and suspension system.
 - .2 Removal of adhesive applied finishes shall include complete removal to substrate including adhesive. Take adequate care to prevent damage to substrate.
- .26 Remove existing floor finishes, include mortar bed, underlayment or other cleavage membranes, base, floor moulding and transition strips.
- .27 Demolish all other items indicated or required.

3.7 DISPOSAL OF MATERIALS

- .1 Remove from Site, rubble, debris, and other materials resulting from demolition and removals work in accordance with Authorities having Jurisdiction, except where specified or indicated on Contract Drawings to be reused.
- .2 Conform to requirements of municipality's Works Department regarding disposal of waste materials.
- .3 Materials prohibited from municipality waste management facilities shall be removed from Site and dispose of at recycling companies specializing in recyclable materials.
- .4 Remove all waste disposal from Sheridan College Campus.

3.8 RESTORATION

- .1 Where demolition removed a structure or installation, rough grade and restore area in accordance with Authorities having Jurisdiction.

END OF SECTION

1 General

1.1 SECTION INCLUDES

- .1 Labour, Products equipment and services necessary for the management of designated substances work in accordance with the Contract Documents.

1.2 DEFINITIONS

- .1 Hazardous Materials: Designated Substances as covered by the Ontario Occupational Health and Safety Act as well PCBs, CFCs, HCFCs, and Fuel Oil.
- .2 PCBs: Polychlorinated Biphenyls.
- .3 PCB equipment: Equipment designed or manufactured to operate with PCB liquid or to which PCB liquid was added or drums or other containers used for the storage of PCB liquid.
- .4 PCB liquid: Material containing PCBs at a concentration of more than 50 mg/kg
- .5 PCB material: Material containing PCBs at a concentration of more than 50 mg/kg whether the material is liquid or not
- .6 PCB waste: PCB equipment, PCB liquid, or PCB material, but does not include:
 - .1 PCB material or PCB equipment after it has been decontaminated pursuant to guidelines issued by the Ministry of Environment or instructions issued by the director.
 - .2 PCB equipment that is:
 - .1 An electrical capacitor that has never contained over one kilogram of PCBs.
 - .2 Electrical, heat transfer or hydraulic equipment or a vapour diffuser pump that is being put to the use for which it was originally designed or is being stored for such use by a person who uses such equipment for the purpose for which was originally designed.
 - .3 Machinery or equipment referred to in Clause 1.2.6.3.1.
 - .3 PCB liquid that:
 - .1 Is at the site of fixed machinery or equipment, the operation of which is intended to destroy the chemical structure of PCB's by using the PCB's as a source of fuel or chlorine for purposes other than the destruction of PCB's or other wastes and with respect to which a certificate of approval has been issued under Section 9 of the Act after the 1st day of January 1981 specifying the manner in which PCB liquid be processed in the machinery or equipment.
 - .2 Is in PCB equipment referred to in subclause (b) (2) Ontario Regulation 11/82.
 - .3 HCFC: Hydrochlorofluorocarbons.
 - .4 CFC: Chlorofluorocarbons.

1.3 REGULATORY AGENCIES

- .1 Comply with Federal, Provincial, and local requirements pertaining to the handling, management, haulage, and/or disposal of Hazardous Materials including but not limited to the following:
 - .1 Ontario Regulation 356, Highway Traffic Act.
 - .2 R. R. O. 1990, Regulation 347, General - Waste Management.

1.4 SUBMITTALS

- .1 Submit proof satisfactory to the Consultant that suitable arrangements have been made to dispose of Hazardous Materials in accordance with requirements of authorities having jurisdiction.
- .2 Submit notifications to applicable authorities having jurisdiction regarding the handling, storage, haulage, and/or disposal of Hazardous Materials as required by Regulations.
- .3 Submit proof satisfactory to the Consultant that the Hazardous Waste materials were appropriately disposed of.

1.5 EXISTING CONDITIONS

- .1 Information pertaining to the presence of Hazardous Materials to be handled; removed, or otherwise disturbed during this project is identified in the DSS report.
- .2 Assessment:
 - .1 Employ an Asbestos Abatement Consultant to confirm the presence of asbestos in the materials being demolished and to remove hazardous materials in accordance with authorities having jurisdiction.
 - .2 Submit Asbestos Abatement Consultant's certificate that hazardous materials have been removed in accordance with Authorities having Jurisdiction

1.6 INSTRUCTION AND TRAINING

- .1 Before commencing work, provide to the Consultant satisfactory proof that every worker has had instruction and training in the hazards of handling and storage of Hazardous Materials, in personal hygiene and work practices, and in the use, cleaning, and disposal, of respirators and protective clothing as required.
- .2 Instruction and training related to respirators shall include instruction and training related to:
 - .1 The limitations of the equipment.
 - .2 The inspection and maintenance of the equipment.
 - .3 The fitting of the equipment.
 - .4 The disinfecting of the equipment.

1.7 WORKER PROTECTION

- .1 Respirators: Provide workers with personally issued and marked as to efficiency and purpose non-powered reusable or replaceable filter type air purifying respirators

suitable for the materials being handled and acceptable to the Provincial Authority having jurisdiction (as required).

- .2 Protective Clothing: Provide workers with full body disposable type coveralls (as required).
- .3 Eating, drinking, chewing, and smoking are not permitted in the work area.
- .4 Store protective clothing in clean plastic bag for reuse or if protective clothing is not to be reused, dispose of as contaminated waste.
- .5 Workers shall wash hands and face when leaving the work area and before eating or drinking.

2 Products

2.1 **MATERIALS**
NOT USED

3 Execution

3.1 **EXAMINATION**

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

3.2 **ASBESTOS CONTAINING MATERIALS**

- .1 Conform to and Manage and dispose of asbestos containing materials in accordance with Regulation Designated Substance - Asbestos on Construction Projects And In Buildings And Repair Operations R.R.O. 1990, Reg. 838, made under Occupational Health and Safety Act as amended by O.Reg. 278/05 and O.Reg 837 as amended by O.Reg. 279/05.

END OF SECTION

- 1** General
- 1.1** **SCOPE**
 - .1 The following specifications are provided to define and clarify areas related to the quality, warranty, and installation of products provided by Inter Dyne Systems and supplied by Canadian Scientific Lab Systems Inc.
- 1.2** **SECTION INCLUDES**
 - .1 Labour, Products equipment and services necessary for the stainless steel casework Work in accordance with the Contract Documents.
- 1.2** **REFERENCES**
 - .1
 - .2 SEFA 8M-2016 Recommended Testing Standards for Laboratory Grade Metal Casework on Base and Wall Cabinets. Report number: 104681075GRR-001B
 - .3 ADA: 2010 ADA Standards for Accessible Design Recommended Guidelines
- 1.3** **SUBMITTALS**
 - .1 Shop Drawings:
 - .1 Submit shop drawings in accordance with Section 01 10 10 indicating materials, material gauges, sizes, finishes, profiles, connection attachments, shop jointing, field jointing, reinforcing, anchorage, fastener types and sizes, location of exposed fastenings, mechanical and electrical service routes, service outlets, cutout locations, and sizes. Include erection drawings, plans, elevations, sections, and details as applicable.
 - .2 Samples: Submit samples of the following in accordance with the requirements of Section 01 10 10:
 - .1 One stainless steel chip representing the manufactured finish shall be provided
 - .2 One of each item of hardware.
 - .3 Quality Assurance:
 - .1 Testing Reports: Manufacturer shall submit test data which is in compliance with the project specifications.
 - .2 Certificates: Any certificates required by the specification may be requested and provided.
 - .3 Instructions: Provide instructions for the installation and maintenance of all products provided and installed within this section.
- 1.4** **DELIVERY, STORAGE AND HANDLING**
 - .1 Do not deliver laboratory casework until painting, utility roughing-in, and similar operations that could damage, soil, or deteriorate casework have been completed in installation areas. If casework must be stored in other than installation areas, store only in areas whose environmental conditions meet requirements specified in "Project Conditions" Article below.

- .2 Protect finished surfaces from soiling and damage during handling and installation. Keep covered with polyethylene film or other protective covering. Mark in large lettering "NO STANDING."

1.5 PROJECT CONDITIONS

- .1 Building must be totally enclosed (This includes but is not limited to: Windows and Doors installed, and the location must be weather tight.)
- .2 All wet-work shall be completed.
- .3 HVAC system is operating and will maintain temperature and relative humidity at occupancy levels through remainder of construction period.
- .4 Nearby and related work shall be completed.
- .5 Site must be free of additional construction such as painting, taping and floating drywall work or other items that could damage or mark finish of installed product.
- .6 Required bracing must be installed properly and be ready for casework installation.

1.6 WARRANTY

- .1 Provide a written warranty that all work performed under this section shall be free from defect of materials, finish and workmanship for a period of five (5) years from date of shipment.
- .2 The warranty of products of another manufacturer, and sold by Inter Dyne Systems Inc, are limited to the warranty extended by that manufacturer to Inter Dyne Systems Inc.

2 Products

2.1 MANUFACTURERS

- .1 Acceptable Manufacturer:
 - .1 Inter Dyne Systems Inc., 676 E. Ellis Rd., Norton Shores, MI 49441 Direct Phone: (231) 799-8760 Web: www.interdynesystems.com or approved equivalent.
 - .2 Canadian Scientific Lab Systems Inc., 7777 Eastview Road., Guelph, ON N1H 6J1 Tel: (226) 780-4793 Email: info@canadianscientific.ca or approved equivalent.

2.2 MATERIALS

- .1 Stainless Steel:
 - .1 Sheet: ASTM A240, Type 304 or 316 alloy
 - .2 Visible surface Finish: Unless otherwise indicated, AISI No. 4 brushed finish.
 - .3 Non-visible surface finish: Unless otherwise indicated, AISI No. 2b finish.
- .2 Glass: Clear Float or Tempered .25" thick, conforming to ANSI Z97.1 glazing quality.
- .3 Acrylic: Clear Acrylic .25" thick conforming to ANSI Z97.1 for use as substitution for clear float glass. Only when specified.

2.3 CASEWORK CONSTRUCTION

.1 General

- .1 The stainless-steel casework and components shall be of modern design and shall be constructed in accordance with the best practice of the Scientific Laboratory Equipment Industry.
- .2 Exceptional quality casework shall be insured by the use of proper machinery, tools, dies, fixtures and skilled workmanship to meet the intended quality and purpose of the project.
- .3 Individual cabinets shall be rigid and self-supporting, for use interchangeable in a group of cabinets, or individual units.
- .4 All cabinets to have a cleanable smooth interior. Bottoms shall be formed down on sides and back to create easily cleanable corners with no burrs or sharp edges.
- .5 Case openings of Inset style cabinets shall be rabbeted on all four sides for hinged doors to provide a dust resistant case.
- .6 Maintain uniform clearances around door and drawer fronts of 1/16 to 3/32 inch.

.2 Gauges and Thickness:

Gauges of steel used in construction of cases shall be 18 gauge (.048), except as follows:

- .1 12ga (.105) – leveling foot gussets.
- .2 14ga (.075) – stainless steel shelf clips.
- .3 16ga (.060) – apron rails, cross rails, end pedestals, pull out shelves, hat channel supports and reinforcement gussets.
- .4 20ga (.036) – Drawer assemblies, door assemblies, removable back panels, sloped tops, filler panels and slip filler panels.

.3 Grain Direction:

Base & Suspended Cabinets: Grain shall run vertical on visible front and side surfaces of all base cabinets, including doors and drawers.

.1 Base & Suspended Cabinets:

- .1 Grain shall run vertical on visible front and side surfaces of all base cabinets, including doors and drawers.
- .2 Interior shelf grain runs front to back along the depth of the cabinet.
- .3 Components in the interior of the cabinet may run horizontally or front to back.

.2 Wall Cabinets:

- .1 Grain shall run vertical on visible front surfaces of all wall cabinets, including doors.

- .2 Grain shall run horizontal on all top and bottom visible surfaces from the front of the cabinet.
 - .3 Interior shelf grain runs front to back along the depth of the cabinet.
 - .4 Components in the interior of the cabinet may run horizontally or front to back.
- .3 Tall Cabinets:
 - .1 Grain shall run vertical on visible front and side surfaces of all tall cabinets, including doors and drawers.
 - .2 Interior shelf grain runs front to back along the depth of the cabinet.
 - .3 Components in the interior of the cabinet may run horizontally or front to back.
- .4 Mobile Cabinets:
 - .1 Grain shall run vertical on visible front and side surfaces of all base cabinets, including doors and drawers.
 - .2 Grain shall run horizontal on all top and bottom visible surfaces from the front of the cabinet.
 - .3 Interior shelf grain runs front to back along the depth of the cabinet.
 - .4 Components in the interior of the cabinet may run horizontally or front to back.
- .5 Fillers:
 - .1 Fillers shall run in the corresponding direction as the cabinet face that the filler is attached to. Except where cabinet dimensions do not permit.
- .6 Aprons, Knee space and Sloped Tops: All grain to run
 - .1 All grain to run horizontally on aprons, knee space panels and sloped tops.
- .4 Cabinet Frame:
 - .1 Side panels to be formed into not less than a L shape in the top, bottom back and a minimum of $\frac{3}{4}$ " C shaped front.
 - .2 One piece die-formed cabinet bottom construction with return side flanges turned down.
 - .3 Top horizontal front rail shall interlock with the flange at the top of the side panels and welded for strength, but shall be flush at the face of the unit.
 - .4 Rear horizontal rail shall interlock with the flange at the top of the side panels and welded for strength. The removable backs shall lock into the top rear rail where applicable.
 - .5 Toe space shall be fully enclosed, 4 inches high by 3 inches deep, with no open gaps or pockets.
 - .6 Bottom corners to accept a foot gusset with a $\frac{3}{8}$ " leveling leg.

- .7 Wall and tall cabinets to be furnished with a welded on solid back with integral mounting to receive a wall cleat.
- .8 Cabinet construction shall be TIG welded to form a strong well-fitted, one-piece unit.
- .9 Front face joints fully welded, ground and polished to provide a continuous flat front plane free of clevises.
- .10 Suspended cabinets shall consist of the same construction as base cabinets with the toe kick removed.
- .5 Backs:
 - .1 Base cabinets furnished with removable back panel for access to stops, valves and service lines.
 - .2 Cabinets with drawers only do not come equipped with back panels.
 - .3 Partial height fixed back panels for sink base cabinets.
 - .4 Wall and tall cabinets to have fixed welded in place backs.
 - .5 Suspended cabinets shall always be furnished with removable back panels.
- .6 Doors:
 - .1 All doors shall close on rubber bumpers.
 - .2 All doors shall be replaceable in the field.
 - .3 Cabinet doors shall not exceed 23" in width. Any cabinets requiring doors to be wider will be supplied with a center divider.
 - .1 Example: a 60inch wide sink base cabinet with double doors to have a center divider between doors.
 - .4 All hinged doors less than 36" in height shall be hung by minimum of two (2) hinges. Doors greater than 36" in height shall be hung by minimum of three (3) hinges.
 - .5 Hinged and sliding solid doors
 - .1 7/8" thick, outer and inner formed and telescoped boxed construction. Reinforced with a channel to prevent sagging or pulling of fasteners.
 - .2 20 gauge outer and inner panels.
 - .3 Hinges to be attached with #8 stainless screws.
 - .4 Sliding doors to accept rollers and flush handles.
 - .6 Hinged and sliding glass doors
 - .1 16 gauge stainless steel outer face to be of one-piece construction, with corners fully welded ground and polished. Reinforced with channels to accept removable inner face.
 - .2 18 gauge stainless steel inner face removable for replacement of glass.
 - .3 Glass set into channels provided by removable back panels.

.7 Drawers:

- .1 Fabricate drawer fronts of 20 gauge (.036) stainless panels. The exterior drawer front shall have a channel formation at the top edge with fully finished return edge to form a finished drawer front when secured to the drawer box. Drawer front has a lip to fit over the inside box on the top and bottom edges. Lock the drawer face onto the drawer box with removable #8 screws from the backside of the drawer front.
- .2 Drawer body shall consist of a two-piece construction, first is the drawer body and second is drawer box front inner panel. Drawer slide rails spot welded to the outer edge of the drawer box sides. Drawer sides shall have a reinforcing bend on the top edges.
- .3 Drawer slides systems shall be designed with self-closing action with a rating of 100lb capacity per drawer. Stainless steel full extension ball bearing slides.
- .4 Drawers shall be removable with a release tab incorporated into the slides.
- .5 All drawers shall close against rubber bumpers.
- .6 Provide drawer pulls in center location of drawer face. All drawers over 24" wide shall be furnished with two (2) drawer pulls.

.8 Shelves:

- .1 Adjustable shelves fabricated from 18 gauge stainless steel, with all sides formed down 1" and with an inner return of 3/4" for stiffness and rigidity.
- .2 Quantity of adjustable shelves supplied per cabinet to be called out in supplied submittal drawings.
- .3 Center fixed shelf in tall cabinets, with all sides formed down 1" and with only the front edge formed with an inner return of 3/4" to match the adjustable shelves. Fixed shelf to be attached to center of tall cabinets to help keep the cabinet rigid.

.9 Knee Space Rails:

- .1 Knee space rails shall be 4" high and fabricated from a single metal channel shaped skirting.

.10 Apron Pencil Drawer Assemblies (SPD):

- .1 Pencil drawer rails shall be 5-3/8" high and fabricated from a single metal channel shaped skirting. Drawer suspension framing shall be mechanically fixed to channels, welded integrally with front and back channel sections formed into a rigid one-piece unit.
- .2 Standard SPD assemblies range from 24 to 48 inches in width with single drawer or double drawer. Drawer suspension shall be with ball bearing slides and self-closing action.

.11 End Pedestals:

- .1 End pedestals shall consist of two (2) 16ga side panels welded together to form a strong rigid unit.

- .2 End pedestals shall be 2" thick and be designed to accept a knee space rail or apron.
- .3 End pedestals shall be provided with two (2) leveling devices.
- .12 American Disability Sink Enclosure (ADSE):
 - .1 ADSE shall consist of a three-piece construction, 2 sides and a removable front panel. Meeting requirements set by ADA guidelines.
 - .2 12 gauge left and right-hand sides mounted on wall surface with preset .28" dia. holes.
 - .3 18 gauge removable front panel attached with #8-32 screws on the front surface. Grain to run vertically on all front removable panels.
- .13 Cabinet Sloped Tops:
 - .1 Sloped tops shall be fabricated from 20ga stainless steel, welded, ground and polished to make a complete unit. It shall mount flush with the front edge of the cabinet and extend back at an angle.
 - .2 Sloped tops shall be supplied with a wall cleat to mount the sloped top to the wall.
- .14 Scribes and Fillers:
 - .1 Provide as needed to close space between cabinets and walls, ceilings and indicated equipment. Fabricate from the same material and with the same finish as cabinets.
 - .2 Supply front base filler panels with flanges on both sides and a 3" x 4" toe space along the working face.
 - .3 Corner filler panels shall be a two-piece construction, one upper and one panel forming the toe space. Each shall be welded together to form one complete unit.
 - .4 Slip filler panels shall consist of a two-piece construction. One double piece and one single piece, the single piece shall slip into the double piece allowing the slip filler to be adjusted as needed along the surface.
 - .5 End closure panels shall be flanged on two (2) sides secured to the back of the cabinet or wall and silicone into place on the adjacent surface. No visible mounting hardware allowed.
- .15 Hardware:
 - .1 Door Hinges: 2-1/2" long stainless steel five (5) knuckle type butt hinges.
 - .2 Wire Pulls: shall be provided for drawers and hinged doors, pulls shall be mounted vertically for hinged doors and mounted horizontally for drawers. Recessed pulls available upon request.
 - .3 Door Catches:
 - .1 Stainless steel magnet catch mounted on cabinet body with a receiving 430 stainless steel magnetized plate mounted on door body.
 - .2 Nylon roller catches available upon request.

- .3 Base cabinet catch to be located on the top of door.
- .4 Wall cabinets catch to be located on the top of the cabinet.
- .5 Tall cabinets to have a catch located on the top of the cabinet and a catch on the bottom of the cabinet.
- .4 Shelf clips: Laser cut 14ga stainless steel removable shelf clips.
- .5 Leveling guides: 3/8-16 stainless steel 250lb capacity glid with minimum 1" adjustment.
- .6 Locks: Stainless-steel heavy-duty cylinder 5-disc type tumbler, stamped with identifying number.
- .7 Swivelling caster with brake: 'Model 670.13.902' by Hafele or approved alternative. (8 total).

2.4 BASE AT MILLWORK AND WALL

- .1 Stainless Steel SS-1 base (B-4): 18 Gauge Stainless Steel wall base, approximately 100 mm high x 18GA thick, coved profile, in lengths as long as possible including premoulded end stops and inner and outer corners. Colour: Brushed Finish.

3 Execution

3.1 EXAMINATION

Site Preparation Recommendations: Casework should not be delivered or installed until the following conditions have been met:

- .1 Building must be fully enclosed and weather tight.
- .2 An operational HVAC system must be in place to maintain both temperature and humidity levels at the same level as when the space is occupied.
- .3 Ceiling, lighting and any overhead ductwork must be installed and completed.
- .4 Site must be free of any further construction that could damage or blemish the finish of the product.
- .5 Required bracing must be properly installed in the correct locations for the installation to proceed.

3.2 INSTALLATION

- .1 Coordinate cutouts for plumbing fixtures, inserts, appliances, outlet boxes, and other fixtures. Round internal corners of cut-outs and seal exposed cores.
- .2 Scribe and cut as required, fit to abutting walls, and surfaces, fit properly into recesses and to accommodate columns, fixtures, outlets, or other projecting, intersecting or penetrating objects leaving a 0.8 mm gap maximum.
- .3 Install millwork at locations shown on drawings. Position accurately, level, plumb straight.

.4 MW-1A, MW-1B – Upper and Lower Cabinets

- .1 Construct sink countertop sizes and details as noted.
- .2 Construct countertop sizes and details as noted.
- .3 Construct upper and lower storage sizes and details as noted.
- .4 Construct cabinet frames, back, doors, shelves, end pedestals/fillers sizes and details as noted.
- .5 Anchor to supports in a concealed manner
- .6 Mitre joints at corners. Keep joints to a minimum.
- .7 Round all corners, edges and ends.
- .8 Install brackets and supports supplied under work of Section 05 50 00.

.5 MW-2A, MW-2B, MW-2C – Upper and Lower Cabinets

- .1 Construct countertop sizes and details as noted.
- .2 Construct upper and lower storage sizes and details as noted.
- .3 Construct cabinet frames, back, doors, shelves, end pedestals/fillers, knee space rails sizes and details as noted.
- .4 Anchor to supports in a concealed manner
- .5 Mitre joints at corners. Keep joints to a minimum.
- .6 Round all corners, edges and ends.
- .7 Install brackets and supports supplied under work of Section 05 50 00.

.6 MW-4 – Workstation

- .1 Construct tabletop sizes and details as noted.
- .2 Construct lower storage sizes and details as noted.
- .3 Construct cabinet frames, doors, drawers, shelves, box core, end pedestals/fillers, knee space rails sizes and details as noted.
- .4 Anchor to supports in a concealed manner
- .5 Mitre joints at corners. Keep joints to a minimum.
- .6 Round all corners, edges and ends.
- .7 Install brackets and supports supplied under work of Section 05 50 00.

.7 MW-5 – Mobile Workstation

- .1 Construct tabletop sizes and details as noted.
- .2 Construct lower storage sizes and details as noted.
- .3 Construct cabinet frames, shelves, end pedestals/fillers sizes and details as noted.
- .4 Anchor to supports in a concealed manner
- .5 Mitre joints at corners. Keep joints to a minimum.
- .6 Round all corners, edges and ends.
- .7 4 heavy duty swiveling casters.
- .8 Install legs and supports supplied under work of Section 05 50 00.

.8 Casework Installation:

- .1 Peel protective plastic off all surfaces that will not be accessible after installation. Leaving on as much of the plastic as possible until the end of installation to ensure finish surfaces do not get scratched or damaged during installation.
- .2 Set casework components plumb, level and true; shim as required, using concealed shims.
- .3 Cabinets in continuous run must be fastened together flush, tight and uniform not exceeding 1/16" of an inch misalignment.
- .4 Wall casework wall cleats shall be secured to solid supporting backing material, not to plaster, lath or gypsum board. Wall cabinets shall hang on wall cleats supported with solid backing materials at all times.
- .5 Top surfaces shall be joined in one level plane. Joints to be flush and gaps shall not exceed 1/8 of an inch between the tops.
- .6 Adjust casework and hardware so doors and drawers operate smoothly without warp or bind.

.9 Fastening:

- .1 Coordinate wall securement, anchorage, and blocking for stainless steel casework items.
- .2 Position items of stainless steel casework Work accurately, level, plumb, true and fasten or anchor securely.
- .3 Design and select fasteners to suit size and nature of components being joined. Use proprietary devices as recommended by manufacturer.

- .4 Provide heavy duty fixture attachments for wall mounted cabinets.
- .5 Set finishing nails to receive filler. Where screws are used to secure members, countersink screw in round cleanly cut hole and plug with wood plug to match material being secured.
- .10 Remove and replace damaged, and/or marked stainless steel casework.

3.3 CLEANING AND PROTECTION

- .1 Cleaning:
 - .1 Remove all protective plastic and labels immediately after installation.
 - .2 Repair or remove and replace defective work as directed on completion of installation.
 - .3 Clean finished surfaces, touch up as required, and remove or refinish damaged or soiled areas to match original factory finish.
- .2 Protection:
 - .1 Provide suitable water-resistant covering over counter surfaces for the remainder of the construction process.
 - .2 Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION

- 1 General**
- 1.1 SECTION INCLUDES**
 - .1 Design, labour, Products, equipment and services necessary for the miscellaneous and metal fabrication Work in accordance with the Contract Documents.
- 1.2 REFERENCES**
 - .1 ANSI/BHMA A156.21, American National Standard for Thresholds.
 - .2 ASTM A108, Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished
 - .3 ASTM A269, Specification for Seamless and Welded Austenitic Stainless Steel Sanitary Tubing for General Service.
 - .4 ASTM A307, Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.
 - .5 CAN/CSA-G40.20/G40.21-M, General Requirements for Rolled or Welded Structural Quality Steel/ Structural Quality Steels.
 - .6 CAN/CSA S16.1-M, Limit States Design of Steel Structures.
 - .7 CSA S136.1-M, Commentary on CAN/CSA S136-M, Cold Formed Steel Structural Members.
 - .8 CSA W47.1, Certification of Companies for Fusion Welding of Steel Structures.
 - .9 CSA W48, Filler Metal and Allied Materials for Metal Arc Welding.
 - .10 CSA W59-M, Welded Steel Construction (Metal Arc Welding).
 - .11 CAN/CSA W117.2-M, Safety in Welding, Cutting and Allied Processes.
 - .12 CGSB 1-GP-181, Organic Zinc Rich Primer.
 - .13 NAAMM, The National Association of Architectural Metal Manufacturers.
 - .14 Steel Structures Painting Council (SSPC), Steel Structures Painting Manual, Vol. 2.
- 1.3 DESIGN REQUIREMENTS**
 - .1 Design details and connections, where not shown on Drawings, in accordance with CAN/CSA-S16.1 and CSA S136.1.
 - .2 All exposed metal, including both steel and aluminum to have eased edges and corners. No sharp edges are permitted.
- 1.4 SUBMITTALS**
 - .1 Shop drawings:
 - .1 Submit shop drawings for fabrication and erection of miscellaneous and metal items in accordance with Section 01 10 10 indicating:
 - .1 Materials, core thicknesses, class of finish (AMP 555), connections, joints, method of anchorage, number of anchors, supports, reinforcement, details, and accessories.

- .2 Ensure shop drawings are of one uniform size and based on field measurements.

.2 Samples:

.1 Submit samples of the following:

- .1 Two 300 x 300 samples of metal demonstrating finish and colour of galvanized steel with clear finish for the Consultant's approval.

1.5 QUALITY ASSURANCE

- .1 Retain a Professional Engineer, licensed in the Province of Ontario, with experience in Work of comparable complexity and scope, to perform the following services as part of the Work of this Section:

- .1 Design oversized hollow metal frames, hollow metal doors, hollow metal glazing transom, hollow metal sidelite, and metal fabrication items that are required to resist live, dead, lateral, wind, or seismic loads.

- .2 Review, stamp, date and sign shop drawings.

- .2 Workmanship: Fabricate Work of this Section to meet the required class of workmanship indicated below in accordance with AMP 555, Section 8.

.1 Class 1: for use on direct exposed to view fabricated items:

- .1 Exposed surfaces are finished smooth with pits, mill marks, nicks, burrs, sharp edges, and scratches filled or ground off. Defects should not show when painted, polished, or finished. .
- .2 Welds should be concealed where possible. Exposed welds are ground to small radius with uniform sized cove unless otherwise noted.
- .3 Distortions should not be visible to the eye.
- .4 Exposed joints are fitted to a hairline finish.

- .3 Execute welding by firms certified in accordance with CSA W47.1 Division 1 or 2.1. Ensure welding operators are licensed per CSA W47.1 for types of welding required by Work.

2 Products

2.1 MATERIALS

.1 General:

- .1 All materials under Work of this Section, including but not limited to, primers and paints are to have low VOC content limits.
- .2 Unless detailed or specified herein, standard products will be acceptable if construction details and installation meet intent of Drawings and Specifications.

- .3 Include all materials, products, accessories, and supplementary parts necessary to complete assembly and installation of Work of this Section.
- .4 Incorporate only metals that are free from defects which impair strength or durability, or which are visible. Install only new metals of best quality, and free from rust or waves and buckles, and that are clean, straight, and with sharp defined profiles.
- .2 Structural shapes, plates, and similar items:
 - .1 Conforming to CAN/CSA-G40.20/G40.21-M, Grade 350W.
- .3 Welding materials: CSA W48 and CSA W59-M.
- .4 Fasteners: Conforming to ASTM A307, Grade A, in areas not exposed to view, use unfinished bolts with hexagon heads and nuts. In areas exposed to view, use bolts, nuts, washers, rivets, lock washers, anchor bolts, machine screws and machine bolts Z275 zinc coated in accordance with ASTM A653/A653M. Supply bolts of lengths required to suit thickness of material being joined, but not projecting more than 6 mm beyond nut, without the use of washers.
- .5 Galvanized primer paint: Inorganic zinc rich primer. For use on galvanized fabrications where touch up is to remain unpainted in finished work; Carbozinc 11WB by Carboline Company, Catha-Coat 305 by Devoe Coatings or Zinc Clad XI by Sherwin Williams.
- .6 Drilled inserts: Mega by ITW Construction Products or HSL by Hilti Inc. heavy-duty anchors, sizes as shown.
- .7 Sleeve anchors: Sleeve anchors, 'HLC Sleeve Anchors, Flat Phillips Head - HLC-FPH 3.8 x 4' by Hilti or approved alternative with countersink flush. Provide sleeve anchors for bolting of steel posts to floor where bolts indicated to be exposed.

2.2 FABRICATION

- .1 Verify dimensions of existing Work before commencing fabrications and report any discrepancies to the Consultant.
- .2 Fit and assemble Work in shop where possible. Execute Work in accordance with details and reviewed shop drawings.
- .3 Use self-tapping shake-proof screws on items requiring assembly by screws or as indicated. Use screws for interior metal work. Use welded connections for exterior metal Work unless otherwise found acceptable by the Consultant.
- .4 Ensure exposed welds are continuous for length of each joint. File or grind exposed welds smooth and flush. Seal exterior steel fabrications against corrosion in accordance with CAN/CSA S16.1-M.
- .5 Execute shop welding to requirements specified.
- .6 Carefully make and fit details. Take special care with exposed finished Work to produce a neat and correct appearance to the Consultant's acceptance.

- .7 Assemble members without twists or open joints.
- .8 Correctly size holes for connecting Work of other trades where such can be determined prior to fabrication. Where possible, show holes on shop drawings. Place holes not to cause appreciable reduction in strength of member.
- .9 Draw mechanical joints to hairline tightness and seal countersunk screw and access holes for locking screws with metal filler where these occur on exposed surfaces.
- .10 Exposed metal edges shall be eased to prevent sharp edges and corner conditions.

2.3 FABRICATED ITEMS

- .1 Refer to Drawings for details of metal fabrication work and related items not specifically listed in this Section.
- .2 Where work is required to be built into work of other Sections supply such members to respective Sections.
- .3 Provide metal fabrication items indicated below and items not indicated to be supplied under other Sections. The following items includes miscellaneous and metal fabrication including but not limited to the items listed below.
- .4 Millwork counter supports:
 - .1 Provide supports for vanity counters. Construct support as detailed. Where indicated, conceal supports within cavity of drywall partition.
 - .2 Provide all drill holes required for concealed anchorage of counters and for anchoring to building structure.
 - .3 Supports to be field painted
 - .4 Coordinate with SECTION 06 20 00.
- .5 Miscellaneous steel brackets, counter supports and angles:
 - .1 Supply and install or supply for installation by trades responsible, all loose steel brackets, supports and angles where indicated, except where such brackets, supports and angles are specified under work of other Sections. Drill for countersunk screws, expansion anchors and anchor bolts.
 - .2 Unless otherwise specified, prime paint for interior installation; hot dipped galvanized steel galvanized finish for exterior installation.
- .6 Lintels:
 - .1 Fabricated from CAN/CSA-G40.20/G40.21-M, Grade 350W, size and location as shown, width to be not less than 25 mm less than width of wall and extend 200 mm beyond opening at each end. Unless otherwise shown, fabricate lintels in block walls of steel sections.
- .7 **Aluminum Metal Flashing Reveal:**
 - .1 Fabricate custom aluminum metal flashing for installation at existing HSS

columns and aluminum glazed screen, sized and located as shown on the Drawings.

- .2 Material: Minimum 2.0 mm (0.080") thick aluminum sheet, alloy 3003-H14 or 5005-H34, in accordance with ASTM B209.
- .3 Finish: Factory-applied fluoropolymer coating (70% PVDF) to AAMA 2605, colour and gloss to match adjacent aluminum framing.
- .4 Fabrication:
 - .1 Fabricate with clean, straight bends; sharp profiles; and smooth, even surfaces free from oil canning.
 - .2 Provide hemmed edges where exposed and closed ends where flashing terminates at columns.
 - .3 Coordinate joints to align with curtain wall mullions or column edges; provide concealed fastenings where possible.
 - .4 Installation: Install level, plumb, and true to line, with positive slope to shed water, in accordance with manufacturer's recommendations and Drawings. Seal all joints watertight with sealants specified in Section 07 92 00.

2.4 **ANCHORS AND FASTENING**

- .1 Use weld studs of size not larger than 10 mm for attaching miscellaneous materials and equipment to building steel. If weight of item requires larger fasteners use clips or brackets and secure by welding or through bolting.
- .2 Use self drilling expansion type concrete anchors for attaching to masonry and concrete
- .3 Do not secure items to steel deck.

2.5 **WELDING**

- .1 Perform welding by electric arc process.
- .2 Execute welding to avoid damage or distortion to Work. Execute welding in accordance with following standards:
 - .1 CSA W48 - for Electrodes. If rods are used, only coated rods are allowed.
 - .2 CSA W59-M and CSA W59S1-M for design of connections and workmanship.
 - .3 CAN/CSA W117.2-M - for safety.
- .3 Thoroughly clean welded joints and expose steel for a sufficient distance to perform welding operations. Finish welds smooth. Supply continuous and ground welds which will be exposed to view and finish paint.
- .4 Test welds for conformance and remove Work not meeting specified standards and replace to Consultant's acceptance.

2.6 HOT DIP GALVANIZING

- .1 After fabrication, hot dip galvanize specific miscellaneous steel items as indicated. After galvanizing, plug relief vents air tight with appropriate aluminum plugs as suitable and required for intended metal fabricated item. Straighten shapes and assemblies true to line and plane after galvanizing. Repair damaged galvanized surfaces with zinc rich primer in accordance with manufacturer's printed directions.
- .2 Hot-dip galvanize members in accordance with requirements of the following ASTM, with minimum coating weights or thicknesses as follows:
 - .1 Rolled, pressed and forged steel shapes, plates, bars and strips: ASTM A123; average weight of zinc coating per square/metre of actual surface, for 4.8 mm and less thickness members 600 g/m2 for 6 mm and heavier members 640 g/m2.
 - .2 Iron and steel hardware: ASTM A153; minimum weight of zinc coating, in ounces per square foot of surface, in accordance with ASTM A153, Table 1 for the various classes of materials used in the Work.

3 Execution

3.1 EXAMINATION

- .1 Examine previously installed Work, upon which this Section depends, verify dimensions and condition of existing Work, and coordinate repairs, alterations, and rectification if necessary. Commencement of Work of this Section is deemed to signify acceptance of existing, prior conditions.
- .2 Obtain Consultant's written approval prior to field cutting or altering of structural members.

3.2 ERECTION

- .1 Install metal fabrications in accordance with reviewed shop drawings and manufacturer's written instructions.
- .2 Fit joints and intersecting members accurately. Make Work in true planes with adequate fastenings. Build and erect Work plumb, true, square, straight, level and accurate to sizes detailed, free from distortion or defects detrimental to appearance or performance.

3.3 TOUCH UPS

- .1 Paint bolt heads, washers, nuts, field welds and previously unpainted items. Touch up is to remain unpainted in finished work; Carbozinc 11WB by Carboline Company, Catha-Coat 305 by Devoe Coatings or Zinc Clad XI by Sherwin Williams.

END OF SECTION

1 General

1.1 SECTION INCLUDES

- .1 Labour, Products, equipment and services necessary for rough carpentry Work in accordance with the Contract Documents.

1.2 REFERENCES

- .1 ASTM A153, Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
- .2 ASTM A325, Specification for Bolts Quenched/Tempered Steel Nominal Thread Diameter M16 - M36 For Structural Steel Joints.
- .3 ASTM A653, Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- .4 ASTM E84, Standard Test Method for Surface Burning Characteristics of Building Materials.
- .5 ASTM F1667, Driven Fasteners: Nails, Spikes and Staples.
- .6 CAN/CSA O80 Series M, Wood Preservation.
- .7 CSA O121-M, Douglas Fir Plywood.
- .8 CAN/CSA O141, Softwood Lumber.
- .9 CAN/ULC-S102, Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.
- .10 NLGA, Standard Grading Rules for Canadian Lumber, National Lumber Grades Authority.

1.3 QUALITY ASSURANCE

- .1 Lumber identification: Grade stamp of an agency certified by the Canadian Lumber Standards Accreditation Board.
- .2 Plywood identification: Grade mark in accordance with applicable CSA standards.
- .3 Lumber quality: Carefully select individual pieces so that knots and obvious defects will not interfere with placing bolts, proper nailing or making proper connections.
- .4 Moisture Content of wood at time of construction shall be 19% maximum.
- .5 Each piece of pressure treated lumber and fire retardant treated lumber shall be shop marked with the pressure treatment brand and ULC monogram respectively, in accordance with CAN/CSA O80-M.
- .6 Dimensions of lumber shall conform to dressed sizes specified in CAN/CSA-0141 unless actual dimensions are otherwise indicated or specified.
- .7 Dimensional references to lumber on Drawings and in Specifications are to nominal sizes unless actual dimensions are indicated. Such actual dimensions shall be dry size.
- .8 Lumber defects: Discard wood with defects which will render a piece unable to serve

its intended function. Lumber will be rejected by Consultant for excessive warp, twist, bow, crook, mildew, fungus, or mould, as well as for improper cutting and fitting, whether or not it has been installed.

1.4 ENVIRONMENTAL REQUIREMENTS

- .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.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING

- .1 Store materials in a dry area. Cover materials with tarpaulins or polyethylene sheets to prevent moisture absorption and impairment of structural and aesthetic properties. Vent to allow air movement. Tie covering to keep in place.

2 Products

2.1 MATERIALS

- .1 General: All materials under Work of this Section, including but not limited to, adhesives are to have low VOC content limits.
- .2 Lumber: Softwood, G4S, moisture content 19% or less at time of installation, in accordance with the following:
 - .1 Lumber shall be of same species and grade, equally seasoned and shall be processed and stamped at same mill. .
 - .2 CSA O141 and NLGA Standard Grading Rules for Canadian Lumber.
 - .3 Board quality: Construction or better.
 - .4 Dimension quality:
 - .1 Structural joists, planks, and framing: No. 1 Select Structural.
 - .2 Light framing: Construction
- .3 Plywood:
 - .1 Plywood (WD-3): Pressure treated plywood, thickness as indicated on drawings, with pressure treatment as specified in this Section.
- .4 Surface applied wood preservative: Green coloured copper naphthenate or 5% pentachlorophenol solution, water repellent preservative or same copper based preservative as used for shop impregnation, in accordance with CAN/CSA O80.
- .5 Fire retardant treatment of lumber and plywood (interior and protected locations): 'Dricon FRT' fire retardant treatment by Biewer Lumber or approved alternative, conforming to ASTM E84, to provide a flame spread rating of 25 or less.
- .6 Rough hardware: Conforming to ASTM F1667; Nails, bolts, screws, anchors, expansion shields, and other fastenings required to frame and fix rough carpentry as

follows: .

- .1 Nails, spikes and staples: Spiral type.
- .2 Bolts: ASTM A325; 12.7 mm diameter minimum with nuts and washers unless noted otherwise.
- .3 Screws: Countersunk head, full thread type.
- .4 Proprietary fasteners: Toggle bolts, expansion shields, lag bolts, screws, inorganic fibre plugs, recommended for purpose by manufacturer.
- .5 Galvanize rough hardware used in fire treated wood and hardware exposed to the atmosphere.
- .7 Fasteners for use in pressure treated wood: Provide hot dipped galvanized fasteners complying to ASTM A153 and connectors in accordance with ASTM A653, Class G185 for non-structural members. Provide type 304 or 316 stainless steel fasteners and connectors for use in Structural, pressure treated wood.

3 Execution

3.1 EXAMINATION

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

3.2 GENERAL

- .1 Lay out work carefully and to accommodate work of others. Cut and fit accurately: erect in position indicated by Drawings.
- .2 Install rough carpentry to allow for expansion and contraction of the materials.
- .3 Cut work into lengths as long as practicable and with square ends. Align, level, square, plumb, and secure work permanently in place. Brace work temporarily as required. Join work only over solid backing.
- .4 Bore holes true to line and to same size as bolts. Drive bolts into place for snug fit, and use plates or washers for bolthead 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.
- .5 Provide anchors, bolts, and inserts required for attachment of the work of this Section, to those performing the work of other Sections and who are responsible for their installation.
- .6 Do not attach work by wood plugs or blocking in concrete or masonry. Use lead shields, expansion shields, or similar methods only as approved by Consultant.

3.3 MISCELLANEOUS WOODWORK

- .1 Fit and install wood furring, strapping, grounds and blocking. Adequately size,

correctly place and conceal members for finishes, fitments and for Work under other Sections. Do not assume that Drawings show required work exactly or completely. Anchor wood members securely in place.

- .2 Install rough bucks, nailing strips and linings to rough openings as required for backing for frames and other Work.
- .3 Except where steel supports are specifically shown, provide wood blocking and supports in metal stud partitions for fastening of item such as casework and other wall mounted accessories. Have respective trades approve the location of such wood blocking.
- .4 Bolt wood blocking or nailing strips to steel framing.
- .5 Align and plumb faces of furring and blocking to tolerance of 1:600.
- .6 Use fire retardant lumber for blocking/framing in ceiling\spaces, partitions and bulkheads.
- .7 Miscellaneous blocking: Provide miscellaneous wood blocking in wall cavities for securing millwork, partitions, screens, flat screen televisions, and any additional areas as indicated and required.
- .8 At all glazed system frames, install wood blocking at header and jambs to ensure rigid installation and to prevent doors and frames from rattling.

3.4 WALL SHEATHING

- .1 Provide plywood wall sheathing for interior wall assemblies as required and indicated on Contract Drawings.
- .2 Apply lumber wall sheathing so that all ends are supported with end joints staggered.
- .3 Apply panel-type sheathing board so that vertical joints are staggered if the sheathing is applied horizontally and a gap of not less than 1.5 mm left between sheets of plywood.

3.5 BACKBOARDS

- .1 Install plywood backboards, primed and painted white on both sides, with fire retardant paint.
- .2 Use minimum 19 mm thick plywood on 19 x 38 mm furring around perimeter and at maximum 300 mm intermediate spacing.

3.6 FASTENERS

- .1 Frame, anchor, fasten, tie and brace members for required strength and rigidity.
- .2 Use hot dipped galvanized fasteners for exterior Work and Work below grade.
- .3 Countersink bolts and bolt heads as required for clearance of other Work.
- .4 Size fasteners to penetrate base member by half of fastener length minimum. Minimize splitting of wood members by staggering nails in direction of grain.

- .5 For plywood use spiral, annular or resin coated nails and staples.
- 3.7 **SURFACE-APPLIED WOOD PRESERVATIVE**
- .1 Treat raw surfaces, drilled holes and cut ends of pressure treated wood with 2 coats of wood preservative immediately after cutting.
 - .2 Apply preservative by dipping, by brush or by pouring into plugged holes to completely saturate surface.

END OF SECTION

- 1 General
- 1.1 **SECTION INCLUDES**
 - .1 Labour, Products, equipment and services necessary for firestopping and smoke seals work in accordance with the Contract Documents.
- 1.2 **REFERENCES**
 - .1 ASTM C303, Standard Test Method for Dimensions and Density of Preformed Block and Board-Type Thermal Insulation.
 - .2 ASTM C920, Standard Specification for Elastomeric Joint Sealants.
 - .3 ASTM C1104, Standard Test Method for Determining the Water Vapor Sorption of Unfaced Mineral Fiber Insulation.
 - .4 ASTM E814, Test Method for Fire Tests of Through-Penetration Fire Stops.
 - .5 ASTM E2174, Standard Practice for On-Site Inspection of Installed Fire Stops.
 - .6 ASTM G21, Standard Test for Determining Resistance of Synthetic Polymeric Materials to Fungi.
 - .7 CAN/CGSB 19.13, Sealing Compound, One Component, Elastomeric, Chemical Curing.
 - .8 CAN/ULC S102, Surface Burning Characteristics of Building Materials and Assemblies.
 - .9 CAN/ULC S114, Standard Method of Test for Determination of Non-Combustibility in Building Materials.
 - .10 CAN/ULC S115, Standard Method of Fire Tests of Firestop Systems.
 - .11 CAN/ULC S129, Standard Method Of Test For Smoulder Resistance Of Insulation (Basket Method).
 - .12 CAN/ULC S702, Thermal Insulation, Mineral Fibre for Buildings.
- 1.3 **DEFINITIONS**
 - .1 Fire Separation: A construction assembly, plane or device, either vertical or horizontal, which is required to prevent the passage of fire and smoke for a prescribed period of time. Proof of compliance to required time rating shall be by ULC, Warnock Hersey (or similar approved) certification or shall be as listed in the Ontario Building Code Supplementary Standard SB-2.
 - .2 Smoke Separation: A construction assembly, plane or device, either vertical or horizontal, which is not required to prevent the passage of fire for a prescribed period of time but is required to prevent the passage of smoke. A "Smoke Separation" is also known as a "Fire Separation with No Rating" or a "Zero Hour Rated Separation".
 - .3 Non-Rated Separation: A construction assembly, plane or device, either vertical or horizontal, which is not required to prevent the passage of fire for a prescribed period of time and is not required to prevent the passage of smoke.
- 1.4 **SYSTEM DESCRIPTION**

- .1 Firestopping and smoke seals: ULC or Intertek Testing Services listed Products and systems in accordance with CAN/ULC S115 suitable to actual application and installation conditions.
- .2 Firestop applications that exist for which no ULC or cUL tested system is available through a manufacturer, a manufacturer's engineering judgment derived from similar ULC or cUL system designs or other tests will be submitted to local authorities having jurisdiction for their review and approval prior to installation. Engineer judgment drawings must follow requirements set forth by the International Firestop Council.
- .3 Firestop and smoke seal system shall achieve a fire resistance rating and smoke seal rating equal to that of assemblies into which they are installed.
- .4 Provide smoke sealants over firestopping materials or combination smoke seal/firestop seal material to form air tight barriers to retard the passage of gas and smoke.
- .5 Firestopping and smoke seals located at movement joints shall be designed with movement capability.
- .6 Provide penetration firestopping with mould and mildew resistance rating of 0 in accordance with ASTM G21.
- .7 Firestopping and smoke seals within mechanical and electrical assemblies shall be provided as part of the work of Divisions of mechanical, electrical and refrigeration respectively.

1.5 SUBMITTALS

- .1 Product data:
 - .1 Submit copies of manufacturer's Product data in accordance with 01 10 10 indicating:
 - .1 Performance criteria, compliance with appropriate cUL or ULC reference standard, characteristics, limitations.
 - .2 Product transportation, storage, handling and installation requirements.
 - .3 Submit firestop and smoke seal manufacturer's Product data for materials and prefabricated devices, including manufacturer's printed installation instructions.
- .2 Shop drawings:
 - .1 Submit shop drawings in accordance with Section 01 10 10 indicating:
 - .1 Fire rated and smoke sealed systems for each typical application.
 - .2 Construction details, accurately reflecting actual job conditions.
 - .3 ULC or Intertek Testing assembly listing.
 - .4 Each floor and wall assembly requiring firestop system with each corresponding ULC firestop system.
- .3 Certification:
 - .1 Submit certified documentation from manufacturer for each worker performing work of this Section.

- .2 Submit installer's and Product manufacturer's certification verifying compliance with the Contract Documents and conformance with ASTM E814 and CAN/ULC S115.

1.6 QUALITY ASSURANCE

- .1 Installers qualifications: Perform work of this Section by a company that has a minimum of five years proven experience in the installation of firestopping and smoke seal work of a similar size and nature and that is approved by manufacturer. Submit to Consultant, applicator's current certificate of approval by the material manufacturer as proof of compliance.
- .2 Manufacturer's direct representative and/or fire protection specialist shall be on-site during initial installation of firestop systems to train appropriate contractor personnel in proper selection and installation procedures conforming to manufacturer's written recommendations published in their literature and drawing details.
- .3 Pre-construction meetings: Arrange with manufacturer's representative, Contractor, Consultant and Field Engineer to determine responsibility for handling such issues as FT rated partitions, firestop custom details, compatibility, mixed penetrations, and to review installation procedures 48 hours in advance of installation.

1.7 DELIVERY STORAGE AND HANDLING

- .1 Deliver materials to Place of Work in manufacturer's unopened containers, containing classification label with labels intact and legible at time of use.
- .2 Do not use damaged or adulterated materials exceeding their expiry date.

1.8 SITE CONDITIONS

- .1 Conform to manufacturer's requirements and maintain a minimum temperature of 5°C for a minimum period of 24 hour before application, during, and until application is fully cured.
- .2 Maintain sealant at a minimum 18°C for best workability.

2 Products

2.1 ACCEPTABLE MANUFACTURERS

- .1 Acceptable manufacturers of rated systems include:
 - .1 AD Fire Protection Systems Inc.
 - .2 Hilti Canada Corporation.
 - .3 3M Canada Inc.
 - .4 Tremco Ltd.

2.2 GENERAL SYSTEM REQUIREMENTS

- .1 All materials under work of this Section, including but not limited to, primers and sealants are to have low VOC content limits.
- .2 Do not use Products containing asbestos.
- .3 Firestopping components shall not contain volatile solvents or require special application to protect plastic pipe from firestopping compound.
- .4 Provide smoke seal sealant in following colours:

- .1 Grey or white in finished areas.
- .2 Red in unfinished areas.
- .5 Smoke sealant for overhead and vertical joints for floor to be self-levelling and non-sagging sealant.
- .6 Smoke sealant at vertical through penetrations in areas with floor drains shall be waterproof type.

2.3 MATERIALS

- .1 Following materials have been provided for convenience. Contractor shall provide complete system with all components and accessories as required for fire resistant and smoke seal installation.
- .2 Firestop sealant: single component, low modulus, silicone rubber, moisture curing sealant to ASTM C920, ULC labelled to CAN/ULC S115.
- .3 Pre-Installed firestop devices for use with non-combustible and combustible pipes, conduit and/or cable bundles penetrating concrete floors and walls.
 - .1 Cast-in place firestop device complete with aerator adaptor when used in conjunction with aerator system. Model CP 680-P by Hilti or approved alternative.
 - .2 Cast-in place firestop device for use with non-combustible penetrants. Model CP 680-M by Hilti or approved alternative.
 - .3 Speed sleeve for use with cable penetrations. Model CP 653 by Hilti or approved alternative.
 - .4 Firestop block. Model CFS-BL by Hilti or approved alternative.
- .4 Re-penetrable, round cable management devices for use with new or existing cable bundles penetrating walls:
 - .1 Speed sleeve with integrated smoke seal fabric membrane. Model CP 653 by Hilti or approved alternative.
 - .2 Firestop Sleeve. Model CFS-SL SK by Hilti or approved alternative.
 - .3 Retrofit sleeve for use with existing cable bundles. Model CFS-SL RK by Hilti or approved alternative.
 - .4 Gangplate for use with multiple cable management devices. Model CFS-SL GP by Hilti or approved alternative.
 - .5 Gangplate Cap for use at blank openings in gangplate for future penetrations. Model CFS-SL GP CAP by Hilti or approved alternative.
- .5 Firestop insulation: to CAN/ULC S702, Type 2; mineral fibre manufactured from rock or slag, suitable for manual application.
 - .1 Density: Minimum 64 kg/m³ when tested to ASTM C303.
 - .2 Combustibility: Noncombustible to CAN/ULC S114.
 - .3 Melt temperature: >1175 degrees C.
 - .4 Surface burning characteristics: to CAN/ULC S102, maximum flame spread of 0, smoke developed of 0.

- .5 Moisture Absorption: 0.04 percent when tested to ASTM C1104.
- .6 Smoulder Resistance: 0.01 percent when tested to CAN/ULC S129.
- .6 Damming, back-up, supports, and anchorage: In accordance with manufacturer's fire rated systems and to acceptance of authorities having jurisdiction.
- .7 Primer: As recommended by firestopping sealant manufacturer.
- 3 Execution
- 3.1 **EXAMINATION**
 - .1 Verify condition and dimensions of previously installed Work upon which this Section depends. Report defects to Consultant. Commencement of work of this Section means acceptance of existing conditions.
 - .2 Verify that substrates and surfaces to receive firestopping and smoke seals are clean, dry, and frost free.
- 3.2 **PREPARATION**
 - .1 Prepare, modify, and adjust void sizes, proportions, and conditions to conform to fire rated and smoke sealed assembly requirements such as assembly opening size and dimensional restrictions.
 - .2 Clean surfaces to remove material detrimental to bond including dust, paint, rust, oil, grease, moisture, frost and other foreign matter to manufacturers recommendations.
 - .3 Mask adjacent surfaces to avoid spillage and over-coating of adjacent surfaces. Remove stains from adjacent surfaces.
- 3.3 **INSTALLATION**
 - .1 Install firestopping and smoke seal systems in accordance with reviewed Shop Drawings, manufacturer's instructions and fire rated assembly to establish continuity and integrity of fire separations.
 - .2 Install firestop insulation in compacted thicknesses required by ULC design. Compress insulation approximately 50 percent.
 - .3 Install primers as recommended by firestop and smoke seal Product manufacturers.
 - .4 Install temporary forming, damming, back-up as required, remove after materials have achieved initial cure and will resist displacement.
 - .5 Install firestop and smoke seal filler in horizontal joints providing 25% compression fit.
 - .6 Use resilient, elastomeric firestopping and smoke seal systems in following locations:
 - .1 Openings and sleeves for future use.
 - .2 Penetration systems subject to vibration or thermal movement.
 - .3 Penetration systems in acoustical containment enclosures.
 - .7 Trowel and tool exposed firestop and smoke seal. Product surfaces to uniform, smooth finish.
 - .8 Seal joints to ensure an air and water resistant seal capable of withstanding compressions and extensions due to thermal wind or seismic joint movement.
 - .9 Taped joints will not be acceptable.

- .10 Repair damaged firestopped and smoke sealed surfaces to acceptance of Consultant.
 - .11 Identify each firestop and smoke seal penetration assembly with permanent label listing following:
 - .1 Assembly and rating in hours.
 - .2 Date of installation.
 - .3 Installing company's name and telephone number.
 - .12 Do not cover materials until full cure has taken place.
- 3.4 **INSPECTION AND TESTING**
- .1 Inspection of through-penetration firestopping shall be performed in accordance with ASTM E2174 to ensure that firestopping and smoke seals have been installed in accordance with Contract documents and to tested and listed firestop system.
- 3.5 **CLEAN-UP**
- .1 Clean all surfaces adjacent to sealed holes and joints to be free of excess firestop materials and soiling as work progresses.
 - .2 Remove excess materials and debris immediately after application.
- 3.6 **SCHEDULE OF FIRESTOP AND SMOKE SEAL LOCATIONS**
- .1 Following firestop and smoke seal location schedule is included for convenience and may not be complete. Examine Contract Drawings and other specification sections and determine entire extent of work of this Section. Generally provide systems with required fire and smoke ratings at following locations:
 - .1 Gaps at intersections of fire-resistance rated walls and partitions.
 - .2 Control and sway joints in fire-resistance rated walls and partitions.
 - .3 Gaps at top of fire-resistance rated partitions and walls.
 - .4 Penetrations through fire-resistance rated walls and partitions including mechanical and electrical services and openings and sleeves for future use.
 - .5 Penetrations through fire-resistance rated floor slabs, ceilings, and roofs.
 - .6 Gaps at edge of floor slabs at exterior walls.
 - .7 Perimeter of retaining angles on rigid ducts greater than 0.012 m², firestopping material between retaining angle and fire separation and between retaining angle and duct, on each side of fire separation.
 - .8 Where indicated on drawings.
 - .9 At non-rated assemblies that require a smoke seal.
 - .10 Where required by Ontario Building Code.

END OF SECTION

1 General

1.1 DESCRIPTION

- .1 This section provide the elastomeric sealants and their implementation that are used to seal building joint assemblies.
- .2 Labour, Products, equipment and services necessary for sealant Work in accordance with the Contract Documents.
- .3 Work of this Section does not include sealants in firestopping and smoke sealed assemblies.
- .4 Work of this Section does not include sealant work identified in individual specification sections.

1.2 REFERENCES

- .1 American Society for Testing and Materials International (ASTM)
 - .1 ASTM C 919-[08], Standard Practice for Use of Sealants in Acoustical Applications.
 - .2 ASTM C834, Specification for Latex Sealants.
 - .3 ASTM C920, Specification for Elastomeric Joint Sealants.
 - .4 ASTM C1330, Specification for Cylindrical Sealant Backing for Use with Cold Liquid Applied Sealants.
- .2 Canadian General Standards Board (CGSB)
 - .1 CGSB 19-GP-5M-[1984], Sealing Compound, One Component, Acrylic Base, Solvent Curing (Issue of 1976 reaffirmed, incorporating Amendment No. 1).
 - .2 CAN/CGSB-19.13-[M87], Sealing Compound, One-component, Elastomeric, Chemical Curing.
 - .3 CGSB 19-GP-14M-[1984], Sealing Compound, One Component, Butyl-Polyisobutylene Polymer Base, Solvent Curing (Reaffirmation of April 1976).
 - .4 CAN/CGSB-19.17-[M90], One-Component Acrylic Emulsion Base Sealing Compound.
 - .5 CAN/CGSB-19.24-[M90], Multi-component, Chemical Curing Sealing Compound.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for joint sealants and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Product data: Submit copies of Product data in accordance with Section 01 10 10 describing type, composition and recommendations or directions for surface preparation, material preparation and material installation.
 - .3 Manufacturer's product to describe:

- .1 Caulking compound.
 - .2 Primers.
 - .3 Sealing compound, each type, including compatibility when different sealants are in contact with each other.
 - .2 Samples:
 - .1 Submit samples of each type of material and colour.
 - .2 Cured samples of exposed sealants for each colour where required to match adjacent material.
 - .3 Two samples of sealant/caulking, for colour selection. Two samples of back-up material and primer for physical characteristics.
 - .3 Manufacturers' Instructions
 - .1 Submit instructions to include installation instructions for each product used.
- 1.4 **DELIVERY, STORAGE AND HANDLING**
 - .1 Arrange delivery of materials in original, unopened packages with labels intact, including batch number, and ensure that on-site storage is kept to a minimum. Do not store materials on site where there exists any danger of damage from moisture, direct sunlight, freezing and other contaminants.
 - .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.
 - .3 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
 - .4 Storage and Handling Requirements:
 - .1 Store materials indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect joint sealants from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.
- 1.5 **QUALITY ASSURANCE**
 - .1 Qualifications: Work of this Section shall be executed by trained applicators approved by sealant manufacturer and having a minimum of 5 years proven experience.
- 1.6 **EXTENDED WARRANTY**
 - .1 Submit an extended warranty for Sealant Work in accordance with General Conditions, except that warranty period is extended to 2 years from date of Substantial Performance of the Work.
 - .1 Warrant against leakage, cracking, crumbling, melting, shrinkage, running, loss of adhesion and staining adjacent surfaces.
 - .2 Coverage: Complete replacement including affected adjacent Work.
- 1.7 **SITE CONDITIONS**

- .1 Do not install materials when ambient air temperature is less than 5 degrees Celsius, when recesses are wet or damp, or to manufacturer's recommendations.
- .2 Ambient Conditions:
 - .1 Proceed with installation of joint sealants only when:
 - .1 Ambient and substrate temperature conditions are within limits permitted by joint sealant manufacturer or are above 4.4 degrees C.
 - .2 Joint substrates are dry.
 - .3 Conform to manufacturer's recommended temperatures, relative humidity, and substrate moisture content for application and curing of sealants including special conditions governing use.
 - .3 Joint-Width Conditions
 - .1 Proceed with installation of joint sealants only where joint widths are as allowed by joint sealant manufacturer for applications indicated.
 - .4 Joint-Substrate Conditions:
 - .1 Proceed with installation of joint sealants only after contaminants capable of interfering with adhesion are removed from joint substrates.
- 2 Products**
- 2.1 SEALANT MATERIALS**
 - .1 All materials under Work of this Section, including but not limited to, primers and sealants are to have low VOC content limits.
 - .2 Use materials as received from manufacturers, without additives or adulterations. Use one manufacturer's Product for each kind of Product specified.
 - .3 Do not use caulking that emits strong odours, contains toxic chemicals or is not certified as mould resistant in air handling units.
 - .4 When low toxicity caulks are not possible, confine usage to areas which off gas to exterior, are contained behind air barriers, or are applied several months before occupancy to maximize off gas time.
 - .5 Where sealants are qualified with primers use only these primers.
 - .6 Where exposed the colours shall match the substrate, as approved by the Owner.
- 2.2 Sealant Type A: ASTM C920, Type S, Grade NS, Class 25; One-part, non-sag type, silicone sealant, in standard colours selected.**
 - .1 'DC CWS' by Dow Corning Inc.
 - .2 'Sikasil 305CN' by Sika.
 - .3 'Tremsil 400' by Tremco.
- 2.3 Sealant Type B: ASTM C920, Type S, Grade NS; One-part mildew-resistant silicone, in standard colours selected.**
 - .1 '786 Mildew Resistant Silicone Sealant' by Dow Corning Inc.
 - .2 'Sikasil GP Mildew Resistant' by Sika.

- .3 'Tremsil 200 Silicone Sealant' by Tremco Ltd.
- 2.4 Sealant Type C: ASTM C834; Pure acrylic siliconized sealant; in standard white colour (paintable).
 - .1 '950A Siliconized Acrylic Latex Caulk' by Sherwin Williams.
 - .2 'Tremflex 834 Siliconized Sealant' by Tremco Ltd.
 - .3 Sealant Type D: Urethanes one part: Non-sag: to CAN/CGSB-19.13, Type 2, approved products include:
 - .1 Dymonic by Tremco;
 - .2 SikaFlex 15LM by Sika;
 - .3 or approved alternate.
 - .4 Preformed compressible and non-compressible back-up materials:
 - .1 Polyethylene, urethane, neoprene or vinyl foam:
 - .1 Extruded closed cell foam backer rod.
 - .2 Size: oversize 30 %.
 - .2 Neoprene or butyl rubber:
 - .1 Round solid rod, Shore A hardness 70.
 - .3 High density foam:
 - .1 Extruded closed cell polyvinyl chloride (PVC), extruded polyethylene, closed cell, Shore A hardness 20, tensile strength 140 to 200 kPa, extruded polyolefin foam, 32 kg/m³ density, or neoprene foam backer, size as recommended by manufacturer.
 - .4 Bond breaker tape:
 - .1 Polyethylene bond breaker tape which will not bond to sealant.
- 2.5 **ACCESSORIES**
 - .1 Primers: Type recommended by material manufacturers for various substrates, primers to prevent staining of adjacent surfaces encountered on project.
 - .2 Joint backing: ASTM C1330; Round, solid section, closed cell, skinned surface, soft polyethylene foam gasket stock, compatible with primer and sealant materials, 30 to 50% oversized, Shore A hardness of 20, tensile strength 140 to 200 kPa. Bond breaker type surface.
 - .3 Bond breaker: Type recommended by material manufacturers.
 - .4 Void filler around the window frames to be one part expanding polyurethane foam.
 - .5 Cleaning agents: As recommended by material manufacturer, non-staining, harmless to substrates and adjacent finished surfaces.
- 2.6 **MIXING**
 - .1 Follow manufacturers instructions on mixing, shelf and pot life.
- 2.7 **JOINT CLEANER**

- .1 Non-corrosive and non-staining type, compatible with joint forming materials and sealant in accordance with sealant manufacturer's written recommendations.
- .2 Primer: in accordance with sealant manufacturer's written recommendations.
- 3 Execution**
- 3.1 EXAMINATION**
 - .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for joint sealants installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence prior to sealant installation.
 - .2 Inform the Consultant of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied. Proceeding with the installation will be the acceptance of the substrate by the Contractor.
- 3.2 SURFACE PREPARATION**
 - .1 Examine joint sizes and conditions to establish correct depth to width relationship for installation of backup materials and sealants.
 - .2 Clean bonding joint surfaces of harmful matter substances including dust, rust, oil grease, and other
 - .3 Do not apply sealants to joint surfaces treated with sealer, curing compound, water repellent, or other coatings unless tests have been performed to ensure compatibility of materials. Remove coatings as required.
 - .4 Ensure joint surfaces are dry and frost free.
 - .5 Prepare surfaces in accordance with manufacturer's directions.
 - .6 Prepare joints to receive sealants to manufacturer's instructions. Ensure that joints are clean and dry and ferrous surfaces are free from rust and oil.
 - .7 Clean recesses to receive sealant, to be free of dirt, dust, loose material, oil, grease, form release agents and other substances detrimental to sealant's performance.
 - .1 Remove lacquer or other protective coatings from metal surfaces, without damaging metal finish, using oil-free solvents. Remove rust, mill scale and coatings from ferrous metals by wire brush, grinding or sand blasting. Ensure recess is dry.
 - .2 Do not apply sealants to joint surfaces treated with sealer, curing compound, water repellent, or other coatings. Remove incompatible coatings as required.
 - .8 Ensure that all materials in contact with sealant are compatible. Test substrate for adhesion.
 - .9 Depth of recess: Maintain depth to ½ joint width up to a maximum of 13 mm and not less than 6 mm at centre of joint. For greater depth, use joint backing under. Where recess is less than specified depth, cut back surface of recess to specified recess depth.

- .10 Install polyethylene backing rod in joints 6 mm or more in width. Roll backing rod into joint. Do not stretch or bend backing rod. Install bond breaker to back of recess.
- .11 Prime sides of recess, in accordance with sealant manufacturer's instructions.
- .12 Condition products for use in accordance with manufacturer's recommendations.

3.3 **INSTALLATION**

- .1 Apply sealant immediately after adjoining Work is in condition to receive such Work. Apply sealant in continuous bead using gun with correctly sized nozzle. Use sufficient pressure to evenly fill joint.
- .2 Ensure sealant has full uniform contact with, and adhesion to, side surfaces of recess. Superficial painting with skin bead is not acceptable. Tool sealant to smooth surface, free from ridges, wrinkles, sags, air pockets, embedded impurities, dirt, stains or other defects.
 - .1 At recesses in angular surfaces, finish sealant with flat profile, flush with face of material at each side.
 - .2 At recesses in flush surfaces, finish compound with concave face, flush with face of material at each side.
- .3 Make sealant bead uniform in colour.
- .4 Cure sealants in accordance with sealant manufacturer's instructions. Do not cover up sealants until proper curing has taken place.
- .5 Immediately remove excess compound or droppings which would set up or become difficult to remove from adjacent finished surfaces, using recommended cleaners, as work progresses. Do not use scrapers, chemicals or other tools which could damage finished surfaces. Remove defective sealant.
- .6 Clean recesses and re-apply sealant.
- .7 Remove masking tape immediately after joints have been sealed and tooled.

3.4 **PRIMING**

- .1 Where necessary to prevent staining, mask adjacent surfaces prior to priming and caulking.
- .2 Prime sides of joints in accordance with sealant manufacturer's instructions immediately prior to caulking.

3.5 **BACKUP MATERIALS**

- .1 Apply bond breaker tape where required to manufacturer's instructions.
- .2 Install joint filler to achieve correct joint depth and shape, with approximately 30% compression.

3.6 **APPLICATION**

- .1 Sealant:
 - .1 Apply sealant in accordance with manufacturer's written instructions to achieve the required minimum and maximum sealant depths.

- .2 Mask edges of joint where irregular surface or sensitive joint border exists to provide neat joint.
- .3 Apply sealant in continuous beads.
- .4 Apply sealant using gun with proper size nozzle to achieve a minimum 6mm depth over the joint profile and adhesive to substrate a minimum of 9mm, and 10mm minimum joint width, while maintaining a consistent depth-to-width ratio.
- .5 Use sufficient pressure to fill voids and joints solid.
- .6 Form surface of sealant with full bead, smooth, free from ridges, wrinkles, sags, air pockets, embedded impurities.
- .7 Tool exposed surfaces before skinning begins to give slightly concave shape.
- .8 Remove excess compound promptly as work progresses and upon completion.
- .9 Apply multiple application of sealant to build up the required joint-to-width ratio for joints in excess of 19mm wide, and within the manufacturer's recommendations.
- .2 Curing:
 - .1 Cure sealants in accordance with sealant manufacturer's instructions.
 - .2 Do not cover up sealants until proper curing has taken place.

3.7 **CLEANING**

- .1 Clean surfaces adjacent to joints, remove sealant smears or other soiling resulting from application of sealants. At metal surfaces, remove residue. Do not mar or damage finishes on materials adjacent to joints. Repair or replace marred or damaged materials.
- .2 Leave Work area clean at end of each day.
- .3 Clean adjacent surfaces immediately.
- .4 Remove excess and droppings, using recommended cleaners as work progresses.
- .5 Remove masking tape after initial set of sealant.
- .6 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment.

3.8 **PROTECTION**

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by joint sealants installation.

3.9 **SCHEDULE OF LOCATIONS**

- .1 Following sealant location schedule is included for convenience and may not be complete. Examine Contract Drawings and other specification sections and determine entire extent of Work of this Section. Generally seal following locations:

- .1 Concrete, masonry, wood and stone to metal. Wood to masonry, concrete and stone.
- .2 Metal to metal.
- .3 All dissimilar materials.
- .4 Where 'sealant' or 'caulking' is indicated on drawings.
- .2 Sealant Type A:
 - .1 Exterior joints between masonry and steel or aluminum.
 - .2 Exterior joints between masonry and shelf angle.
 - .3 Exterior joints between steel or aluminum and concrete or masonry. Interior and exterior control joints, except in floors.
 - .4 Door frames, louvre frames, interior and exterior side.
 - .5 Protrusions through interior and exterior walls and floors, interior and exterior side, except where fire rated seals are required.
 - .6 Seal thresholds.
- .3 Sealant Type B:
 - .1 Between mechanical fixtures/fittings. Between access panels.
- .4 Sealant Type C:
 - .1 Perimeter of interior windows.
 - .2 Junction between drywall and masonry.
- .5 Sealant Type D:
 - .1 Exterior joints between roof and mechanical fixtures/fittings
 - .2 Perimeter of roof.

END OF SECTION

1 General

1.1 SECTION INCLUDES

- .1 Labour, Products, equipment, tools, and services necessary for the metal frames work in accordance with the Contract Documents.

1.2 REFERENCES

- .1 ASTM A653/A653M, Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zincron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- .2 ASTM A568/A568M, Specification for General Requirements for Steel, Carbon and High-Strength Low-Alloy, Hot-Rolled Sheet and Cold-Rolled Sheet.
- .3 CAN/CGSB-1.198, Cementitious Primer, (for Galvanized Surfaces).
- .4 CSA W47.1, Certification of Companies for Fusion Welding of Steel Structures.
- .5 CGSB 31-GP-105Ma Zinc Phosphate Conversion Coating for Paint Base
- .6 CAN/CSA-G40.21-M92 Structural Quality Steels
- .7 CSA W59-M89 Welded Steel Construction (Metal Arc Welding)

1.3 DESIGN REQUIREMENTS

- .1 Design exterior frame assemblies to accommodate expansion and contraction when subjected to minimum and maximum surface temperature of -35°C to 35°C.

1.4 SUBMITTALS

- .1 Product data: Submit manufacturer's Product data in accordance with Section 01 10 10 indicating frame construction.
- .2 Shop drawings:
 - .1 Submit shop drawings in accordance with Section 01 10 10 for each type of frame indicating:
 - .1 Thickness and type of steel.
 - .2 Thickness and type of core.
 - .3 Thickness and type of steel stiffeners and location of them within the door.
 - .4 Thickness and type of metal facing on edges of door and method of fastening.
 - .5 Location of mortises, reinforcement, anchorages, joining, welding, sleeving, exposed fasteners, openings and arrangement for hardware.
 - .2 Include schedule identifying each unit with door marks and numbers relating to numbering on Contract Drawings and in door schedule

- .3 Mill Certification: Submit mill certification on all materials used to fabricate items specified.

1.5 **QUALITY ASSURANCE**

- .1 Perform work in accordance with requirements by a member of the Canadian Steel Door and Frame Manufacturers Association.

2 Products

2.1 **ACCEPTABLE MANUFACTURERS**

- .1 Apex Industries
- .2 Daybar Industries Limited
- .3 Fleming Doors Products.
- .4 Steel-Craft Door Products Ltd

2.2 **MATERIALS**

- .1 General:
 - .1 All materials under work of this Section, including but not limited to, primers are to have low VOC content limits.
 - .2 Materials used for the frame construction in this section to conform to: CAN/CSA-G40.21, Type 44W coating designation to ASTM A653.
 - .3 Galvanized Steel Sheets: (G90) Mill phosphatize in addition to coating specified at referenced HM standard. Provide frames where indicated on drawings.
 - .4 Supports and Anchors: Same material as frame including gage and galvanizing where indicated.
 - .5 Inserts, Bolts, and Fasteners: Manufacturer's standard units. Hot-dip galvanize in compliance with ASTM A 153, Class C or D as applicable at exterior walls and where opening is indicated to be galvanized.
 - .6 Provide shop primers for security hollow metal frames were welded.
- .2 Minimum base steel thickness:
 - .1 Frames 1.6 mm
 - .2 Hinge reinforcements 2.7 mm
 - .3 All other reinforcement 1.6 mm
 - .4 Top and bottom channels 1.2 mm
 - .5 Glazing stops 0.9 mm
 - .6 Guard boxes 0.9 mm
 - .7 Jamb spreaders 0.9 mm

- .3 Top caps and thermal breaks: CGSB 41-GP-19Ma; Rigid PVC extrusions.
- .4 Primer: CAN/CGSB 1.198.
- .5 Screws: Stainless steel screws with countersunk flat head.
- .6 Door silencers: Type 6-180, black neoprene.
- .7 Frame anchors:
 - .1 Frames in steel stud partitions: 0.9 mm minimum steel anchors of suitable design securely welded inside each jamb.
 - .2 Floor anchors: 1.6 mm minimum adjustable floor clip angles with 2 holes for anchorage to floor.
 - .3 Frames in existing walls: 0.9 mm minimum frame anchors to suit design.
 - .4 Labeled frames: In accordance with ULC requirements.
- .8 Floor anchors: 1.6 mm minimum adjustable floor clip angles with 2 holes for anchorage to floor.
- .9 Labels for fire doors and door frame: Brass plate, riveted to door and door frame.
- 2.3 Grilles: Corrosion resistant steel with baked enamel finish. Model 61DG Series by Nailor Industries Inc or approved alternative by Hart and Cooley.
- 2.4 **FABRICATION**
 - .1 General
 - .1 Fabricate frames in accordance with reviewed shop drawings.
 - .2 Welding: CSA W59-M to produce a finished unit with no visible seams or joints, square, true and free of distortion.
 - .3 Welding: Continuous unless specified otherwise. Execute welding by a firm fully acceptable to the Canadian Welding Bureau to requirements of CSA W47.1.
 - .4 Form profiles accurately to details shown on Contract Drawings.
 - .5 Ream and remove burrs from drilled and punched holes.
 - .6 Grind welded corners and joints to a flat plane and fill with metallic filler and sand to a uniform smooth finish. Apply one coat of primer.
 - .2 Frames and screens:
 - .1 Fabricate frames of welded construction. Cut mitres and joints accurately and weld continuously on inside of frame profile. Exterior frames to be thermally broken.
 - .2 Construct large frame sections with provision for on Site assembly to suit Site conditions.

- .3 Blank, reinforce, drill and tap frames for mortised, templated hardware. Protect mortised cut-outs with guard boxes.
- .4 Reinforce frames where required for surface mounted hardware.
- .5 Reinforce frames over 1200 mm wide with roll formed steel channels or hollow structural sections specified in Section 05 50 00 and as indicated on drawings.
- .6 Prepare each door opening for single stud rubber door silencers, 3 for single door openings located in strike jamb, and 2 for double door openings located in head.
- .7 Install 2 channel or angle spreaders per frame, to ensure correct frame alignment. Install stiffener plates or spreaders between frame trim where required, to prevent bending of trim and to maintain alignment when setting in place.
- .8 Frame Fill: Prepare heads, jambs, and sills abutting structure, walls, or floors for solid anchorage with full grout fill. Exclude grout from mullions except where otherwise indicated.
 - .1 Grout Guards: At frames to be grouted, tightly weld 0.45 mm(0.018") minimum steel grout guards at screw holes, cut outs, and hardware preparations including those for removable glazing stops, locksets, pushbuttons, strike plates, hinges, etc. Additionally at hinge preparations Contractor to provide polyurethane or polystyrene foam fill or otherwise tightly seal grout guards to keep screw holes grout free.
- .3 Anchorage:
 - .1 Anchor units to floor and wall construction. Locate each wall anchor immediately above or below each hinge reinforcement on hinge jamb and directly opposite on strike jamb, minimum number of anchors for each jamb:
 - .1 Frames up to 2285 mm 3 anchors.
 - .2 Frames from 2285 mm to 2440 mm 4 anchors.
 - .2 Where frames are to be set in masonry or concrete, supply adjustable anchors to trade installing frame.
 - .3 Fabricate frames for installation in steel stud partitions with steel anchors of suitable design, minimum number of anchors for each jamb:
 - .1 Frames up to 2285 mm height 4 anchors.
 - .2 Frames 2285 mm to 2440 mm 5 anchors.
 - .4 Frames in previously placed concrete, masonry, precast or structural steel:

- .1 Anchors located at 150 mm maximum from top and bottom of each jamb, and intermediate anchors at maximum 660 mm o.c.

3 Execution

3.1 EXAMINATION

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

3.2 HOLLOW METAL FRAME INSTALLATION

- .1 Install hollow metal frames plumb, square, level, secure, and at correct elevation.
- .2 Install doors clear of floor finishes, and with the correct rebate opening for the door installation. Install door silencers.
- .3 Secure anchorages and connections to adjacent construction. Brace frames rigidly in position while building-in. Remove temporary steel shipping jamb spreaders. Install wood spreaders at third points of frame rebate height to maintain frame width. Supply and install vertical supports as indicated on drawings for openings over 1200 mm in width. Remove wood spreaders after frames have been built-in.
- .4 Allow for structural deflection and prevent structural loads from being transmitted to hollow metal frames.
- .5 Touch-up areas where galvanized coating has been removed or damaged with primer.

3.3 ADJUSTING AND CLEANING

- .1 Adjust doors for smooth and balanced door movement.
- .2 Clean doors and frames.

END OF SECTION

- 1 General**
- 1.1 SECTION INCLUDES**
 - .1 Labour, Products, equipment and services necessary for the wood doors work in accordance with the Contract Documents.
- 1.2 REFERENCES**
 - .1 ANSI A208.1, Particleboard.
 - .2 AWMAC, Architectural Woodwork Manufacturers' Association of Canada. Quality Standards for Architectural Woodwork.
 - .3 Architectural Woodwork Standards (AWS) - Quality Standards for Architectural Woodwork.
 - .4 CAN/CSA O132.2 Series, Wood Flush Doors.
 - .5 CSA O112 Series, Wood Adhesives.
- 1.3 SUBMITTALS**
 - .1 Product data: Submit manufacturer's Product data in accordance with Section 01 10 10 indicating door and frame construction.
 - .2 Shop drawings:
 - .1 Submit shop drawings in accordance with Section 01 10 10 for wood doors and metal frames indicating:
 - .1 Thickness and type of steel and steel stiffeners and location of them within the door.
 - .2 Detail thicknesses, core construction and door sizes,
 - .3 Quantities, fastenings and finishes.
 - .4 Location of mortises, reinforcement, anchorages, joining, welding, sleeving, exposed fasteners, openings and arrangement for hardware.
- 1.4 QUALITY ASSURANCE**
 - .1 Perform work in accordance with requirements by a member of the Canadian Steel Door and Frame Manufacturers Association.
 - .2 Perform work in accordance with requirements of AWMAC, Quality Standards for Architectural Woodwork, Premium Grade and CSA O132.2-M, except as indicated otherwise. The AWMAC standard governs over the CSA standard.
- 1.5 DELIVERY, STORAGE, AND HANDLING**
 - .1 Deliver, store, and handle wood doors in accordance with the AWMAC Quality Standards amended as follows: .1 Wrap wood doors individually in protective wrapping for shipment and Site storage.
 - .2 Handle wood doors carefully to prevent damage; replace damaged doors.
 - .3 Store doors flat on a dry, level surface. Ventilate and maintain recommended relative humidity before, during and after installation.

2 Products

2.1 MANUFACTURER

.1 Manufacturer for Work of this Section is limited to one of the following:

- .1 Baillargeon Door
- .2 Or Lambton Doors.

2.2 WOOD DOORS - GENERAL

- .1 Wood Doors: Height, width, configuration and location as scheduled on Drawings.
- .2 Vision Panel: Height, width, configuration and location as scheduled on Drawings.

2.3 MATERIALS

.1 General:

.1 Materials used for work of this Section are to include, but not be limited to the following criteria:

- .1 Regionally sourced materials.
- .2 Certified wood.
- .3 Low VOC content limits.

.2 Adhesives - Urea-formaldehyde-free glues.

.2 Ultra-Heavy Duty Wood Interior Door (solid core):

.1 Product: 8520-ME (5-ply - Particle Core) as manufactured by Baillargeon Wood Door Manufacturer. Lifetime Warranty.

- .1 Core: Particleboard. Solid particleboard. Density of 28-32 lb per cubic foot. Complies with ANSI A208-1 standards (LD-1/LD-2).
- .2 Fire Rating: 20-minutes, in compliance with NFPA 80.
- .3 Stiles: 1/8 inch (3 mm) thick veneer, longitudinally laminated by hot pressing with type 1 structural glue, as per ASTM-D5456-93 (LVL), including a 7/8 inch (22 mm) piece of hardwood, matched with faces, for a total width of 4-3/16 inches (107 mm).
- .4 Top and bottom rails: 1/8 inch (3 mm) thick veneer, longitudinally laminated by hot pressing with type 1 structural glue, as per ASTM-D5456-93 (LVL), for a total width of 3-5/16 inches (85 mm).
- .5 Stiles and Rails: Bonded to core.
- .6 Lock Block: Integrated.
- .7 Glue: Type1 PVA Cross-link.
- .8 Faces: Refer to Door Characteristics.

.3 Wood doors (solid core):

- .1 5 ply wood door: As manufactured by Baillargeon Doors Inc. or Lambton Doors.
- .2 Core: To ANSI A208.1, minimum density 513 kg/m³ minimum, sanded faces, of thickness to fill void. Extruded particle board cores with voids are not permitted.
- .3 Rails:
 - .1 Top: 35 mm structural composite lumber.
 - .2 Bottom: 35 mm structural composite lumber.
- .4 Stiles
 - .1 16 mm hardwood laminated to 19 mm structural composite lumber.
 - .2 Edge detail: AWMAC No.2.
- .5 Crossbanding: Minimum 2.2 mm thick minimum wood based composite.
- .6 Door facing: Minimum 0.8 mm paint / stain grade (to suit finish) maple Veneer finished in accordance with Section 09 91 00.
- .7 Sidelite and Borrowed Lites:
 - .1 Frames Material: Match adjacent door frame material.
 - .2 Glass: Nominal 1/4 inch (6 mm) rated glass complying with Section 08 80 00.
 - .3 Glazing Clips: Frame manufacturer's proprietary 0.0179 inch (0.045 mm) galvanized steel.
 - .4 Sealants: Comply with section 07 91 00.
 - .5 Jamb Thickness: Nominal 3/4 inch (19 mm), plus/minus 1/16 inch (mm)
 - .6 Opening Size: Maximum opening of 48 inches (mm) wide by 96 inches high(mm). Please consult manufacturer specifications grid for maximum approved dimensions.

2.4 **FABRICATION**

- .1 General
 - .1 Factory-machine frames for hardware that is not surface applied. Locate hardware to comply with DHI-WDHS-3. Comply with final hardware schedules, door frame Shop Drawings, DHI A115-W series standards, and hardware templates as furnished by door hardware supplier.
 - .1 Comply with requirements in NFPA 80 for fire-rated doors.
 - .2 Manufacturer's Label: Do not remove, cover, or paint over label. After completion of machining frame, apply Warnock Hersey (WH) certification label to finished frame with screw-type nails a minimum length of 5/8 inch (16 mm) or with minimum 18 gage staples with 1/4 inch (6 mm) crown and 5/8 inch (16 mm) leg length. If staples are used, Use 2 staples, 1 at each end of label.

- .3 Gasket Type: Machine frames for smoke gaskets by company registered with Warnock Hersey (Intertek Testing).
- .4 Gasket Type: Machine frames for draft gaskets by company registered with Warnock Hersey (Intertek Testing). 5. Gasket Attachment: Pressure-sensitive.
- .5 Gasket Attachment: Kerf type (Category H) attached to machined frame per manufacturer's requirements in order to give frame an "S" label rating.
- .6 Positive Pressure Certification: Apply edge sealing gasket (Category G) to achieve certification.
- .7 Fabricate doors and frames in accordance with reviewed shop drawings.
- .8 Form profiles accurately to details shown on Contract Drawings.
- .9 Fabricate doors square, true, and free from distortion waves, ridges or core ghost lines. Factory machine doors for finish hardware and flooring.
- .10 Fabricate doors using hot press construction technology. Bond stiles and rails to core using adhesive. Sand for uniform thickness. Laminate door facing and trim, to assembled core in hot press.
- .11 Cut and bevel stile edges as follows:
 - .1 Lock side: 3 mm in 50 mm.
 - .2 Hinge side: 1.5 mm in 50 mm.
- .12 Coordinate with Section 08 70 00 as required for sizing and installation of door gaskets and automatic door bottoms as required for acoustic doors. Accurately size frame and door to accept the required gasketing and door bottoms and to maintain the required clear width/height.
- .13 Fabricate doors to achieve STC rating as indicated on drawings and in accordance with ASTM E90.
- .14 Unless otherwise indicated, finish wood doors as indicated in factory and deliver to site ready for hanging.

3 Execution

3.1 EXAMINATION

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

3.2 WOOD DOOR INSTALLATION

- .1 Install doors plumb, rigid, square, clear of floor finishes, and with correct rebate opening for door installation.
- .2 Conform to requirements of AWMAC Quality Standard, for wood door installation.
- .3 Install door grilles plumb and level, where indicated.

3.3 ADJUSTING AND CLEANING

- .1 Replace the following wood doors:

- .1 Warped more than 3 mm, measured at any point on door, relative to perfectly flat surface.
- .2 Core telegraphing visible at 1500 mm distance, under final Site lighting conditions.
- .2 Adjust doors for smooth and balanced door movement.
- .3 Clean doors, frames and screens.

END OF SECTION

- 1 General**
- 1.1 SECTION INCLUDES**
 - .1 Labour, Products, equipment and services necessary for finish hardware work in accordance with the Contract Documents.
- 1.2 REFERENCES**
 - .1 BHMA, Builders Hardware Manufacturing Association.
 - .2 NFPA 80, Standard for Fire Doors and Other Opening Protectives.
- 1.3 SUBMITTALS**
 - .1 Product data: Submit manufacturer's Product data in accordance with Section 01 10 10 indicating compliance with reference standards, transportation, storage, handling and installation requirements.
 - .2 Shop Drawings:
 - .1 Submit Shop Drawings and 3 complete hardware lists in accordance with Section 01 10 10 indicating:
 - .1 Door locations, sizes, hardware manufacturer's catalogue numbers, finish symbols and quantities required.
 - .2 Locations and mounting heights of each type of hardware.
 - .2 Supply templates and required information to door and frame manufacturer to enable accurate sizes, locations of cut-outs and reinforcement for hardware.
 - .3 Submit templates to required trade to arrange for provisions for accurate setting and fitting of hardware.
 - .3 Samples:
 - .1 Submit 2 samples in accordance with Section 01 10 10 of each item that is different from hardware specified and include manufacturer's parts lists and installation instructions.
 - .2 Submit hardware component samples illustrating style, colour and finish. Tag samples identifying applicable Specification article number, brand name and number, finish, building location, date and catalogue number.
 - .3 Do not order hardware until samples have been accepted. Submit new samples to replace rejected samples. Supply hardware and finishes identical to each accepted sample.
 - .4 Closeout submittals:
 - .1 Submit the following in accordance with Section 01 10 10 for each Product for incorporation into Operation and Maintenance Manual:
 - .1 Maintenance data.
 - .2 Operating instructions and safety precautions.
 - .3 Parts list with name and address of supplier.
 - .4 Lubrication schedule and type of lubricant recommended.

- .5 Keys, tools and special devices.
- .6 Inspection procedures related to preventive maintenance

1.4 QUALITY ASSURANCE

- .1 General:
 - .1 Manufacturers: Companies specializing in manufacturing door hardware.
 - .2 Hardware supplier: Company specializing in supplying commercial door hardware and acceptable to manufacturer.
- .2 Certifications:
 - .1 Employ an Architectural Hardware Consultant to inspect completed installation and certify that hardware has been installed in accordance with manufacturer's printed instructions, Authorities having Jurisdiction and as specified.
 - .2 Submit manufacturer's certificate that finish hardware and fire rated hardware meets specified requirements.

1.5 DELIVERY, STORAGE, AND HANDLING

- .1 Be responsible for packaging of hardware, on a set by set basis. As material is received from various manufacturers identify it to correspond to Hardware List symbols.
- .2 Label packages legibly, indicating manufacturer's number, types, sizes, opening number and Hardware List reference number. Wrap hardware and include in package, screws, bolts and fastening necessary for correct installation. If hardware package is not complete, pay additional charges incurred by installer.
- .3 Deliver hardware to Site packaged, labelled and cross-referenced to hardware list for each item and its scheduled installation location.
- .4 Accept Products of this Section on Site and ensure that each item is undamaged.
- .5 Catalogue and store hardware in secure area.

2 Products

2.1 GENERAL

- .1 Provide hardware schedule to Consultant for approval indicating products, materials and finishes. Do not order products until schedule has been approved by Consultant.
- .2 Carefully check and verify Hardware List against Contract Drawings to ensure that hardware listed can be used as specified. Inform Consultant of concerns regarding quality, quantity, operation or function of hardware selected:
 - .1 Verify hand of doors, examine details on Contract Drawings and at Site to ensure hardware supplied can be correctly installed and is correct for work as constructed.
 - .2 Select hardware in accordance with applicable codes and regulations and to approval of local Fire Marshal.

- .3 Replace and pay for defective hardware including hardware which was incorrectly selected, and remedial and installation costs.
 - .3 Ensure that hardware selected will function correctly, meets Contract requirements and Ontario Building Code and authorities having jurisdiction.
 - .4 Ensure that each hardware item is of same type, design and by same manufacturer.
 - .5 Manufacturer's names or trade marks are not permitted on exposed surfaces of hardware.
 - .6 Include in packing slip a list of parts, name of supplier and door number in which lock is to be installed.
 - .7 Hardware for fire rated and labelled door and frame assemblies: ULC listed or as accepted by authorities having jurisdiction.
 - .8 Fire rated assemblies:
 - .1 Hardware: Selected and installed in accordance with applicable codes and regulations, NFPA-80 and to approval of Ontario Fire Marshal.
 - .2 Fire rated doors: ULC labelled hardware. Submit written certification of conformance to ULC requirements for each type of hardware prior to delivery.
 - .3 Locksets and latchsets on fire rated doors: 19 mm throw minimum.
- 2.2 **ACCESSORIES**
- .1 Items to be attached to masonry or concrete with expandable shields, lag screws, bolts or other fastening devices as required. Exposed screws: Stainless steel, Phillips or Robertson heads.
- 2.3 **FINISHES**
- .1 Metal finishes: Free from defects, clean, unstained and of a uniform colour for each type of finish required. Exposed surfaces and anchors: Specified finish symbol of item.
- 3 Execution**
- 3.1 **EXAMINATION**
- .1 Verify condition and dimensions of previously installed Work upon which this Section depends. Report defects to Consultant. Commencement of work of this Section means acceptance of existing conditions.
- 3.2 **INSTALLATION**
- .1 Install hardware in accordance with reviewed Shop Drawings, manufacturer's installation instructions, and applicable Codes and regulations.
 - .2 Install hardware in accordance with hardware templates.
 - .3 Adjust fixed and operable hardware for correct clearances and function.
 - .4 Mount hardware measured from finished floor to centre of hardware, unless indicated otherwise or required by Code:
 - .1 Top hinge: 250 mm from head of door to top.
 - .2 Bottom hinge: 265 mm from finished floor to bottom of hinge.

- .3 Intermediate hinge: Equal distance between top and bottom hinge.
- .4 Locksets, latchsets: 1000 mm.
- .5 Panic device crossbar: 1000 mm.
- .6 Push plates: 1100 mm to bottom of plates.
- .7 Guard bars: 1100 mm.
- .8 Door pulls: 1100 mm to bottom of pulls.
- .9 Blank strike: 1450 mm.
- .10 Blank fronts: 1450 mm.
- .5 Include for supply and installation of wiring for electric strikes from electrical junction box to electric strike hardware.
- .6 Locate door stops to contact doors 75 mm from latch edge.
- .7 Install hardware and trim square and plumb to doors.
- .8 Replace wrappings for hardware provided by manufacturer after installation.
- .9 Safeguard keys to keep them out of unauthorized hands, tag them with door number, and deliver them to person designated by Consultant at building completion.

3.3 FIELD QUALITY CONTROL

- .1 Have hardware inspected after installation by hardware supplier's representative, obtain certification in writing that hardware has been supplied and installed in accordance with Specifications and hardware manufacturer's instructions and is functioning correctly.
- .2 Inspect fire rated openings to ensure they are installed in compliance with NFPA 80 requirements and Authorities having Jurisdiction.
- .3 Test access control system and electrified hardware devices for proper operation. Verify electric door release hardware operates properly upon activation of fire alarm system.

3.4 ADJUSTING

- .1 Verify under work of this Section, that installed hardware functions properly.
- .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 manufacturer's instructions.
- .3 Adjust doors with self closing devices or automatic closing devices for proper operation after the HVAC system is balanced and adjusted. Verify spring power of non sized door closers is properly adjusted.

3.5 CLEANING

- .1 Remove wrappings at completion of the Project and clean hardware in accordance with manufacturer's instructions

END OF SECTION






Sheridan College Davis Campus Renovation

HwSet 1

1 SGL Door DB111A

965.000 X 2133.000 X 45.000 X WD X HMF X --

Each Assembly to have:






Qty		Description	Catalog Number		Finish	Mfr
3	EA	HINGE	5BB1HW 5 X 4.5		652	IVE
1	EA	ELECTRIC STRIKE	1006CS		630	HES
1	EA	STOREROOM LOCK	MARK 195 GB		626	MAR
1	EA	PERMANENT CYLINDER	BY OWNER		626	UNK
1	EA	OH STOP	100S ADJ		630	GLY
1	EA	AUTO OPERATOR AND ACCESSORIES	SUPPLIED BY 08 71 13		689	UNK
1	EA	KICK PLATE	8400 8" X LDW		630	IVE
1	EA	DOOR SWEEP	8192AA		AA	ZER
1	EA	REQUEST TO EXIT	BY DIV 28			UNK
1	EA	CARD READER	BY DIV 28			UNK
1	EA	RELAY	CX-12			CAM
1	EA	DOOR CONTACT	BY DIV 28			UNK

HwSet 2

1 SGL Door DB111B

965.000 X 2133.000 X 45.000 X WD X HMF X --

Each Assembly to have:

Qty		Description	Catalog Number		Finish	Mfr
3	EA	HINGE	5BB1HW 5 X 4.5		652	IVE
1	EA	ELECTRIC STRIKE	1006CS		630	HES
1	EA	STOREROOM LOCK	MARK 195 GB		626	MAR
1	EA	PERMANENT CYLINDER	BY OWNER		626	UNK
1	EA	AUTO OPERATOR AND ACCESSORIES	SUPPLIED BY 08 71 13		689	UNK
1	EA	KICK PLATE	8400 8" X LDW		630	IVE
1	EA	WALL STOP	WS406/407CVX		626	IVE
1	EA	DOOR SWEEP	8192AA		AA	ZER
1	EA	WIRE HARNESS	CON-6W			SCH
1	EA	REQUEST TO EXIT	BY DIV 28			UNK
1	EA	CARD READER	BY DIV 28			UNK
1	EA	RELAY	CX-12			CAM
1	EA	DOOR CONTACT	BY DIV 28			UNK

Sheridan College Davis Campus Renovation

HwSet 3

1 PR Door DB111E

2000.000 X 2000.000 X 45.000 X HMD X HMF X 45MIN

Each Assembly to have:



Qty		Description	Catalog Number		Finish	Mfr
5	EA	HINGE	5BB1 5 X 4.5 NRP		652	IVE
1	EA	ELECTRIC HINGE	5BB1 5 X 4.5 CON TW8		652	IVE
1	EA	ELECTRIC STRIKE	1006CS		630	HES
1	EA	CONST LATCHING BOLT	FB52		630	IVE
1	EA	STOREROOM LOCK	MARK 195 GB (FIRE LATCH)		626	MAR
1	EA	PERMANENT CYLINDER	BY OWNER		626	UNK
1	EA	COORDINATOR	COR X FL		628	IVE
2	EA	MOUNTING BRACKET	MB1F/MB2F TO SUIT		689	IVE
2	EA	SURFACE CLOSER	4040XP SCUSH WMS		689	LCN
2	EA	KICK PLATE	8400 8" X LDW		630	IVE
1	EA	GASKETING	188SBK PSA (1 X W, 2 X H)		BK	ZER
2	EA	MEETING STILE	8192BK (1 X H)		BK	ZER
1	EA	REQUEST TO EXIT	BY DIV 28			UNK
1	EA	CARD READER	BY DIV 28			UNK
2	EA	DOOR CONTACT	BY DIV 28			UNK
1	EA	POWER SUPPLY	PS902 120/240 VAC		LGR	SCE

HwSet 4

1 SGL Door DB111F

965.000 X 2120.000 X 45.000 X EXST X EXST X --

Each Assembly to have:

Qty		Description	Catalog Number		Finish	Mfr
1	EA	STOREROOM LOCK	MARK 195 GB		626	MAR
1	EA	PERMANENT CYLINDER	BY OWNER		626	UNK
1	EA	ELECTRIC STRIKE	HES 4500C		630	HES
1	EA	HARDWARE	BALANCE OF EXISTING HARDWARE TO REMAIN			UNK
1	EA	REQUEST TO EXIT	BY DIV 28			UNK
1	EA	CARD READER	BY DIV 28			UNK
1	EA	DOOR CONTACT	BY DIV 28			UNK
1	EA	POWER SUPPLY	PS902 120/240 VAC		LGR	SCE





Sheridan College Davis Campus Renovation

HwSet 5

1 SGL Door DB110

920.000 X 2133.000 X 45.000 X WD X HMF X 45MIN

Each Assembly to have:

Qty		Description	Catalog Number		Finish	Mfr
3	EA	HINGE	5BB1 5 X 4.5 NRP		652	IVE
1	EA	CLASSROOM LOCK	MARK 195 J		626	MAR
1	EA	PERMANENT CYLINDER	BY OWNER		626	UNK
1	EA	OH STOP	100S		630	GLY
1	EA	CONTRÔLE DE PORTES	4040XP EDA		689	LCN
1	EA	KICK PLATE	8400 8" X LDW		630	IVE

Major door hardware approved for use at Sheridan College

Exit Devices: Sargent 80 series exit devices with ETJ trim if applicable. The specific series within the line will be determined by the door configuration and application however typically rim devices are 8888 series and vertical rod are NB8700 series

Mortice locks: Schlage L9000 series with 03B 630/626 trim are used in new building Construction as well as renovations within buildings where they are predominant. (XL11-422 option when used with an electric strike)

Cylindrical locks: Marks cylindrical leversets, Survivor series with American style lever Typically Grade one, 626 finish. These are used in retrofits and renovations within Buildings where cylindrical locks are predominant.

Key Cylinders: Sheridan has two key systems; new buildings have Medeco restricted Bi-axial keys and cylinders (H3 end user Keyway) and older ones have Schlage restricted paracentric systems. Some global door groups have Medeco cylinders within Schlage buildings as well. Confirm the requirements with the project coordinator if you plan to be providing key cylinders.

Cylinder guard CGC security collar C26d

Door closers: LCN 4040xp series closer are used in all applications unless there is an issue where the door swing requires a greater range of motion that the closer can provide, the particular door design does not have sufficient area to apply the closer or the closer will interfere with other hardware. The substitute is the LCN 1460 is to be used if one of the above issues exist.

Door Stays Glynn Johnson sized to suit application

Electric door closer/holders: the LCN Sentronic product line. Govern your choice by the door and frame conditions

Electric strikes folger adam 700 series or 300 series LBM option, 24 VDC 32d finish

Barrier Free door operators: The Micom Smart Swing SW800. This is to be used on exterior doors and interior doors. Although they are classed as low energy, additional safety sensors must be used if a safety issue is perceived with any installation. Sliding doors always require safety sensors. All applications require qualified personnel to determine the exact requirements. Activation switches: Camden CM60/4 which is a 6" round fully active switch with logo/text. Barrier free washrooms incorporate the 4" square switches with "AURA" illuminated enclosures for occupancy indication

Weatherstrip Crowder (KNC)

Thresholds Crowder (KNC)

Card Access: the system components are to be supplied and installed by the security system integrator who must be a Softwarehouse Dealer and be certified to supply, install and maintain the systems. Components: iClass card readers, Folger Adam strikes, Sentrol door contacts and T-rex exit sensors

1 General

1.1 **SECTION INCLUDES**

- .1 Labour, Products, equipment and services necessary for masonry Work in accordance with the Contract Documents.

1.2 **REFERENCES**

- .1 ASTM D2240, Test Method for Rubber Property - Durometer Hardness.
- .2 CAN/CGSB-12.1-M, Tempered or Laminated Safety Glass.
- .3 CAN/CGSB-12.3-M, Flat, Clear Float Glass.
- .4 CAN/CGSB-12.8, Insulating Glass Units.
- .5 CAN/CGSB-12.20-M, Structural Design of Glass for Buildings.
- .6 Glass Association of North America (GANA) Glazing Manual.

1.3 **DESIGN REQUIREMENTS**

- .1 Glass Design:
 - .1 Design glass using a probability of breakage of 8 lites per 1000 at the first application of design load.
 - .2 Design glass to CAN/CGSB-12.20-M. Perform stress analysis. Design units to accommodate live, dead, lateral, wind, seismic, handling, transportation, and erection loads.
 - .3 Perform a thermal stress analysis on each glass unit with Low-E coating and provide heat strengthening and/or tempered units as necessary to prevent thermal breakage.
 - .4 Perform a thermal stress analysis on each insulating thermal unit and provide heat strengthening and/or tempered units as necessary to prevent thermal breakage.
 - .5 Where required, design glazing units so as not to allow thermal stress fracture due to heat build-up behind insulating units.
- .2 Limit glass deflection to flexural limit of glass with full recovery of glazing materials.
- .3 Utilize inner light of multiple light sealed units for continuity of air and vapour seal.

1.4 **SUBMITTALS**

- .1 Shop drawings:
 - .1 Shop drawings: Submit shop drawings in accordance with Section 01 10 10 for fabrication and erection of glazing elements indicating materials, thicknesses, finishes, connections, joints, method of anchorage, number of anchors, supports, reinforcement, details, and accessories.
- .2 Samples:

- .1 Submit following samples in accordance with Section 01 10 10.
- .2 Submit one sample of each type of glass.
 - 1. 300 x 300 mm of each type of glass unit
- .3 Certificates: Submit manufacturer's certification that glass and glazing materials are compatible Submit following samples in accordance with Section 01 10 10.

1.5 **QUALITY ASSURANCE**

- .1 Installers qualifications: Perform Work of this Section by a company that has a minimum of five years proven experience in the installation of glazing units of a similar size and nature.

1.6 **SITE CONDITIONS**

- .1 Glaze with compounds, sealants, or tapes only when glazing surfaces are at temperatures over 4 degree C, and when positive that no moisture is accumulating on them from rain, mist, or condensation.
- .2 When temperature of glazing surfaces is below 4 degree Celsius, obtain from Consultant approval of glazing methods and protective measures which will be used during glazing operations.

1.7 **EXTENDED WARRANTY**

- .1 Interior glazing work: Provide a 5 year warranty, commencing from date of Substantial Performance, against defects in interior glazing work and warrant them to be free from:
 - .1 The glass units shall be free from condensation, fogging material obstruction of vision as a result of dust or film formation on the internal glass surfaces by any cause under design conditions.
 - .2 The glass units shall not change their mechanical design properties and shall not in any way deteriorate, degrade, delaminate or change their visual appearance.
 - .3 The glass units will not break due to thermal shock and temperature differential due to inherent glass faults, other than extrinsic glass breakage. Cracked or scratched glass, shrinking, cracking, staining, hardening, sagging of glazing materials; loosening or rattling of glass; All will be considered defective work.
 - .4 Warranty to include the removal of defective Products, replacement with new Products conforming to the specifications, and restoration of work damaged by removal and replacement including labour and installation costs.

2 Products

2.1 **ACCEPTABLE MANUFACTURERS**

- .1 Glass manufacturers:
 - .1 AGC Flat Glass.
 - .2 Cardinal Glass Industries.
 - .3 Guardian Industries.
 - .4 PPG Industries Ltd.
 - .5 Viracon Inc.
 - .6 Oldcastle Building Envelope.
 - .7 Other approved manufacturer.
- 2.2 **MATERIALS**
 - .1 All materials under Work of this Section, including but not limited to, primers, coatings, sealers, sealants, adhesives and cleaners are to have low VOC content limits
 - .2 Glazing types:
 - .1 **GL-1:**
 - .1 6mm thickness, as determined by glazing engineer employed by this Section 08 80 00.
 - .2 Tempered safety glass to CAN/CGSB-12.1-M90, Type 2, Class B,
 - .3 Tempering shall be obtained using horizontal, tong-free method.
 - .4 Glazing and rebate primers, sealants, sealers, and cleaners: Compatible with each other.
 - .5 Type as recommended by glass manufacturer.
 - .3 Glazing sealant: Silicone sealant as recommended by glazing manufacturer. Verify compatibility with insulating glass unit secondary sealant.
 - .4 Glazing and rebate primers, sealants, sealers, and cleaners: Compatible with each other. Type as recommended by glass manufacturer.
 - .5 Heel & toe bead: Silicone sealant as recommended by glazing manufacturer.
 - .6 Glazing gasket: 'Visionstrip' by Tremco Ltd., extruded composite glazing seal, size as recommended by manufacturer.
 - .7 Glazing tape: 'Polyshim II' glazing tape EPDM shim.
 - .8 Glazing splines: EPDM or neoprene, extruded shape to suit glazing channel retaining slot, colour as selected.
 - .9 Setting blocks (regular): EPDM, 80 - 90 Shore A durometer hardness to ASTM D2240, sized to suit glazing method, glass unit weight and area.
 - .10 Edge blocks: EPDM, 60-70 Shore A Durometer hardness, sized with 3 mm clearance from glass edge and spanning glass thickness(es). Capable of withstanding weight of glass unit, self adhesive on face.

- .11 Glass presence markers: Easily removable, non-residue depositing.
- .12 Screws, bolts and fasteners: Type 304 stainless steel.

2.3 FABRICATION

- .1 Verify glazing dimensions on Site.
- .2 Clearly label each glass lite with maker's name and glass type. Ensure labels are easily removable, non-residue depositing type. Do not remove labels until after Work is accepted by Consultant.
- .3 Fabricate glazing not less than 3 mm smaller than rebate size in either dimension; allow for edge spacers, shims, and setting blocks as necessary.
- .4 Work shall have smooth finished surfaces free from distortion and defects detrimental to appearance and performance.
- .5 Carefully make and fit details. Take special care with exposed finished Work to produce a neat and correct appearance to the Consultant's acceptance.
- .6 Grind and polish a 1.5 mm arise to both edges of exposed glazing at locations where glazing is not encapsulated in framing and where edges are exposed to occupants.
- .7 Fabricate argon filled thermal units with air space filled minimum 90% with argon gas.
- .8 Provide bird warning glass in accordance with City of Toronto Green Development Standard - Bird Friendly Development Guidelines. Style as selected by Consultant.

3 Execution

3.1 EXAMINATION

- .1 Verify condition and dimensions of previously installed Work upon which this Section depends. Report defects to Consultant. Commencement of Work means acceptance of existing conditions.
- .2 Verify that openings for glazing are correctly sized and within tolerance.
- .3 Verify that surfaces of glazing channels or recesses are clean, free of obstructions, and ready to receive glazing.
- .4 Laminated glass edges shall be completely covered by tape to protect against sealants and water if required by Manufacturer.

3.2 PREPARATION

- .1 Clean contact surfaces with solvent and wipe dry.
- .2 Seal porous glazing channels or recesses with substrate compatible primer or sealer.
- .3 Prime surfaces scheduled to receive sealant.

3.3 INSTALLATION

- .1 Provide glazing in accordance with IGMA recommendations. Provide continuous contact between glazing tapes and gasket to the glazing.
- .2 Install glazing to the Work of Sections 08 14 00 Wood Doors.
- .3 Provide neat, straight sight lines. Trim excess glazing material flush with top of stops and fixed leg of frames.
- .4 Remove protective coatings, glazing stops, clean rebate and glass contact surfaces with solvent, wipe dry.
- .5 Apply primer/sealer to contract surfaces, prior to glazing
- .6 Apply glazing tape as per manufacturer's instructions including recommended corner sealant.
- .7 Use setting blocks at 1/4 points and spacers to centre glass unit in frame.
- .8 Install glazing in accordance with reviewed shop drawings and manufacturer's written instructions. Install glazing with full contact and adhesion at perimeter. Maintain edge clearance recommended by glass manufacturer.
- .9 Re-install glazing stops ensuring continuous contact and rattle-free installation. Do not distort glass. Trim tape protruding more than 2 mm above stop.
- .10 Install glazing gasket in accordance with manufacturer's recommendations.
- .11 Do not cut or abrade tempered, heat treated, or coated glass.
- .12 Install glass presence markers in two cross stripes extending from diagonal corners. Maintain markers until final clean-up.
- .13 Remove, dispose of, and replace broken, cut, abraded glass, and defective glass including but not limited to production dimples, 'tiger-stripping', chips, cracks, etc.
- .14 Exterior glass: Glaze units with gasket on exterior side and glazing tape on interior side. Seal gap between glazing and stop with sealant to depth equal to bite of frame. Apply cap head of sealant along void between stop and glazing, to uniform line, flush with sight line. Tool or wipe sealant surface smooth.
- .15 Interior glass: Glaze interior glass using glazing gasket glazing tape.
 - .1 Install so that appropriate ULC markings remain permanently visible.
- .16 Apply a continuous heel bead of sealant around perimeter of inboard lite of the sealed unit and the metal framing.

3.4 CLEANING

- .1 Immediately remove sealant and compound droppings from finished surfaces.
- .2 Remove labels, protective material, and glass presence markers from prefinished surfaces.
- .3 Clean glass surfaces with cleaning agents and methods in accordance with

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Manufacturer's written instructions.

- .4 Do not wash glass film for 30 days after installation.
- .5 Do not use bristle brushes on glass film.

END OF SECTION

1 General

1.1 SECTION INCLUDES

- .1 Removal of one existing clear vision insulating glass unit from existing aluminum curtain wall framing.
- .2 Supply and installation of a factory-fabricated insulated aluminum-faced spandrel panel, dimensioned to suit existing glazing pocket and sightlines.
- .3 Factory preparation of panel with reinforced opening to receive mechanical grille (grille supplied and installed under Division 23 – Mechanical).
- .4 All sealants, gaskets, setting blocks, and accessories required to achieve a complete, weather-tight, and visually integrated installation.

1.2 REFERENCES

- .1 ASTM B209 – Aluminum and Aluminum-Alloy Sheet and Plate.
- .2 ASTM B221 – Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
- .3 ASTM C920 – Elastomeric Joint Sealants.
- .4 CAN/ULC-S702 – Thermal Insulation, Mineral Fibre, for Buildings.
- .5 AAMA CW-DG-1 – Aluminum Curtain Wall Design Guide Manual.
- .6 AAMA 2605 – High-Performance Organic Coatings on Architectural Aluminum.

1.3 SUBMITTALS

- .1 Product Data: Submit Manufacturer's literature for spandrel panel assembly, insulation, finishes, and accessories in accordance with Section 01 10 10.
- .2 Shop Drawings:
 - .1 Submit shop drawings in accordance with Section 01 10 10.
 - .1 Panel dimensions, construction, finish, and edge details.
 - .2 Factory-prepared grille opening size and location.
 - .3 Interface and sealing details with existing curtain wall framing.
- .3 Samples:
 - .1 Submit the following samples in accordance with Section 01 10 10.
 - .1 150 x 150 mm panel face sample showing specified finish and colour.
 - .2 Colour chips for finish matching to existing curtain wall system.

1.4 QUALITY ASSURANCE

- .1 General:
 - .1 Installer Qualifications: Minimum 5 years' experience in aluminum curtain wall and panel replacement projects of similar scope and complexity.
 - .2 Manufacturer Qualifications: Minimum 10 years' experience in fabrication of architectural spandrel panels compatible with aluminum curtain wall systems.

- .3 Mock-Up: Provide one installed panel, including grille opening, for review of fit, finish, and compatibility before proceeding with remainder of work.

1.5 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver panels in original manufacturer's protective packaging with identification labels intact.
- .2 Store flat in a dry, ventilated location, elevated above ground, protected from weather, sunlight, and damage.
- .3 Handle to avoid warping, denting, or other physical damage.

1.6 WARRANTY

- .1 Provide manufacturer's written warranty for a period of 5 years from date of Substantial Performance, covering:
 - .1 Water penetration.
 - .2 Material and fabrication defects.
 - .3 Finish performance, including colour retention and chalk resistance, in accordance with AAMA 2605.

2 Products

2.1 SPANDREL PANEL ASSEMBLY

- .1 Panel Type: Insulated aluminum-faced panel, factory-fabricated for installation into existing curtain wall glazing pocket.
- .2 Thickness: Match existing glazing unit thickness to maintain compatibility with existing framing and gaskets.
- .3 Core:
 - .1 Polyisocyanurate or mineral fibre insulation to CAN/ULC-S702.
 - .2 Minimum RSI 2.1 (R-12) thermal resistance.
- .4 Faces:
 - .1 Exterior: Minimum 1.5 mm aluminum sheet, finished to match existing curtain wall colour, gloss, and texture.
 - .2 Interior: Minimum 1.0 mm aluminum sheet, finish to match interior face of existing framing.
- .5 Edge Construction: Extruded aluminum perimeter channel compatible with existing glazing pocket; factory-sealed edges to prevent moisture ingress.
- .6 Finish: Factory-applied 70% PVDF fluoropolymer coating, complying with AAMA 2605, colour/gloss to match existing system.
- .7 Grille Opening:
 - .1 Factory-prepared cut-out sized and located per approved shop drawings.

- .2 Provide continuous structural reinforcement within panel around opening to maintain panel integrity and meet OBC wind load requirements.
- .3 Coordinate with Division 23 for grille dimensions and attachment requirements.

2.2 ACCEPTABLE MANUFACTURERS

- .1 Kawneer Company Canada Limited.
- .2 Alumicor Limited.
- .3 CRL / U.S. Aluminum.
- .4 Windspec Inc.
- .5 Or Approved equivalent.

2.3 ACCESSORIES

- .1 Glazing Gaskets: Manufacturer's standard EPDM extrusions, compatible with existing curtain wall system; new gaskets required.
- .2 Setting Blocks: Manufacturer's standard elastomeric type, sized for panel weight and thickness.
- .3 Perimeter Sealants: As specified in Section 07 92 00; colour to match adjacent curtain wall joints.

3 Execution

3.1 EXAMINATION

- .1 Verify existing curtain wall framing is clean, plumb, square, and free of damage at panel location.
- .2 Report any deficiencies to Consultant before commencing installation.

3.2 REMOVAL

- .1 Remove existing glass unit, gaskets, and setting blocks without damaging existing curtain wall framing.
- .2 Remove all old sealant and debris from glazing pocket.

3.3 INSTALLATION

- .1 Install spandrel panel in accordance with manufacturer's instructions and approved shop drawings.
- .2 Set panel on continuous setting blocks; install new gaskets on all sides.
- .3 Ensure grille opening is oriented and located per mechanical drawings.
- .4 Apply perimeter sealant for continuous air and water seal.
- .5 Maintain alignment and flush sightlines with adjacent curtain wall units.

3.4 FIELD QUALITY CONTROL

- .1 Inspect installation for alignment, seal continuity, and finish quality.
- .2 Replace panels or components that are damaged, misaligned, or do not meet specifications.

3.5 CLEANING AND PROTECTION

- .1 Clean exposed surfaces with manufacturer-approved cleaners; do not use abrasive materials.
- .2 Protect installed panels from damage until Substantial Performance.

END OF SECTION

1 General

1.1 SECTION INCLUDES

- .1 Design, labour, Products, equipment and services necessary for gypsum board work.

1.2 REFERENCES

- .1 ASTM A653/A653M, Specification for Steel Sheet, Zinc-coated (Galvanized) or Zincron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- .2 ASTM C475, Specification for Joint Compound and Joint Tape for Finishing Gypsum Board.
- .3 ASTM C645, Specification for Nonstructural Steel Framing Members.
- .4 ASTM C665, Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing.
- .5 ASTM C754, Specification for Steel Framing Members to Receive Screw-Attached Gypsum Board.
- .6 ASTM C834, Standard Specification for Latex Sealants.
- .7 ASTM C840, Specification for Application and Finishing of Gypsum Board.
- .8 ASTM C1002, Specification for Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs.
- .9 ASTM C1178, Specification for Glass Mat Water-Resistant Gypsum Backing Board.
- .10 ASTM C1278, Specification for Fiber-Reinforced Gypsum Panel.
- .11 ASTM C1396, Specification for Gypsum Board.
- .12 ASTM E84, Standard Test Method for Surface Burning Characteristics of Building Materials.

1.3 DESIGN REQUIREMENTS

- .1 Design ceiling suspension system in accordance with manufacturer's printed directions and ASTM C754.
- .2 Design ceiling system for adequate support of electrical fixtures as required by the current bulletin of the Electrical Safety Authority.
- .3 Design hanger anchor and entire suspension system static loading not to exceed 25% of their ultimate capacity including lighting fixture dead loads.
- .4 Design suspension system to support weight of mechanical and electrical items such as air handling boots and lighting fixtures, and with adequate support to allow rotation/relocation of light fixtures.
- .5 Design subframing as necessary to accommodate, and to circumvent, conflicts and interferences where ducts or other equipment prevent the regular spacing of hangers.
- .6 Design wall framing system and reinforce as necessary to accommodate and support items attached to and supported by wall framing system.
- .7 Design wall framing system for wall assemblies with a height greater than 3000 mm and those assemblies incorporating non-standard gypsum board assemblies

including, but not limited to, abuse resistant gypsum board, large format tile applications, etc.

1.4 REGULATORY REQUIREMENTS

- .1 Provide fire separations and fire protection exactly as specified in test design specification that validates the specified rating. Verify that work specified in other Sections, as a part of the entire assembly, meets applicable validating test design specification.

1.5 SUBMITTALS

- .1 Product data:
 - .1 Submit copies of manufacturer's Product data in accordance with Section 01 10 10 indicating:
 - .1 Performance criteria, compliance with appropriate reference standard, characteristics, and limitations.
 - .2 Product transportation, storage, handling and installation requirements.
- .2 Shop Drawings:
 - .1 Submit Shop Drawings in accordance with Section 01 10 10 indicating:
 - .1 Wall assemblies, suspension systems, adjacent construction, elevations, sections and details, dimensions, thickness, finishes and relationship to adjacent construction.
 - .2 Framing and blocking for items being supported of wall systems.
- .3 Certifications: Submit written certification stating that suspended ceiling system is designed for adequate support of electrical fixtures as required by the current bulletin of the Electrical Safety Authority.

1.6 QUALITY ASSURANCE

- .1 Qualifications: Execute the work of this Section by skilled, qualified, and experienced workers trained in the installation of the work of this Section.
- .2 Retain a Professional Engineer, licensed in Province of Ontario, with experience in work of comparable complexity and scope, to perform following services as part of work of this Section:
 - .1 Design of wall systems with height greater than 3000 mm and at nonstandard gypsum board assemblies including, but not limited to, assemblies incorporating abuse resistant gypsum board, large format tile applications, etc.
 - .2 Design of suspended gypsum board assemblies.
 - .3 Review, stamp, and sign Shop Drawings and design calculations.
 - .4 Conduct shop and on-site inspections, prepare and submit written inspection reports verifying that this part of Work is in accordance with Contract Documents and reviewed Shop Drawings.

1.7 SITE CONDITIONS

- .1 Do not begin work of this Section until:

- .1 Mechanical and electrical work above the ceiling is complete.
 - .2 Substrate and ambient temperature is above 15 degrees Celsius.
 - .3 Relative humidity is below 80%.
 - .4 Ventilation is adequate to remove excess moisture.
 - .2 Install temporary protection and facilities to maintain Product manufacturer's, and above specification, environmental requirements 24 h before, during, and 24 h after installation.
- 2 Products**
- 2.1 MATERIALS**
- .1 General:
 - .1 All materials under work of this Section, including but not limited to, sealants, adhesives, and primers are to have low VOC content limits.
 - .2 Steel framing: ASTM C754; ASTM A653/A653-M, Z275; cold rolled, galvanized steel sheet.
 - .1 Bailey Metal Products Limited
 - .2 Corus Metal Profiles
 - .3 Steel studs and track runners: ASTM C645; Galvanized steel studs and runners, 32 mm wide x depth as indicated on Contract Drawings. Formed from galvanized steel sheet, thicknesses as follows:
 - .1 Studs less than 3000 mm: Minimum 0.53 mm (25 ga.).
 - .2 Studs greater than 3000 mm and non-standard assemblies: Minimum 0.91 mm (20 ga.), unless stud thickness of greater thickness is required to accommodate intended loading, spans, or conditions.
 - .3 Track runners and ancillary components to match stud thickness.
 - .4 Main carrying channels: ASTM C645; Formed from galvanized steel sheet, 38 x 19 mm cold rolled, channels.
 - .5 Resilient channel: ASTM C645; 0.5 mm thick galvanized metal, 57 mm wide x 12 mm deep for walls and ceiling to reduce sound transmission.
 - .6 Furring channels: ASTM C645; Formed from galvanized steel sheet, 22 mm winged flange type, cold rolled.
 - .7 Furring channels (hat type): ASTM C645; 0.5 mm base steel thickness, galvanized. 70 mm wide x 22 mm deep hat shaped channel.
 - .8 Heavy duty furring channels: ASTM C645; 0.9 mm steel thickness, galvanized hat shaped channel with a wider and deeper size as required by manufacturers.
 - .9 Hanger wires: 4.1 mm minimum diameter galvanized pencil rod.
 - .10 Tie wire: 1.6 mm thick minimum diameter, soft annealed, galvanized steel wire.
 - .11 Corner bead, casing bead, and special shapes: Formed from 0.6 mm thick minimum, galvanized steel sheet, designed to be concealed by joint compound.

- .12 Deflection track: ASTM C 645 top runner with 50.8-mm- deep flanges, in thickness indicated for studs and in width to accommodate depth of studs.
- .13 Deflection track (fire rated): Provide 25 mm deep leg deflection track where indicated on rated walls. 'Fire Trak Shadowline' by Fire Trak Corporation or approved alternative.
- .14 Ceiling clips: Hot dip galvanized partition attachment clips, in square and reveal edge; 'PAC 15 Series' to match grid system by CGC Inc. or approved alternative.
- .15 Gaskets (acoustic partitions): Adhesive-backed, closed-cell vinyl foam strips that allow fastener penetration without foam displacement, 3.2 mm thick, in width to suit steel stud size.
- .16 Control joint strip: Roll formed from galvanized steel sheet, with a tape protected recess, 6 mm wide x 11 mm deep.
- .17 Screw fasteners: ASTM C1002 Type S; Corrosion resistant.
- .18 Concrete anchors: tie wire sleeve anchors, 'Redi-Drive Anchors' by ITW Red Head or approved alternative.
- .19 Acoustic/Fire insulation: stone wool insulation, of thickness as indicated on Contract Drawings, 'Safe'n'Sound' by Rockwell.
- .20 Sealants:
 - .1 Acoustic sealant (non-rated): Non-hardening acoustic sealant for use at nonrated assemblies, ASTM C834; Acrylic, mould resistant sealant, paintable. 'Smoke and Acoustic Sealant CP506' by Hilti or approved alternative.
 - .2 Sealant (fire-rated): Non-hardening sealant for use at fire-rated assemblies: ASTM E84; Acrylic based firestop sealant, colour: red or white as selected by Consultant. 'Flexible Firestop Sealant CP606' by Hilti or approved alternative.
 - .3 Standard sealants: In accordance with Section 07 91 00.
- .21 Sound Damping Gypsum panel (GB-1): 15.9 mm thick unless indicated otherwise on drawings; 'QuietRock 530' by Pabco Gypsum.
- .22 Primer: Where indicated by board manufacturer, provide primer as required to achieve finishes as defined in ASTM C840.
- .23 Joint reinforcing tape:
 - .1 Standard gypsum board: ASTM C475; 50 mm wide x 0.25 mm thick, perforated paper, with chamfered edges.
 - .2 Moisture resistant and tile backer boards: ASTM C475; fibreglass mat joint tape as recommended by board manufacturer to suit location.
- .24 Bonding adhesive: Type for purpose intended and as recommended and approved by manufacturer.
- .25 Joint and patching compound: ASTM C475; Asbestos-free, supplied by manufacturer of gypsum board used.

- .26 Fast setting patching compound: ASTM C475; Asbestos-free, Sheetrock or Durabond by CGC Inc., 'Moisture and Mold Resistant Setting Compound with M2Tech' by Certainteed Gypsum Canada or approved alternative.
- .27 Access doors: Supplied by other Sections for installation as part of the work of this Section

2.2 TRIM ACCESSORIES

- .1 Accessories for Interior Installation: Cornerbead, edge trim, and control joints complying with ASTM C1047 and requirements indicated below:
 - .1 Shapes as required in accordance with ASTM C1047.
 - .2 **Casing Trim (L or LC Beads) (T-1 Trim):** Bailey D200 and 4411, Nicholson Rollforming Metal Trim 200-A and 200-B, fillable edge trim with 0.55 mm (0.022") base thickness commercial-grade steel and zinc coating per ASTM A653/A653M-11; perforated flanges.
 - .3 **Z-Reveal Types (T-3 Trim):** Fry Reglet DRMZ-625-100, DRMZ-625-50, or DRMZ-25-25, or equivalent by Gordon Interior Specialties.
 - .4 **Aluminum Gypsum Board Trim:** Extruded aluminum alloy 6063-T5 conforming to ANSI H35.1/H35.1M-2013, with fin, tapered, grooved profiles prepunched for screw attachment and bonding agent, as manufactured by Gordon Inc., Softforms, or Fry Reglet.
 - .5 **Drywall Edge Trim:** Gordon CA-4-DW Profile or equivalent by Fry Reglet.

3 Execution

3.1 EXAMINATION

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

3.2 STEEL STUDS AND FURRING

- .1 Install steel studs and furring in accordance with reviewed Shop Drawings and manufacturer's written instructions.
- .2 Install steel stud partitions to underside of structure unless indicated otherwise.
- .3 Install track runners at floors, ceilings, and underside of structure; align track runners accurately and secure to structure at 600 mm centres maximum.
- .4 Install double top track runner assembly to prevent the transmission of structural loads to steel studs.
- .5 Install steel studs vertically at 400 mm o.c., unless otherwise indicated, and not more than 50 mm from abutting walls, at openings, and at each side of corners. Install studs securely to track runners.

- .6 Schedule and coordinate steel framing installation with mechanical and electrical services installation.
- .7 Install full height, double studs at door and service openings, fastened together and stiffened back to the structure to prevent vibration when doors close.
- .8 Provide double studs boxed together at all openings, sill, head and jambs and at door jambs, fastened together and stiffened back to the structure to prevent vibration. At each opening exceeding 900 mm in width, double studs shall be 20 ga. extending to structure above, and adequately anchored at each end. Provide steel studs above and below openings spaced at 400 mm oc maximum. All metal stud partitions above doors and screens over 1220 mm wide shall be secured to structure over and reinforced with sway bracing to stabilize walls to prevent lateral movement.
- .9 Erect three studs at corner and intermediate intersections of partitions. Space 50 mm apart and brace together with wired 19 mm channels.
- .10 Stiffen partitions over 2440 mm high or 3000 mm long, or both, with horizontal bracing extended for full length of partitions. Provide one line of bracing in partitions. Space lines to provide equal unbraced panels. Provide bracing for portions of partitions over door openings in partitions over 3000 mm high, and bracing both above and below openings in partitions located no greater than 150 mm from top and bottom of opening, and extending two stud spaces beyond each edge of opening for both doors and windows. Wire tie or weld bracing to studs.
- .11 Frame control joints using back to back double studs at abutting structural elements, at dissimilar backup interface, at dissimilar walls and ceilings, at structural expansion and control joints, at door and other openings, and at 9000 mm maximum spacing in continuous runs. Install control joint strips and secure in place.
- .12 Install additional support framing at openings and cutouts for built-in equipment, upper cabinet support, access panels and similar items.
- .13 Attach to framing adequate steel reinforcing members or a 1.2 mm (18 ga.) steel stud mounted horizontally and notched around furring members to support the load of, and to withstand the withdrawal and shear forces imposed by, items installed upon the work of this Section. Such items include, but are not restricted to, miscellaneous metals, coat hooks, washroom accessories, handrail anchors, rub rails, grab bars, guards, wall-hung cabinets and fitments, shelving, curtain and drape tracks, miscellaneous specialties; Owner supplied equipment; and minor mechanical and electrical work. Heavy mechanical and electrical equipment shall be selfsupporting in Divisions 21, 22, 23 and 26.
- .14 Provide for support and incorporation of flush-mounted and recessed mechanical and electrical equipment and fixtures only after consultation and verification of methods with those performing the work of Divisions 21, 22, 23 and 26.
- .15 Install cross bracing in accordance with the steel stud manufacturer's recommendations.

3.3 FIRE RATED ASSEMBLIES

- .1 Install Products in fire rated assemblies in strict accordance with applicable ULC tested and approved designs.

- .2 Stiffen fire rated walls over 3.66 m high, where linear length of wall is greater than 2.44 m between perpendicular wall supports, with diagonal bracing above the ceiling extending perpendicular to wall at a 45E angle to structure above. Locate diagonal bracing at maximum 2.44 m o.c.
- .3 Where double layers of gypsum board are shown, and required for fire rating, screw first layer to studs and furring and laminate the second layer to the first using joint filler as an adhesive. Stagger joints between first and second layers.

3.4 ACOUSTICAL INSULATION

- .1 Install acoustic insulation in partitions, between steel studs, and as indicated on Contract Drawings and in accordance with the manufacturer's instructions. Fill stud cavities to full height of partitions and carefully cut and fit acoustic insulation around services and protrusions.

3.5 ACOUSTICAL SEALANT

- .1 Install acoustical sealant to acoustically insulated partitions in accordance with the manufacturer's instructions and Contract Drawings.
- .2 Install acoustical sealant under floor runner track, at partition perimeter both sides and at openings, cut-outs, and penetrations, concealed from view in the final installation.
- .3 Install firestop fill material behind fire rated acoustical sealant and provide firestop identification tag.
- .4 Smooth acoustical sealant with trowel prior to skin forming.

3.6 BUILT-IN CORNER GUARDS

- .1 Install built-in corner guards in accordance with manufacturer's written instructions level, secure and rigid.

3.7 GYPSUM BOARD

- .1 Comply with ASTM C840. Install gypsum board in accordance with reviewed Shop Drawings and manufacturer's written instructions.
- .2 Install gypsum board vertically or horizontally, whichever results in fewer end joints. Locate end joints over supporting members.
- .3 Install gypsum board in lightly butted contact at edges and ends and with 1.6 mm maximum open space between boards; do not force gypsum board into place. Do not install imperfect, damaged or damp boards.
- .4 Install gypsum board butting paired tapered edge joints, and mill-cut or field-cut end joints; do not place tapered edges against cut edges or ends.
- .5 Install vertical joints minimum 300 mm from the jamb lines of openings and stagger vertical joints over different studs on opposite sides of partitions.
- .6 Do not locate joints within 200 mm of corners or openings, except where control joints occur at jamb lines or where openings occur adjacent to corners. Where necessary, place a single vertical joint over the centre of wide openings.
- .7 Cut, drill and patch gypsum board as may be necessary to accommodate the work of other trades.
- .8 Fire Separations:

- .1 Construct gypsum board assemblies, where located, in accordance with tested assemblies to obtain required or indicated fire rated assemblies. As a minimum fire separations shall consist of metal framing covered on both sides by fire-rated gypsum board.
- .2 Install assemblies tightly to enclosing constructions to maintain integrity of the separations. Install casing beads at all perimeter edges.

3.8 CORNER, CASING BEADS AND TRIM

- .1 Corner reinforcing bead: Install along all external angles, erect plumb, level and with a minimum of joints. Secure with screws at 225 mm o.c. apply filler over flanges flush with nose of the bead and extending at least 75 mm onto surface of board each side of corner. When filler dries, apply a thin coat of topping cement and blend onto adjoining surfaces.
- .2 Casing bead: Install where wallboard butts against a surface having no trim concealing the juncture and where shown on drawings. Erect casing beads plumb or level, with minimum joints, and secure with screws at 300 mm o.c. apply filler over flange flush with bead and extending at least 75 mm onto surface of board. When dry, apply a thin coat of topping cement and blend onto adjoining surfaces.
- .3 Recess channels and trim: Install recess channels and special metal trim where shown. Secure to substrate. Provide casing beads full height on wallboard edges at recess channels and metal trim.

3.9 JOINT TAPING AND FINISHING

- .1 Install reinforcing tape and a minimum of 3 coats of joint compound over gypsum board joints, metal trim and accessories, and screw fasteners in accordance with the gypsum board manufacturer's instructions.
- .2 Fill gaps between, and any imperfections in, gypsum boards with joint compound, allow to dry, and sand smooth ready for painting.
- .3 Install finished gypsum board work smooth, seamless, plumb, true, flush, and with square, plumb, and neat corners.
- .4 Finish gypsum board in accordance with ASTM C840 to the following grades:
 - .1 Level 0: No taping, finishing, or accessories required. Use above suspended ceilings and within other concealed spaces, unless the assembly is fire rated, sound rated, sound or smoke controlled, or unless the space serves as an air plenum.
 - .2 Level 1: At joints and interior angles embed tape in joint compound. Leave surface free of excess joint compound. Tool marks and ridges are acceptable. Use above suspended ceilings and within other concealed spaces if the gypsum board assembly is fire rated, sound rated, sound or smoke controlled, or the space serves as an air plenum.
 - .3 Level 2: At joints and interior angles embed tape in joint compound with one separate coat of joint compound applied over joints, angles, fastener heads, and accessories. Use for water resistant gypsum board indicated for use as a substrate for ceramic tile.

- .4 Level 3: At joints and interior angles embed tape in joint compound with two separate coats of joint compound applied over all joints, angles, fastener heads, and accessories. Apply joint compound smooth and free of tool marks and ridges. Use where heavy grade wall coverings are the final decoration.
- .5 Level 4: At joints and interior angles embed tape in joint compound with three separate coats of joint compound applied over all joints, angles, fastener heads, and accessories. Apply joint compound smooth and free of tool marks and ridges. Use for all locations except those indicated for other finish levels.
- .6 Level 5: At joints and interior angles embed tape in joint compound with three separate coats of joint compound applied over all joints, angles, fastener heads, and accessories. Apply a thin skim coat of joint compound, or a material manufactured especially for this purpose, to the entire surface. Leave surface smooth and free of tool marks and ridges. Use where semi-gloss or gloss finish coatings are the final decoration.

3.10 **SITE TOLERANCES**

- .1 Install metal support systems to ensure that, within a tolerance of +3 mm and -1.5 mm for plaster thickness, finish surfaces will be flat within 3 mm under a 3 m straightedge, and with no variation greater than 1.5 mm in any running 300 mm, and that surface planes shall be within 3 mm of dimensioned location.

3.11 **WORK IN EXISTING AREAS**

- .1 In existing areas, where existing gypsum board work has been demolished and/or damaged and repair work is required, provide new gypsum board finish.
- .2 Thoroughly prepare areas to be repaired. Provide neat, clean and straight cuts.
- .3 Finish all repair work as specified for new work.
- .4 In existing areas where existing openings are to be filled in with gypsum board, provide new gypsum board wall and ceiling construction. Ensure new board faces are flush with faces of abutting existing walls and ceilings.

3.12 **REPAIR**

- .1 Make good cut-outs for services and other work, fill in defective joints, holes and other depressions with joint compound.
- .2 Make good defective work, and ensure that surfaces are smooth, evenly textured and within specified tolerances to receive finish treatments.

END OF SECTION

1 General

1.1 SECTION INCLUDES

- .1 Labour, Products, equipment and services necessary for tile work in accordance with the Contract Documents.

1.2 REFERENCES

- .1 ANSI A108/A118/A136.1, Installation of Ceramic Tile.
- .2 ANSI A137.1, Specifications for Ceramic Tile.
- .3 ASTM C144, Specification for Aggregate for Masonry Mortar.
- .4 ASTM C920, Specification for Elastomeric Joint Sealants.
- .5 CAN/CSA A3000, Cementitious Materials Compendium.
- .6 CGSB 71-GP-22M, Organic Adhesive for Installation of Ceramic Wall Tile.
- .7 ISO 23599, Assistive Products for Blind and Vision-Impaired Persons - Tactile Walking Surface Indicators.
- .8 TTMAC Specification Guide 09300 Tile Installation Manual.
- .9 TTMAC, Maintenance Guide.

1.3 SUBMITTALS

- .1 Product data:
 - .1 Submit copies of manufacturer's Product data in accordance with Section 01 10 10 indicating:
 - .1 Performance criteria, compliance with appropriate reference standard, characteristics, limitations and warranties.
 - .2 Product transportation, storage, handling and installation requirements.
- .2 Shop drawings:
 - .1 Submit shop drawings in accordance with Section 01 10 10 indicating:
 - .1 Tile layout, patterns, and colour arrangement.
 - .2 Perimeter conditions, junctions with dissimilar materials.
 - .3 Setting details
- .3 Samples:
 - .1 Submit following sample panels in accordance with Section 01 10 10.
 - .1 Each colour, texture, size, and pattern of tile.
 - .2 Adhere tile samples to 400 x 400 x 12.5 mm thick cement board complete with selected grout colour in joints.
- .4 Certificates: Submit manufacturer's certificates stating that materials supplied are in accordance with this specification.
- .5 Closeout submittals: Submit recommended maintenance instructions and listing of recommended maintenance Products for incorporation into Operations and Maintenance Manuals in accordance with Section 01 10 10.

1.4 QUALITY ASSURANCE

- .1 Perform work of this Section by a company with proven, acceptable experience on installations of similar complexity and scope.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver materials in adequate crates or containers with manufacturer's name and product description clearly marked.
- .2 Handle and store tiles in a manner to avoid chipping, breakage or the instruction of foreign matter. Take precautions to protect the mortar and grout admixtures from freezing or from excessive heat.

1.6 SITE CONDITIONS

- .1 Do not install work of this Section outside of the following environmental ranges without the Consultant's and Product manufacturer's written acceptance:
 - .1 Ambient air and surface temperature: 15 degree Celsius to 45 degree Celsius.
 - .2 Precipitation: None.
- .2 Install temporary protection and facilities to maintain the Product manufacturer's, and specified, environmental requirements for 7 Days before, during, and 7 Days after installation.

1.7 MAINTENANCE

- .1 Submit extra tile amounting to 3% of gross area covered, allowing proportionately for each pattern and type specified and which are part of the same Production run as installed Products. Store maintenance Products as directed by the Consultant.

2 Products

2.1 MATERIALS

- .1 General: All materials under work of this Section, including but not limited to, sealants, adhesives, and sealers are to have low VOC content limits.
- .2 Tile:
 - .1 To ANSI A137.1.
 - .2 Supply coves, caps, inside and outside corners and bullnose tile as required.
 - .3 Where unfinished tile edge is exposed, supply cap to Consultant's selection.
 - .4 Tile Types:
 - .1 Porcelain tile (POR-1): Porcelain floor tile, sized at 12" x 24". 'Chord' by Daltile or approved alternative from Stone Tile International or Centura to match existing. To be selected by the Consultant from the manufacturer's full colour range in all Price Groups.
 - .2 Porcelain Tile Base: Cove porcelain base tile to match floor porcelain tile and match existing.
 - .5 Floor / Wall transitions:
 - .1 Tile to adjacent floor finish with flush condition: Schluter 'SCHIENE', anodized aluminium finish.
 - .2 Tile to adjacent floor finish at lower elevation not exceeding 13 mm (1/2"): Schluter 'RENO-U', anodized aluminium finish.
 - .3 Tile to adjacent floor finish at lower elevation exceeding 13 mm (1/2") or to finished concrete: Schluter 'RENO-RAMP/-K', anodized aluminium finish. Wall edge protection: Aluminium edge protection with trapezoid-perforated anchoring

leg and an anodized finish, continuous at all exposed tile edges, depth as required to suit tile thickness. 'Jolly' by Schluter Systems or approved alternative.

- .6 POR-1 Baseboard edge protection: Aluminium edge protection with trapezoid-perforated anchoring leg and an anodized finish, continuous at all exposed tile edges, depth as required to suit tile thickness. 'Jolly' by Schluter Systems or approved alternative.

2.2 **ACCESSORIES**

- .1 Cement: CAN/CSA A3000, Type GU.
- .2 Sand: ASTM C144.
- .3 Water: Potable and free of minerals and other contaminants which are detrimental to mortar and grout mixes.
- .4 Polymer additive: Keralastic by Mapei Inc or approved alternative by Ardex, Flextile Ltd. or Laticrete International.
- .5 Thin-set mortar: 2 component to ANSI A108/A118/A136.1:
 - .1 'Kerabond with Keralastic Latex Additive' by Mapei Inc., 'Ardex X77 Microtec' by Ardex, '56SR/51 w/44' by Flextile Ltd., or '254/255' by Laticrete International.
 - .2 White coloured mortar shall be provided at appropriate tile types including, but not limited to; glass tile, light coloured marble, green marble and light coloured granite.
- .6 Medium bed mortar: to ANSI A118.4:
 - .1 'Ultraflex LFT' by Mapei Inc., or approved alternative by Ardex, Flextile Ltd., or Laticrete International.
 - .2 White coloured mortar shall be provided at appropriate tile types including, but not limited to; glass tile, light coloured marble, green marble and light coloured granite
- .7 Thick bed sloped topping: Factory mixed blend of portland cement and aggregates with latex admix. 'Ardex X32 Microtec' by Ardex, '226 thick bed mortar with 3701 admix' by Laticrete, or 'Topcem with Planicrete AC Admixture' by Mapei Inc.
- .8 Shower area system: Provide the following system for use at shower areas as manufactured by Laticrete or Mapei Inc.:
 - .1 Adhesive: Polymer fortified, thin-set mortar complete with antimicrobials. '254' by Laticrete or 'Ultraflex LFT' by Mapei.
 - .2 Mortar bed: Factory mixed blend of portland cement and aggregates with latex admixture '226 thick bed mortar with 3701 admixture' by Laticrete or approved alternative by Mapei.
 - .3 Waterproofing: Single component, self curing liquid rubber polymer. 'Hydro Ban' by Laticrete or 'Aquadefense' by Mapei.
 - .4 Finish: As indicated on Interior Design Schedule.
 - .5 Epoxy grout: High performance sanded epoxy grout 'SpectraLOCK Pro Grout' by Laticrete or 'Kerapoxy CQ' by Mapei in colour as selected by Consultant.
- .9 Primer: To meet specified requirements of adhesive manufacturer.
- .10 Cleaner: In accordance with TTMAC's requirements and as recommended by tile manufacturer.
- .11 Organic adhesive (walls): CGSB 71-GP-22M, Type 1.

- .12 Grout:
 - .1 Floors and bases (below 3 mm joint width): 'Keracolor U' by Mapei Inc. or approved alternative by Ardex, Flextile Ltd. or Laticrete International.
 - .2 Floors and bases (3 mm to 10 mm joint width): 'UltraColor Plus' by Mapei Inc. or approved alternative by Ardex, Flextile Ltd. or Laticrete International.
 - .3 Walls (1.5 mm to 3 mm joint width): 'Keracolor U' by Mapei Inc. or approved alternative by Ardex, Flextile Ltd. or Laticrete International.
 - .4 Walls (over 3 mm joint width): 'Ultracolor Plus' by Mapei Inc. or approved alternative by Ardex, Flextile Ltd. or Laticrete International.
 - .5 Grout colour: To be selected by the Consultant from the manufacturer's full colour range.
- .13 Tile sealant: In accordance with Section 07 91 00.

2.3 **MIXES**

- .1 Levelling bed mix:
 - .1 1 part Portland cement.
 - .2 4 parts sand.
 - .3 1 part water (including polymer additive), adjusted for water content of sand
 - .4 1/10 part polymer additive.

3 Execution

3.1 **EXAMINATION**

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

3.2 **SURFACE PREPARATION**

- .1 Clean and dry surfaces thoroughly. Remove oil, wax, grease, dust, dirt, paint, tar, primers, form release agents, curing compound, and other foreign material from substrate surfaces which may prevent or reduce adhesion.
- .2 Neutralize any trace of strong acids or alkali from the substrate.

3.3 **CONTROL JOINTS**

- .1 Provide control, expansion and isolation joints in accordance with TTMAC specification 301MJ and as indicated on drawings. Install in locations indicated on drawings and specified herein.
- .2 Continue control, construction, and cold joints in the structural substrate up through the tile finish, and align with mortar joints where possible. Review joint locations on Site with the Consultant.
- .3 Install joint widths to match grout joint widths, except where a minimum width is indicated.
- .4 Install control joints in the following typical locations:
 - .1 Aligned over changes in type of substrate.
 - .2 At the restraining perimeters such as walls and columns.
 - .3 Interior areas (not subject to sunlight): 6 mm minimum width, at 7320 mm o.c. maximum.

- .4 Interior areas (subject to sunlight): 6 mm minimum width, at 3660 mm o.c maximum.
 - .5 As indicated on the Contract Drawings.
 - .5 Seal control joints in accordance with Section 07 91 00.
- 3.4 **LEVELLING BED**
- .1 Install a levelling bed on uneven substrate surfaces, level and plumb substrates in accordance with the following tolerances:
 - .1 Vertical surfaces: 3 mm in 2.4 m maximum.
 - .2 Horizontal surfaces: 6 mm in 3 m from finished levels of the surface, or better.
 - .2 Clean structural substrate control joints and blow-clean with compressed air. Grout fill control joints flush to slab with levelling bed.
- 3.5 **GENERAL INSTALLATION REQUIREMENTS**
- .1 Install tiles in accordance with manufacturer's instructions and TTMAC Specification Guide 093000 Tile Installation Manual. Manufacturer's installation instructions govern over TTMAC Installation Manual.
 - .2 Install in accordance with Installation of Ceramic Tile with Dry-Set Portland Cement Mortar or Latex Portland Cement Mortar ANSI A108.5 (ANSI A108/A118/A136.1-2020) and Installation of Grout in Tilework ANSI A108.10 (ANSI A108/A118/A136.1-2020).
 - .3 Lay out work to produce a symmetrical pattern with minimum amount of cutting. Ensure cut tile at room perimeter and at joints is not less than ½ full size.
 - .4 Install trim to be placed under tile in locations indicated on Drawings.
 - .5 Set tiles in place and rap or beat with a beating block as necessary to ensure a proper bond and to level surface. Align tile for uniform joints and allow to set until firm. Clean excess mortar from surface of tile with a wet cloth or sponge while mortar is fresh.
 - .6 Ensure following minimum mortar contact coverage to back of tiles. Contact must be evenly distributed to give full support of the tile.
 - .7 100% for tack and deck applications.
 - .8 Adjust joints between units uniform, plumb, straight, even, and true, with adjacent tile flush. Align grout joints in both directions unless indicated otherwise.
 - .9 Align floor, base and wall grout joints.
 - .10 Install tile accessory fittings for a complete and fully coordinated tile assembly.
 - .11 Install wall tile full height unless indicated otherwise.
 - .12 Do not place tile, trim, and accessories over control, expansion, or isolation joints. Stop materials in either side on joints and provide control, expansion and isolation joints as specified.
 - .13 Cut and fit tile neatly around piping, fittings, joints, projections and around recesses items e.g. washroom accessories. Where surface mounted equipment and accessories are installed on tile surfaces, extend tile over surfaces. Cut edges smooth, even, and free from chipping; chipped and broken edges are not acceptable.
 - .14 Do not proceed with grouting until minimum 48 hours after tile has set, to prevent displacement of tiles.
 - .15 Apply grout in accordance with grout manufacturer's directions to produce watertight, filled joints without voids, cracks and excess grout. Thoroughly compact and tool floor grout.

Finish grout flush to edge thickness of tile and remove excess grout with soft burlap or sponge moistened with clean water.

- .16 At floor deck drains, install slopes to drains as required by applicable codes and regulations, authorities having jurisdiction, and as indicated and water test before tile installation.
- .17 Ponding of water on pool deck and in emptied pool basin is unacceptable. Areas where ponding occurs shall be removed and reinstalled.
- .18 Provide edge protection at tile edges and corners, unless otherwise indicated, using maximum length pieces.
- .19 Provide edge protection and transition strips at tile transitions, unless otherwise indicated, using maximum length pieces.
- .20 Review locations of tile accessories with Consultant prior to setting tile and comply with directions of Consultant.
- .21 Lap tile and seal with sealant at inside corners. Caulk around pipes and openings made in tile with sealant.

3.6 **WATERPROOFING MEMBRANE INSTALLATION**

- .1 Install waterproof membrane to locations as indicated or scheduled to provide watertight performance.
- .2 Install waterproofing to comply with ANSI A108.13 (ANSI A108/A118/A136.1-2020) and manufacturer's written instructions to produce waterproof membrane of uniform thickness and bonded securely to substrate.
- .3 Work waterproofing membrane into adhesive with a flat trowel to achieve full contact and to remove air pockets.
- .4 Install prefabricated corners at outside and inside corner conditions.
- .5 Install prefabricated pipe collars at penetrations.
- .6 Install waterproofing strips at corner conditions at change in substrate plane conditions and where required by manufacturer's installation instructions.
- .7 Provide strips of waterproofing where required to span expansion joints or terminate waterproofing into movement joint type tile setting accessories, in accordance with manufacturer's instructions.
- .8 Seal waterproofing at penetrations and terminations in accordance with manufacturer's installation instructions.

3.7 **TILE SETTING**

- .1 Lay out tile work as indicated on drawings, and where lay-out is not indicated, lay-out tiles so tiles less than 1/2 the least dimension do not occur and with minimum amount of cutting.
- .2 Using a damp towel, wipe off the back side of tile to remove any dust or other residue that may be left over from the manufacturing process.
- .3 Place as much tile as possible in one operation before setting bed reaches initial set. Clean back and remove bed when it has set before tile is laid.
- .4 Prime materials and by methods specified by manufacturer of bond coat.
- .5 Line up joints between tile installed on stairs from tread to tread.
- .6 Except where tiles have setting tabs, and except for expansion, control and isolation joints, maintain joint widths as selected by Consultant.

- .7 Back up tile coves, curbs and other shaped pieces solid with mortar. Rigidly set, reinforce or otherwise make firm and secure such pieces.
- .8 Beat tiles in thoroughly and sufficiently to cause mortar ribs or notches to come together into a continuous void free bed and allow the mortar to flow up partially into the joint space to maximum of 1/3 the thickness of the tile. Sound floor tiles by tapping and reset all tiles with voids in setting bed.
- .9 Tile shall contact setting materials for minimum of 100% coverage unless otherwise indicated.
- .10 Obtain 100% mortar coverage with applicable requirements for back buttering of tile in referenced TTMAC and ANSI A108/A118/A136.1-2020 series of tile installation standards.
- .11 Remove any excess setting material from the joint area so that 2/3 of the depth of the tile is available for grouting.
- .12 Remove smudges or smears of setting material from the tile surface with a damp sponge or cloth immediately after final adjustment and beat-in while the mortar is fresh.
- .13 Do necessary cutting and drilling of fixtures, fittings, and built-in or penetrating units without marring the tile. Replace all cracked or damaged tile.
- .14 Cut tiles to conform to irregularities in wall lines and vertical planes along outer edges. Smooth cut edges with carborundum block or by other means to provide clean straight edge.
- .15 Install tiles to provide even distribution of shading, colour, and characteristics.

3.8

MORTAR-BED TILING

- .1 Apply latex-Portland cement thin bed mortar with flat trowel as a slurry bond coat approximately 1.5 mm thick over clean concrete slab.
- .2 Place latex-Portland cement thick bed mortar over slurry bond coat while bond coat is wet and tacky. Omit reinforcing wire fabric and fully compact bed by tamping.
- .3 Spread latex-Portland cement thin bed mortar with flat trowel over surface of "green"/fresh mortar bed as a slurry bond coat approximately 1.5 mm (1/16") thick.
- .4 Apply latex-Portland cement thin bed mortar slurry bond coat to back of tile or threshold and place each piece/sheet while slurry bond coats are wet and tacky. Beat with a hardwood block or rubber mallet to level/imbed pieces before mortar bed takes initial set.
- .5 Clean excess mortar from finished surfaces.
- .6 For installation of tile over cured (pre-floated) latex-Portland cement thick bed mortar, follow Thin-Set Method.

3.9

THIN-SET METHOD

- .1 Use the appropriate trowel notch size to ensure full bedding of the tile.
- .2 Work the thin-set mortar into good contact with the substrate and comb with notched side of trowel.
- .3 Beat each piece/sheet into the thin-set mortar with a beating block or rubber mallet to insure full bedding and flatness.
- .4 Clean excess thin-set mortar from tile face and joints between pieces. Do not cover, bridge or fill tile joints located over expansion joints with adhesive.

3.10

CONTROL JOINTS

- .1 Carry substrate control and movements joints through to tile work.

- .2 Install control joints around the perimeter of tiled areas, around columns and where tile abuts other hard materials.
- .3 Cut tiles on both sides along the edges of control or movement joints.
- .4 Install control joints in the following typical locations:
 - .1 Aligned over changes in type of substrate.
 - .2 At the restraining perimeters such as walls and columns.
 - .3 Interior areas (not subject to sunlight): 6 mm minimum width, at 6000 mm o.c. maximum.
 - .4 Interior areas (subject to sunlight): 6 mm minimum width, at 3660 mm o.c maximum.
 - .5 Review locations with Consultant prior to setting tile and comply with instruction given by Consultant.
 - .6 Control joint width: 6.4 mm minimum, unless indicated otherwise.

3.11 TRIM ACCESSORIES INSTALLATION

- .1 Coordinate transitions with work of other sections.
- .2 Install trims in accordance with manufacturer's installation instructions.
- .3 Install in continuous lengths.
- .4 Scribe and fit to obstructions.
- .5 Cope mitre corners.

3.12 GROUTING OR POINTING

- .1 Apply grout in accordance with manufacturer's printed instructions.
- .2 The initial curing time for thin-set mortar prior to application of grout shall be 72 hours or more unless advised by manufacturer and approved by Consultant.
- .3 The minimum cure time for epoxy grout and thin-set mortar shall be 21 days before immersion in water.
- .4 ANSI A118.3 2000 Chemical Resistant, Water-Cleanable Tile Setting and Grouting Epoxy and Water-Cleanable Tile Setting Epoxy Adhesive.
- .5 Allow tile installation to cure a minimum of 24 hours at ambient temperature of 21°C prior to grouting.
- .6 Install chemical epoxy resistant grout in compliance with current revisions of Installation of Ceramic Tile Portland. Cement Mortar ANSI A108.1 (ANSI A108/A118/A136.1-2020) and Installation of Grout in Tile Work ANSI A108.10 (ANSI A108/A118/A136.1-2020).
- .7 Verify grout joints are free of dirt, debris, water or tile spacers and face of tiles are clean.
- .8 Apply grout release to face of absorptive, abrasive, non-slip or rough textured tile units that are not hot paraffin coated to facilitate cleaning.
- .9 Spread using a sharp edged, hard rubber float and work grout into joints using diagonal strokes (45° angle).
- .10 Pack joints full and free of voids/pits. Stroke diagonally to remove excess grout and to avoid pulling grout out of filled joints.
- .11 Once excess grout is removed, begin cleaning grout haze approximately 20-30 minutes after grouting depending on temperature. Using a circular motion, lightly scrub grouted surfaces with the damp sponge to dissolve grout film/haze. Then drag sponge diagonally over the

scrubbed surfaces to remove froth. Rinse sponge frequently and change cleaning solution at least every 5m2. Discard sponges as they become tacky texture with residue.

- .12 Within 1 hour of finishing first cleaning, clean the same area again following the same procedure but utilizing a clean white scrub pad and fresh cleaning solution. Rinse scrub pad frequently. Drag a clean sponge diagonally over the scrubbed surfaces to remove froth. Use each side of sponge only once before rinsing and change cleaning solution at least every 5m2. Allow cleaned areas to dry and inspect tile surface. Rinse with clean water and allow surface to dry. Inspect grout joint for pinholes/voids and repair them with freshly mixed grout.
- .13 Grout joint width to be 3.2 mm unless otherwise indicated.
- .14 Do not cover, bridge or fill any expansion joints in tile with grout.

3.13 **TILE INSTALLATION TOLERANCES**

- .1 Tile up to 152 mm x 152 mm in size: 1 mm: maximum lippage.
- .2 Tile on outdoor shower with depth later than 1350 mm: no lippage.
- .3 Finish planes shall be straight and plumb to within 6 mm in 3000 mm.

3.14 **CLEANING AND ADJUSTING**

- .1 Clean off excess grout with soft burlap or sponge moistened with clean water.
- .2 Remove grout residue from tile after grouting has cured.
- .3 Unglazed tile may be cleaned with acid solutions only when permitted by tile and grout manufacturer's written instructions, but no sooner than 10 days after installation. Protect metal surfaces, cast iron, and vitreous plumbing fixtures from effects of acid cleaning.
- .4 Polish floor and wall tile after grout has cured in accordance with Tile, Marble, Terrazzo, Stone Specifications & Standards TTMAC recommendations in the Maintenance Guide; do not use acid for cleaning.
 - .1 Re-point joints after cleaning as required to eliminate imperfections, then re-clean as necessary. Avoid scratching tile surfaces.
 - .2 Flush surface with clean water before and after cleaning.

3.15 **PROTECTION**

- .1 Prevent traffic over tiled areas, and protect tiled assemblies from weather, freezing, and water immersion, for 96 hours minimum, after final installation.
- .2 Prevent direct impact, vibration and heavy hammering on adjacent and opposite walls for 96 hours minimum, after final installation.
- .3 Cover work temporarily with building paper properly lapped and taped at joints until work has been approved by Consultant.

END OF SECTION

1. GENERAL

1.1 SECTION INCLUDES

- .1 Design, labour, Products, equipment and services necessary for acoustical ceilings work in accordance with the Contract Documents.

1.2 REFERENCE STANDARDS

- .1 ASTM A580/A580M - Standard Specification for Stainless Steel Wire 2018.
- .2 ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process 2020.
- .3 ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate 2021a.
- .4 ASTM C423 - Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method 2022.
- .5 ASTM C635/C635M - Standard Specification for Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings 2022.
- .6 ASTM C636/C636M - Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels 2019.
- .7 ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2022.
- .8 ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials 2020.
- .9 ASTM E413 - Classification for Rating Sound Insulation 2022.
- .10 ASTM E1264 - Standard Classification for Acoustical Ceiling Products 2022.
- .11 UL (GGG) - GREENGUARD Gold Certified Products Current Edition.

1.3 ADMINISTRATIVE REQUIREMENTS

- .1 Coordination: Coordinate work of this section with installation of mechanical and electrical components and with other construction activities affected by work of this section.
 - .1 Review with affected installers those locations of facility services lines and equipment within ceiling plenum that prevent installation of hangers at spacings compliant with limitations established in referenced standards. Arrange for each affected mechanical or electrical installer to provide necessary number of additional structural support points for ceiling installer.
- .2 Preinstallation Meeting: Convene one week before starting work of this section.
- .3 Sequencing: Schedule work of affected trades to minimize or eliminate installation conflicts and rework.
 - .1 Supply hanger clips during steel deck erection. Supply additional hangers and inserts as required.
 - .2 Ensure that acoustical ceilings are not installed until building is enclosed, sufficient heat is provided, dust generating activities have terminated, and overhead work is completed, tested, and approved. Do not install acoustical units until after interior wet work is dry.

1.4 SUBMITTALS

- .1 Submit the following in accordance with Section 01 10 10.
 - .1 Shop Drawings: Indicate grid layout and related dimensioning.
 - .2 Product Data: Provide data on suspension system components and acoustical units.
 - .3 Samples: Two samples of each type of tile panels indicating material and finish of acoustical units to be used.
 - .4 Samples: Two samples of each suspension system main runner, cross runner, and perimeter molding member.
 - .5 Manufacturer's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.
- .2 Installer's qualification statement.
- .3 Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

1.5 QUALITY ASSURANCE

- .1 Designer Qualifications for Seismic Design: Perform under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed in the State in which the Project is located.
- .2 Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience and approved by manufacturer.

1.6 FIELD CONDITIONS

- .1 Maintain uniform temperature of minimum 60 degrees F (16 degrees C), and maximum humidity of 40 percent before, during, and after acoustical unit installation.

2. PRODUCTS

2.1 CEILING ASSEMBLIES

- .1 Acoustical Ceiling Assembly Type (ACT-2):
 - .1 Acoustical Units: Mars Healthcare 75/35 3/4" 86684
 - a. (ACT-1) Panel Size: 24'X48' inches (2 by 4) panel
 - b. (ACT -2) Panel Size: 24'X24' inches (2 by 2) panel
 - c. Panel Edge: SLT edge.
 - d. Color: Flat White 050.
 - e. Characteristics: Noise Reduction Coefficient = 0.75, Ceiling Attenuation Class = 35, Light Reflectance = 0.90,
 - .2 Suspension Grid: Donn AX/AXCE 15/16-inch Suspension System,
 - a. Color: Flat White 050

2.2 CEILING PERFORMANCE REQUIREMENTS

- .1 Design for maximum deflection of [1/360] of span.
- .2 Fire-Resistance Rating: Determined in accordance with test procedures in ASTM E119 and complying with the following:

2.3 CEILING COMPONENT PRODUCTS

- .1 Acoustical Units:
 - .1 Acoustical Units - General: ASTM E1264, Fire Class A.
 - a. VOC Content: As specified in Section 016116.
 - b. VOC Content: Certified as Low Emission by one of the following:

- 1) Product listing in UL (GGG).
 - 2) Product listing in CHPS (HPPD).
 - c. Noise Reduction Coefficient (NRC) rating, Ceiling Attenuation Class (CAC) rating, and Light Reflectance Coefficient (LR) performance for each type of unit specified below, as determined in accordance with ASTM E1264.
 - d. Fire Class / Surface Burning Characteristics: Determined in accordance with test method ASTM E84.
 - 1) Surface Burning Characteristics: Unless otherwise indicated, flame spread index of [25 or less], smoke developed index of [50 or less].
- .2 Acoustical Panels: Mineral fiber with membrane-faced overlay, with the following characteristics:
 - a. Classification: ASTM E1264 Type IV.
 - 1) Form(s): Includes the following, as applicable to each product specified.
 - (a) Form 1 - Nodular.
 - (b) Form 2 - Water felted.
 - 2) Pattern(s): Includes the following, as applicable to each product specified.
 - (a) E - Lightly textured.
 - (b) G - Smooth.
 - b. Thickness: As applicable to each product specified.
 - c. Recycled Content: As applicable to selected products.
 - d. Material Ingredients Transparency: Products included in the USG EcoBlueprint Program.
 - e. Low Emissions (VOC): Greenguard-certified products.
 - f. Products:
 - 1) USG Corporation; Mars Healthcare 75/35 3/4"
Panels: www.usg.com/ceilings/#sle.
- .2 Suspension Systems:
 - .1 Metal Suspension Systems - General: Complying with ASTM C635/C635M; die cut and interlocking components, with [curtain pockets],[splices],[wall angles and moldings] as required.
 - a. Materials:
 - 1) Steel Grid: ASTM A653/A653M [G30] coating, unless otherwise indicated.
 - 2) Aluminum Grid: Aluminum sheet, ASTM B209/B209M.
 - .2 Exposed Suspension System: Aluminum grid and cap; factory-applied closed-cell foam gaskets.
 - a. Application(s): Cleanroom.
 - b. Structural Classification: Light-duty, when tested in accordance with ASTM C635/C635M.
 - c. Clean Room Classification: ISO 14644-1, Class 5.
 - d. Recycled Materials Content: Classified as containing greater than 50 percent total recycled content.
 - e. System meets USDA/FSIS requirements.
 - f. System meets FGI Guidelines for Design and Construction of Hospitals.
 - g. System is capable of withstanding cleaning and disinfecting chemicals.
 - h. Profile: Tee; 15/16 inch (24 mm) face width.
 - i. Recycled Materials Content: Up to 90 percent.

- j. Finish: Baked enamel.
- k. Color: As indicated on drawings.
- l. Accessories: Quick-release clips.
- m. Products:
 - 1) USG Corporation; AX 15/16 Inch Suspension System: www.usg.com/ceilings/#sle.
 - 2) Substitutions: Approved equivalent by Armstrong World Industries Inc.
- .3 Moldings and Trim:
 - .1 Edge Molding, [Expansion Joints], and Splices - General: Same material, thickness, and finish as metal pan panels, unless otherwise indicated.
 - .2 Perimeter Wall Moldings: [Same metal and finish as grid].
 - a. Size: As required for installation conditions[None - N/A].
 - b. Angle Moldings: L-shaped, for mounting at same elevation as face of grid.
 - c. Gaskets For Perimeter Moldings: Closed-cell foam, factory-applied to molding.
 - d. Acoustical Sealant For Perimeter Moldings: Nonhardening, nonskinning, for use in conjunction with suspended ceiling system.
 - 1) Substitutions: Approved equivalent by Armstrong World Industries Inc.

2.4 ACCESSORIES

- .1 Support Channels, Carriers, and Hangers: Galvanized steel; size and type to suit application and ceiling system flatness requirement specified.
- .2 Hat-Shaped Metal Channels: Steel, 22 gauge, 0.0299 inch (0.76 mm), minimum.
- .3 Suspension Wire[None - N/A]: Size and type as required for application, [seismic requirements], and ceiling system flatness requirement specified.
 - .1 Concealed Suspension:
 - a. Suspension Wire: Steel, annealed, [galvanized] finish, 12 gauge, 0.0808 (2.05 mm) diameter, complying with ASTM A641/A641M.
 - .2 Exposed (To View) Suspension:
 - a. Suspension Wire: Stainless steel, 18 gauge, 0.0403 (1.02 mm) diameter, complying with ASTM A580/A580M.
 - b. Suspension Rope: 1/32 inch (0.8 mm) stainless steel rope wire complying with ASTM A492, with loop and crimp-end connection.
- .4 Compression Framing and Bracing: Metal stud sizes, gauges, and spacings as determined by qualified structural design professional and complying with applicable codes.
- .5 Compression Posts: 3.4 inch (19 mm) nominal diameter EMT conduit, lengths as required by installation conditions.
- .6 Hold-Down Clips: Manufacturer's standard clips to suit application.
- .7 Seismic Clips: Manufacturer's standard clips for seismic conditions and to suit application.
- .8 Unopposed Tee Attachment Clip: Manufacturer's standard clip designed to create code-compliant cross tee connections when a cross tee is installed in a main tee without another cross tee directly opposite ("ashlar" installations).
- .9 Gypsum Board and Framing Materials: See Section 09 21 16.

- .10 Touch-Up Paint for Exposed Surfaces: Type and color to match acoustical units and suspension system grid and trim elements.
- .11 Touch-Up Paint For Concealed Items: Zinc rich type, as recommended by ceiling system manufacturer.

2.5 FABRICATION

- .1 Shop fabricate ceiling[None - N/A] components to the greatest extent possible.
- .2 Fabricate components to allow access to ceiling plenum as required.

3. EXECUTION

3.1 EXAMINATION

- .1 Verify existing conditions before starting work.
- .2 Verify that layout of hangers will not interfere with other work.
- .3 Verify that field measurements are as indicated on shop drawings.
- .4 Start of installation constitutes acceptance of project conditions.

3.2 PREPARATION

- .1 Coordinate the location of hangers with other work.
- .2 Provide hanger clips during steel deck erection. Provide for anticipated additional hangers and inserts as required.
- .3 Install ceiling system after major above-ceiling work is complete.
- .4 Acclimate wood ceiling materials by removing from packaging in installation area a minimum of 72 hours prior to installation.

3.3 INSTALLATION - SUSPENSION SYSTEM

- .1 Install suspension system in accordance with ASTM C636/C636M and manufacturer's instructions and as supplemented in this section.
- .2 Install hangers and inserts coordinated with overhead work. Provide additional hangers and supports as required.
- .3 Rigidly secure system, including integral mechanical and electrical components, for maximum deflection of 1:360.
- .4 Lay out system to a balanced grid design with edge units no less than 50 percent of acoustical unit size.
- .5 Locate system on room axis according to reflected ceiling plan.
- .6 Where ducts, facility services, or equipment prevent the regular spacing of hangers, reinforce the nearest affected hangers and related carrying channels to span the extra distance.
- .7 Do not support components on main runners or cross runners if weight causes total dead load to exceed deflection capability.
- .8 Support fixture loads using supplementary hangers located within 6 inches (152 mm) of each corner, or support components independently.
- .9 Do not eccentrically load system or induce rotation of runners.
- .10 Edge Moldings: Install at intersection of ceiling and vertical surfaces and penetrations, using components of maximum length; set level. Provide edge moldings at junction with

other ceiling finishes. Miter corners. Provide preformed edge closures to match bullnosed cornered partitions.

- .1 Install in bed of acoustical sealant.
 - .2 Use longest practical lengths.
 - .3 Overlap and rivet corners.
- .11 Install light fixture boxes constructed of gypsum board above light fixtures in accordance with fire rated assembly requirements and light fixture ventilation requirements.

3.4 INSTALLATION - ACOUSTICAL UNITS

- .1 Install acoustical units in accordance with manufacturer's instructions.
- .2 Fit acoustical units in place, free from damaged edges or other defects detrimental to appearance and function.
- .3 Fit edge trim neatly against abutting surfaces.
- .4 Install acoustical units level, in uniform plane, and free from twist, warp, and dents.
- .5 Cutting Acoustical Units:
 - .1 Cut to fit irregular grid and perimeter edge trim.
 - .2 Make field cut edges of same profile as factory edges.
- .6 Lay acoustical insulation for a distance of 48 inches (1219 mm) either side of acoustical partitions as indicated.
- .7 Install hold-down clips on acoustical units within 20 ft (6 m) of an exterior door.

3.5 TOLERANCES

- .1 Maximum Variation from Flat and Level Surface: 1/8 inch in 10 feet (3 mm in 3 m).
- .2 Maximum Variation from Plumb of Grid Members Caused by Eccentric Loads: Two degrees.

3.6 CLEANING

- .1 Clean and touch up minor finish damage. Remove and replace components that cannot be successfully cleaned and repaired.

END OF SECTION

1. General

1.1 SECTION INCLUDES

- .1 Flooring and accessories as shown on the drawings and schedules and as indicated by the requirements of this section.

1.2 REFERENCES

- .1 ASTM International:
 - .1 ASTM E 648 Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source
 - .2 ASTM E 662 Standard Test Method for Specific Optical Density of Smoke Generated by Solid Materials
 - .3 ASTM F 710 Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring
 - .4 ASTM F 1913 Standard Specification for Sheet Vinyl Floor Covering without Backing
 - .5 ASTM F 1482, Standard Guide to Wood Underlayment Products Available for Use Under Resilient Flooring
 - .6 ASTM F 1861 Standard Specification for Resilient Wall Base
 - .7 ASTM F 1869 Standard Test Method for Measuring Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride
 - .8 ASTM F 2170 Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes.
- .2 National Fire Protection Association (NFPA):
 - .1 NFPA 253 Standard Method of Test for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source
 - .2 NFPA 258 Standard Test Method for Measuring the Smoke Generated by Solid Materials

1.3 SYSTEM DESCRIPTION

- .1 Performance Requirements: Provide flooring which has been manufactured, fabricated, and installed to performance criteria certified by manufacturer without defects, damage, or failure.
- .2 Administrative Requirements
 - .1 Pre-installation Meeting: Conduct an on-site pre-installation meeting to verify project requirements, substrate conditions, manufacturer's installation instructions and manufacturer's warranty requirements. Comply with Division 1 Project Management and Coordination (Project Meetings) Section.
- .3 Test Installations/ Mock-ups: Install at the project site a job mock-up using acceptable products and manufacturer approved installation methods, including concrete substrate testing. Obtain Owner's and Consultant's acceptance of finish color, texture and pattern, and workmanship standards.
 - .1 Maintenance: Maintain mock-up during construction for workmanship comparison; remove and legally dispose of mock-up when no longer required.
 - .2 Incorporation: Mock-up may be incorporated into the final construction with Owner's approval.

- .4 Sequencing and Scheduling
 - .1 Install flooring and accessories after the other finishing operations, including painting, have been completed. Close spaces to traffic during the installation of the flooring.
 - .2 Do not install flooring over concrete slabs until they are sufficiently dry to achieve a bond with the adhesive, in accordance with the manufacturer's recommended bond, moisture tests and pH test.

1.4 SUBMITTALS

- .1 Submit shop drawings indicating, seaming plan, coving details, and manufacturer's technical data, installation and maintenance instructions for flooring and accessories in accordance with Section 01 10 10.
- .2 Submit the manufacturer's standard samples showing the required colors for flooring, welding rods, and applicable accessories in accordance with Section 01 10 10.
- .3 Submit copies of manufacturer's Product data in accordance with Section 01 10 10 for adhesives, weld rod, moisture mitigation systems, primers, patching/leveling compounds, floor finishes (polishes) and cleaning agents and Material Information Sheets for flooring products indicating:
 - .1 Performance criteria, compliance with appropriate reference standard, characteristics, and limitations.
 - .2 Product transportation, storage, handling and installation requirements.
- .4 Submit the manufacturer's certification that the flooring has been tested by an independent laboratory and complies with the required fire tests.
- .5 Closeout Submittals: Submit the following:
 - .1 Operation and Maintenance Data: Operation and maintenance data for installed products in accordance with Division 1 Closeout Submittals (Maintenance Data and Operation Data) Section. Include methods for maintaining installed products, and precautions against cleaning materials and methods detrimental to finishes and performance.
 - .2 Warranty: Warranty documents specified herein

1.5 QUALITY ASSURANCE

- .1 Single-Source Responsibility: provide types of flooring and accessories supplied by one manufacturer, including moisture mitigation systems, primers, leveling and patching compounds, and adhesives.
- .2 Select an installer who is experienced and competent in the installation of Armstrong resilient sheet flooring using heat-welded seams and the use of Armstrong Flooring subfloor preparation products.
 - .1 Engage installers certified as Armstrong Flooring Certified Installers
 - .2 Confirm installer's certification by requesting their credentials.
- .3 Fire Performance Characteristics: Provide resilient vinyl sheet flooring with the following fire performance characteristics as determined by testing material in accordance with

ASTM test methods indicated below by a certified testing laboratory or other testing agency acceptable to authorities having jurisdiction:

- .1 ASTM E 648 Critical Radiant Flux of 0.45 watts per sq. cm. or greater, Class I
- .2 ASTM E 662 (Smoke Generation) Maximum Specific Optical Density of 450 or less
- .3 CAN/ULC-S102.2 – Flame Spread Rating and Smoke Developed – Results as tested.

1.6 DELIVERY, STORAGE, AND HANDLING

- .1 Comply with Division 1 Product Requirements Sections
- .2 Comply with manufacturer's ordering instructions and lead time requirements to avoid construction delays.
- .3 Deliver materials in good condition to the jobsite in the manufacturer's original unopened containers that bear the name and brand of the manufacturer, project identification, and shipping and handling instructions.
- .4 Store materials in a clean, dry, enclosed space off the ground, protected from harmful weather conditions and at temperature and humidity conditions recommended by the manufacturer. Protect adhesives from freezing. Store flooring, adhesives, and accessories in the spaces where they will be installed for at least 48 hours before beginning installation.

1.7 PROJECT CONDITIONS

- .1 Maintain a minimum temperature in the spaces to receive the flooring and accessories of 65°F (18°C) and a maximum temperature of 100°F (38°C) for at least 48 hours before, during, and for not less than 48 hours after installation. Thereafter, maintain a minimum temperature of 55°F (13°C) in areas where work is completed. Protect all materials from the direct flow of heat from hot-air registers, radiators, or other heating fixtures and appliances. Refer to product installation recommendations for a complete guide on project conditions.

1.8 LIMITED WARRANTY

- .1 Resilient Flooring: Submit a written warranty executed by the manufacturer, agreeing to repair or replace resilient flooring that fails within the warranty period.
- .2 Limited Warranty Period: 10 years.
- .3 The Limited Warranty shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and will be in addition to and run concurrent with other warranties made by the Contractor under the requirements of the Contract Documents.
- .4 For the Limited Warranty to be valid, this product is required to be installed using the appropriate Armstrong Flooring Guaranteed Installation System. Product installed not using the specific instructions from the Guaranteed Installation System will void the warranty.

1.9 EXTENDED SYSTEM LIMITED WARRANTY

- .1 Resilient Flooring System: Submit a written warranty executed by the manufacturer, agreeing to repair or replace system (subfloor preparation products, adhesive, and floor covering) that fails within the warranty period.
- .2 Limited Warranty Period: 10 years on top of the Resilient Flooring Limited Warranty
- .3 S-463 Level Strong cement based self-leveling compound
- .4 The installation of an Armstrong Flooring product along with the recommended Armstrong Flooring adhesive, as well as any one of the Strong System subfloor preparation products listed above, provides 10 additional years of limited warranty coverage. The Strong System limited warranty covers the installation integrity for the length of the flooring product warranty plus 10 years. To qualify for the Strong System Warranty, any subfloor preparation product needed for an installation must be an Armstrong Flooring product.
- .5 For the System Limited Warranty to be valid, this product is required to be installed using the appropriate Armstrong Flooring Guaranteed Installation System. Product installed not using the specific instructions from the Guaranteed Installation System will void the warranty.
- .6 When Armstrong Flooring Strong System subfloor preparation products are used with other manufacturers' floor coverings, adhesives, or other subfloor preparation products, Armstrong Flooring warrants our products to be free from manufacturing defects from the date of purchase through the limited warranty period of 20 years.

1.10 MAINTENANCE

- .1 Extra Materials: Deliver extra materials to Owner. Furnish extra materials from the same production run as products installed. Packaged with protective covering for storage and identified with appropriate labels.
 - .1 Quantity: Furnish quantity of flooring units equal to 10 % of amount installed.
 - .2 Delivery, Storage and Protection: Comply with Owner's requirements for delivery, storage, and protection of extra material.

2. Products

2.1 MANUFACTURER

- .1 Homogeneous Resilient sheet flooring, wall base, adhesives, and accessories: (LINO-1 and LINO-2)
 - .1 AHF Products, 3840 Hempland Road, Mountville, PA 17554,
www.armstrongflooring.com/commercial or approved equivalent.

2.2 HOMOGENEOUS RESILIENT SHEET FLOORING MATERIALS

- .1 Provide Homogeneous Sheet Flooring: Medintone™ with Diamond 10® Technology manufactured by AHF Products or approved equivalent.

- .1 Description: An unbacked, nonlayered, homogeneous sheet vinyl flooring. Protected by a diamond-infused UV-cured polyurethane finish, the colors and pattern detail are dispersed uniformly throughout the thickness of the product. Color pigments are insoluble in water and resistant to cleaning agents and light.
 - .2 Homogeneous sheet flooring shall conform to the requirements of ASTM F1913 Standard Specification for Sheet Floor Covering Without Backing
 - .3 Pattern and Color: color selected from the range currently available from AHF Products.]
 - .4 Width: 6 ft. 5 in. (1.98 m).
 - .5 Length: up to 65.62 ft. (20 m)
 - .6 Thickness: 0.080 in. (2.0 mm)
- .2 Weld Rod:
- .1 Provide solid color vinyl weld rod as produced by AHF Products and intended for heat welding of seams. Color shall be compatible with field color of flooring or as selected by Architect to contrast with field color of flooring. Color selected from the range currently available from AHF Products
- .3 Seam Adhesive:
- .1 Provide Armstrong Flooring S-761 Seam Adhesive at seams as recommended by the resilient flooring manufacturer.

2.4 WALL BASE MATERIALS

- .1 Wall base: Provide 1/8 in. (3.18 mm) thick, 4 in. (10.16 cm) high Armstrong Flooring Color-Integrated Wall Base with a matte finish, conforming to ASTM F 1861, Type TP - Rubber, Thermoplastic, Group 1 - Solid, Style B – Cove.

2.5 ADHESIVES

- .1 Provide Armstrong Flooring S-995 Sheet Flooring Adhesive Premium Commercial adhesive for field areas and Armstrong Flooring
- .2 S-725 Wall Base Adhesive at the wall base as recommended by the flooring manufacturer.

2.6 ACCESSORIES

- .1 For priming porous substrates to aid in adhesive bond strength and reducing subfloor porosity, provide S-464 Prime Strong™ acrylic primer for porous substrates. For non-porous substrates, provide S-465 NP Prime Strong™ acrylic primer for non-porous substrates.
- .2 For sealing joints between the top of wall base or integral cove cap and irregular wall surfaces such as masonry, provide plastic filler applied according to the manufacturer's recommendations.
- .3 Provide transition/reducing strips tapered to meet abutting materials.
- .4 Provide threshold of thickness and width as shown on the drawings.

- .5 Provide resilient edge strips of width shown on the drawings, of equal gauge to the flooring, homogeneous vinyl, or rubber composition, tapered or bullnose edge, with color to match or contrast with the flooring, or as selected by the Architect from standard colors available.
- .6 Provide metal edge strips of width shown on the drawings and of required thickness to protect exposed edges of the flooring. Provide units of maximum available length to minimize the number of joints. Use butt-type metal edge strips for concealed anchorage or overlap.

3. Execution

3.1 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: Comply with manufacturer's product data, including technical bulletins, product catalog, installation instructions, and product carton instructions for installation and maintenance procedures as needed.

3.2 EXAMINATION

- .1 Site Verification of Conditions: Verify substrate conditions (which have been previously installed under other sections) are acceptable for product installation in accordance with manufacturer's instructions (i.e., moisture tests, bond test, pH test).
- .2 Visually inspect flooring materials, adhesives, and accessories prior to installation. Flooring material with visual defects shall not be installed and shall not be considered as a legitimate claim.
- .3 Examine subfloors prior to installation to determine that surfaces are smooth and free from cracks, holes, ridges, and other defects that might prevent adhesive bond or impair durability or appearance of the flooring material.
- .4 Inspect subfloors prior to installation to determine that surfaces are free from curing, sealing, parting and hardening compounds; residual adhesives; adhesive removers; and other foreign materials that might prevent adhesive bond. Visually inspect for evidence of moisture, alkaline salts, carbonation, dusting, mold, or mildew.
- .5 Report conditions contrary to contract requirements that would prevent a 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 subfloor. Installation indicates acceptance of substrates regarding conditions existing at the time of installation.

3.3 PREPARATION

- .1 Subfloor Preparation: Smooth concrete surfaces, removing rough areas, projections, ridges, and bumps, and filling low spots, control or construction joints, and other defects with Armstrong Flooring
- .2 S-194 Cement-Based Patch, Underlayment and Embossing Leveler / S-195 Underlayment Additive
- .3 Subfloor Cleaning: The surface shall be free of dust, solvents, varnish, paint, wax, oil, grease, sealers, release agents, curing compounds, residual adhesive, adhesive

removers, and other foreign materials that might affect the adhesion of resilient flooring to the concrete or cause a discoloration of the flooring from below. Remove residual adhesives as recommended by the flooring manufacturer. Remove curing and hardening compounds not compatible with the adhesives used, as indicated by a bond test or by the compound manufacturer's recommendations for flooring. Avoid organic solvents. Spray paints, permanent markers and other indelible ink markers must not be used to write on the back of the flooring material or used to mark the concrete slab as they could bleed through, telegraphing up to the surface and permanently staining the flooring material. If these contaminants are present on the substrate, they must be mechanically removed prior to the installation of the flooring material. Refer to the product installation recommendations and ASTM F 710 Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring for additional information on subfloor preparation.

- .4 When using S-995 Adhesive, perform subfloor moisture testing in accordance with ASTM F 2170, "Standard Test Method for Determining Relative Humidity in Concrete Slabs Using *in-situ* Probes" and Bond Tests as described in the Armstrong Flooring Guaranteed Installation System to determine if surfaces are dry; free of curing and hardening compounds, old adhesive, and other coatings; and ready to receive flooring. The internal relative humidity of the concrete shall not exceed 95%. On installations where both the Percent Relative Humidity and the Moisture Vapor Emission Rate tests are conducted, results for both tests shall comply with the allowable limits listed above. Do not proceed with flooring installation until the results of moisture tests are acceptable. All test results shall be documented and retained.
- .5 Concrete pH Testing: Perform pH tests on concrete floors regardless of their age or grade level. All test results shall be documented and retained.
- .6 Wood subfloors: Armstrong Flooring resilient floors are recommended on suspended wood subfloors with a 1/4" underlayment (see product installation systems for exceptions) and a minimum of 18" of well-ventilated air space below. Armstrong Flooring does not recommend installing resilient flooring on wood subfloors applied directly over concrete or on sleeper-construction subfloors. Loading requirements for subfloors are normally set by various building codes on both local and national levels. Trade associations such as APA—The Engineered Wood Association provide structural guidelines for meeting various code requirements. Subfloor panels are commonly marked with span ratings showing the maximum center-to-center spacing in inches of supports over which the panels should be placed.
 - .1 Refer to the flooring installation recommendations for additional information.
- .7 Wood subfloors - Surface Cleaning: Make subfloor free from dust, dirt, grease, and all foreign materials.
 - .1 Check panels for sources of discoloration such as contamination from paint, varnish, stain overspray or spills, plumbing sealers, asphalt, heater fuel, markers, or potential staining agents such as wood or bark not visible on the surface, edge sealers, logo markings, printed nail patterns and synthetic patches.
 - .2 Remove old adhesive.
 - .3 Cover adhesive, oil, or wax residue with an appropriate underlayment. If the residue is tacky, place a layer of felt or polyethylene sheeting over it to prevent a cracking sound when walking on the floor.

- .4 Remove all paint, varnish, oil, and wax from all subfloors. Many buildings constructed before 1978 contain lead-based paint, which can pose a health hazard if not handled properly. State and federal regulations govern activities that disturb lead-based painted surfaces and may also require notice to building occupants. Do not remove or sand lead-based paint without consulting a qualified lead professional for guidance on lead-based paint testing and safety precautions. Armstrong Flooring does not recommend the use of solvents to remove paint, varnish, oil, wax, or old adhesive residues because the solvents can remain in the subfloor and negatively affect the new installation. Whenever sanding, be certain the work site is well ventilated and avoid breathing dust. If high dust levels are anticipated, use the appropriate National Institute for Occupational Safety and Health (NIOSH) designated dust respirator. All power sanding tools must be equipped with dust collectors. Avoid contact with skin or eyes. Wear gloves, eye protection and long-sleeve, loose fitting clothes
- .5 For additional information on the installation and preparation of wood and board-type underlayments see the current edition of ASTM F1482, "Standard Practice for Installation and Preparation of Panel Type Underlayments to Receive Resilient Flooring."
- .6 Vacuum or broom-clean surfaces to be covered immediately before the application of flooring.

3.4 INSTALLATION OF FLOORING

- .1 Install flooring in strict accordance with the latest edition of the flooring installation recommendations. Failure to comply may result in voiding the manufacturer's warranty listed in Section 1.08.
- .2 Install flooring wall to wall before the installation of floor-set cabinets, casework, furniture, equipment, movable partitions, etc. Extend flooring into toe spaces, door recesses, closets, and similar openings as shown on the drawings.
- .3 If required, install flooring on pan-type floor access covers. Maintain continuity of color and pattern within pieces of flooring installed on these covers. Adhere flooring to the subfloor around covers and to covers.
- .4 Scribe, cut, and fit or flash cove to permanent fixtures, columns, walls, partitions, pipes, outlets, and built-in furniture and cabinets.
- .5 Adhere flooring to the subfloor without cracks, voids, raising and puckering at the seams. Roll with a 100-pound (45.36 kilogram) roller in the field areas. Hand-roll flooring at the perimeter and the seams to assure adhesion. Refer to specific rolling instructions of the flooring manufacturer.
- .6 Lay flooring to provide a minimum number of seams. Avoid cross seams, filler pieces, and strips. Match edges for color shading and pattern at the seams in compliance with the manufacturer's recommendations.
- .7 Install flooring with adhesives, tools, and procedures in strict accordance with the manufacturer's written instructions. Observe the recommended adhesive trowel notching, open times, and working times.
- .8 Prepare heat-welded seams with special routing tool supplied for this purpose and heat weld with vinyl welding rod in seams. Use methods and sequence of work in

conformance with written instructions of the flooring manufacturer. Finish all seams flush and free from voids, recesses, and raised areas.

3.5 INSTALLATION OF ACCESSORIES

- .1 Apply top set wall base to walls, columns, casework, and other permanent fixtures in areas where top-set base is required. Install base in lengths if practical, with inside corners fabricated from base materials that are mitered or coped. Tightly bond base to vertical substrate with continuous contact at horizontal and vertical surfaces.
- .2 Fill voids with plastic filler along the top edge of the resilient wall base or integral cove cap on masonry surfaces or other similar irregular substrates.
- .3 Place resilient edge strips tightly butted to flooring, and secure with adhesive recommended by the edge strip manufacturer. Install edge strips at edges of flooring that would otherwise be exposed.
- .4 Apply butt-type metal edge strips where shown on the drawings, before flooring installation. Secure units to the substrate, complying with the edge strip manufacturer's recommendations.

3.6 CLEANING

- .1 Perform initial and on-going maintenance according to the latest edition of the maintenance recommendations for Homogeneous Sheet Flooring.

3.7 PROTECTION

- .1 Protect installed flooring as recommended by the flooring manufacturer against damage from rolling loads, other trades, or the placement of fixtures and furnishings. (See Finishing the Job in the latest edition of Armstrong Flooring Guaranteed Installation Systems manual.

END OF SECTION

- 1 General**
- 1.1 SECTION INCLUDES**
 - .1 Labour, Products, equipment and services necessary for painting work in accordance with the Contract Documents.
- 1.2 REFERENCES**
 - .1 CAN/CGSB 85.10, Protective Coatings for Metals.
 - .2 CAN/CGSB-85.100, Painting.
 - .3 Master Painters Institute (MPI), Painting Specification Manual.
 - .4 SSPC Steel Structures Painting Council, Standards.
 - .5 AMPP Association for Materials Protection & Performance, Standards.
- 1.3 SUBMITTALS**
 - .1 Product data:
 - .1 Submit copies of manufacturer's Product data in accordance with Section 01 10 10 indicating:
 - .1 Performance criteria, compliance with appropriate reference standard, characteristics, limitations.
 - .2 Product transportation, storage, handling and installation requirements.
 - .3 Product name, type and use.
 - .4 Manufacturer's product number.
 - .5 Colour numbers.
 - .6 MPI Environmentally Friendly classification system rating.
Manufacturer's WHMIS Safety Data Sheets (SDS).
 - .2 Submit listing of manufacturer's Product types, Product codes, and Product names, number of coats, and dry film thicknesses, corresponding to each Painting Schedule code; submit listing minimum of 8 weeks before materials are required.
 - .2 Samples:
 - .1 Submit following samples in accordance with Section 01 10 10.
 - .1 Four 300 x 150 mm draw downs of each colour minimum 4 weeks before paints are required.
 - .2 Identify each sample with Contract number and title, colour reference, sheen, date, and name of applicator.
 - .3 Certificates:
 - .1 Submit certification from paint manufacturer, on company letterhead, indicating each product proposed for use is Manufacturer's premium grade, first line Product.

- .2 Submit certified documentation to confirm each airless spray painter has minimum of 5 years experience on applications of similar complexity and scope.
- .3 Submit certified documentation to confirm each worker has Provincial Tradesman Qualification certificate of proficiency.
- .4 Reports:
 - .1 Submit written field inspection and test report results after each inspection.
 - .2 Submit Field Quality Control test result reports for alkali content, substrate moisture, and dry film thickness.
 - .3 Submit electronic moisture meter manufacturer's specifications including tolerances. Submit record of latest meter calibration to meet manufacturer's recommendations.

1.4 QUALITY ASSURANCE

- .1 Finishing work: Perform work to MPI requirements for premium grade.
- .2 Supervision: Have work supervised by a full-time qualified foreperson who has 10 years minimum experience on Contracts of similar complexity and scope
- .3 Mock-up:
 - .1 Construct three 2 square metre mock-ups of different Paint Schedule code systems, selected by Consultant, in locations acceptable to Consultant to demonstrate installation workmanship, colour, and hiding power of Products.
 - .2 Obtain Consultant's acceptance in writing before proceeding with the work of this Section.
 - .3 Mock-ups may remain as part of the Work if acceptable to Consultant and will serve as a standard for similar code systems.
 - .4 Repaint over mock-ups which do not form part of the Work.

1.5 EXTRA MATERIALS

- .1 Submit one - four litre can of each type and colour of primer and finish coating. Identify colour and paint type in relation to established colour schedule and finish system.

1.6 DELIVERY, STORAGE, AND HANDLING

- .1 Install correct, safe temporary storage for paint, thinner, solvents, and other volatile, corrosive, hazardous, and explosive materials in accordance with requirements of authorities having jurisdiction.
- .2 Post hazard warning signage in areas of storage and mixing. Install and maintain sufficient CO2 fire extinguishers of minimum 9 kg capacity, accessible in each storage mixing and storage areas.
- .3 Maintain storage enclosures at minimum 10 degrees Celsius ambient temperature and to manufacturer's instructions.

- .1 Labels shall clearly indicate:
 - .1 Manufacturer's name and address.
 - .2 Type of paint or coating.
 - .3 Compliance with applicable standard.
 - .4 Colour number in accordance with established colour schedule.

1.7 SITE CONDITIONS

- .1 Heating, Ventilation and Lighting:
 - .1 Ventilate enclosed spaces.
 - .2 Perform no painting work unless adequate and continuous ventilation and sufficient heating facilities are in place to maintain ambient air and substrate temperatures above 10°C for 24 hours before, during and after paint application until paint has cured sufficiently.
 - .3 Where required, provide continuous ventilation for seven days after completion of application of paint.
 - .4 Perform no painting work unless a minimum lighting level of 323 Lux is provided on surfaces to be painted. Adequate lighting facilities shall be provided by General Contractor.
- .2 Apply coatings under the following conditions:
 - .1 Exterior coatings (except Latex): 5 degrees Celsius minimum.
 - .2 Exterior latex coatings: 10 degrees Celsius minimum.
 - .3 24 hours minimum after rain, frost, condensation, or dew.
 - .4 When no condensation is possible (unless specifically formulated against condensation).
 - .5 Interior coatings: 7 degrees Celsius minimum.
 - .6 Relative humidity: 85% maximum.
 - .7 Not in direct exposure to sun light.
- .3 Maintain temperature conditions indicated above for 24 hours before, during and 24 hours after painting.
- .4 Install clean plywood sheets to protect floors and walls in storage and mixing areas, from paint drips, spatters, and spills.
- .5 Surface and Environmental Conditions:
 - .1 Apply paint finish only in areas where dust is no longer being generated by related construction operations or when wind or ventilation conditions are such that airborne particles will not affect quality of finished surface.
 - .2 Apply paint only to adequately prepared surfaces and to surfaces within moisture limits noted herein.
 - .3 Apply paint only when previous coat of paint is dry or adequately cured.

- .4 Apply paint finishes only when temperature at location of installation can be satisfactorily maintained within manufacturer's recommendations.
 - .5 Apply paint in occupied facilities during silent hours only. Schedule operations to approval of Owner such that painted surfaces will have dried and cured sufficiently before occupants are affected.
 - .6 Apply sufficient masking, clean drop cloths, and protective coverings for full protection of work not being painted including, but not limited to, the following:
 - .1 Light fixtures, fire and smoke detectors.
 - .2 Sprinkler heads.
 - .3 Non-Prepainted diffusers and registers.
 - .4 Non-Prepainted equipment.
 - .5 Fire rating labels and equipment specification plates.
 - .6 Finished surfaces.
 - .7 Nameplates.
- 1.8 **ENVIRONMENTAL PERFORMANCE REQUIREMENTS**
- .1 Provide paint products meeting MPI "Green Performance Standard GPS-1-05".
- 1.9 **WASTE MANAGEMENT AND DISPOSAL**
- .1 Remove from site and dispose of packaging materials at appropriate recycling facilities.
 - .2 Place materials defined as hazardous or toxic in designated containers.
 - .3 Ensure emptied containers are sealed and stored safely.
 - .4 Unused paint, coating materials must be disposed of at official hazardous material collections site as approved by Owner.
 - .5 Paint, stain and wood preservative finishes and related materials (thinners, and solvents) are regarded as hazardous products and are subject to regulations for disposal.
 - .6 Material which cannot be reused must be treated as hazardous waste and disposed of in an appropriate manner.
 - .7 Place materials defined as hazardous or toxic waste, including used sealant and adhesive tubes and containers, in containers or areas designated for hazardous waste.
 - .8 To reduce the amount of contaminants entering waterways, sanitary/storm drain systems or into ground follow these procedures:
 - .1 Retain cleaning water for water-based materials to allow sediments to be filtered out.
 - .2 Retain cleaners, thinners, solvents and excess paint and place in designated containers and ensure proper disposal.

- .3 Return solvent and oil soaked rags used during painting operations for contaminant recovery, proper disposal, or appropriate cleaning and laundering.
- .4 Dispose of contaminants in approved legal manner in accordance with hazardous waste regulations.
- .5 Empty paint cans are to be dry prior to disposal or recycling (where available).

1.10 MAINTENANCE

- .1 Deliver to Owner's place of storage on completion of work, sealed containers of each finish painting material applied, and in each colour. Label each container as for original, including mixing formula. Provide the following:
 - .1 1 L of extra materials when less than 50 L are used for Project;
 - .2 3.78 L of extra stock when 50 to 200 L are used;
 - .3 7.57 L of extra stock when over 200 L are used.

1.11 SCHEDULE OF WORK

- .1 Submit work schedule for various phases of painting to Consultant for approval. Submit schedule minimum of 1 week in advance of proposed operations.
- .2 Obtain written authorization from Consultant for any changes in work schedule.
- .3 Schedule painting operations to prevent disruption of occupants in and about the building.

2 Products

2.1 MATERIALS

- .1 Paint:
 - .1 All materials under work of this Section, including but not limited to, primers, stains, and paints are to have low VOC content limits.
 - .2 Products in accordance with the MPI Painting Specification Manual, and MPI Maintenance Repainting Manual, Exterior and Interior Systems;
 - .1 For each MPI paint code, manufacture's premium grade, first line Products is to be use.
 - .2 Uniform dispersion of pigment in a homogeneous mixture.
 - .3 Ready-mixed and tinted whenever possible.
- .2 Products within each MPI paint system code: From single manufacturer.
- .3 Acceptable manufacturers:
 - .1 Benjamin Moore.
 - .2 Dulux Paints/PPG.
 - .3 Sherwin Williams.

2.2 COLOUR SCHEDULE

- .1 Consultant will select choice of colours and gloss when compiling a Colour Schedule after award of Contract; allow for colour selection beyond paint manufacturer's standard colour range.
- .2 Second coat in a three coat system to be tinted slightly lighter colour than top coat to show visible difference between coats.
- .3 Refer to Colour Schedule for selected colour references. Allow for 12 different colours, an additional deep and ultra-deep colours; 4 coats may be required.
- .4 Conform to gloss reflectance definitions listed in MPI Specification Manual.

2.3 PAINTING AND FINISHING SCHEDULE

- .1 Refer to Table 1, MPI Painting and Finishing Schedule coded systems, comply with MPI Painting Specification Manual.

Table 1: Interior Painting and Finish Schedule				
TYPICAL INTERIOR SUBSTRATES	Typical substrates (Including but not limited to)	MPI Manual Ref.	MPI Finish System Code	Primer/Topcoat (PPG)
Concrete Surface	Concrete walls and ceiling	RIN 4.2	RIN 4.2A	Spot Prime – Dulux Gripper Universal Acrylic Primer/ Sealer 60000A Topcoat- Dulux Lifemaster Eggshell 59317
Gypsum Board	Walls & ceilings	RIN 9.2	RIN 9.2A	Spot Prime – Dulux Ultra Interior Latex Primer/ Sealer 976000 Topcoat- Dulux Lifemaster Eggshell 59317
Galvanized Metal/ Aluminum	HM Doors & Frames, Window Frames & Mullions	RIN 5.3	RIN 5.3J	Spot Prime – PPG Pitt-Tech Plus EP Acrylic Primer 90-1912 Topcoat – PPG Pitt-Glaze WB1 Precatalyzed Acrylic Epoxy Semi-Gloss 16-

				1510
Structural Steel	Columns, beams, joists	RIN 5.1	RIN 5.3RR	Spot Prime – PPG Pitt-Tech Plus EP Acrylic Primer 90-1912 Topcoat – PPG Pitt-Glaze WB1 Precatalyzed Acrylic Epoxy Semi-Gloss 16-1510

3 Execution

3.1 EXAMINATION

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

3.2 CONDITION OF SURFACES:

- .1 Prior to commencement of repainting work, thoroughly examine (and test as required) all interior conditions and surfaces scheduled to be repainted and report in writing to the Consultant any conditions or surfaces that will adversely affect work of this section.
- .2 The degree of surface deterioration (DSD) shall be assessed using the assessment criteria indicated in the MPI Maintenance Repainting Manual. In general, the MPI DSD ratings and descriptions are as follows:

CONDITION	DESCRIPTION
DSD-0	Sound Surface (may include visual (aesthetic) defects that do not affect film's protective properties).
DSD-1	Slightly Deteriorated Surface (may show fading; gloss reduction, slight surface contamination, minor pin holes scratches, etc.) / Minor cosmetic defects (runs, sags, etc.).
DSD-2	Moderately Deteriorated Surface (small areas of peeling, flaking, slight cracking, staining, etc.).
DSD-3	Severely Deteriorated Surface (heavy peeling, flaking, cracking, checking, scratches, scuffs, abrasion, small holes and gouges).
DSD-4	Substrate Damage (repair or replacement of surface required by Contractor).

- .3 Other than the repair of DSD-1 to DSD-3 defects included under this scope of work, structural and DSD-4 substrate defects discovered prior to and after surface preparation or after first coat of paint shall be made good and sanded by others

ready for painting, unless otherwise agreed to by the Consultant and painter to be included in this Work.

- .4 No repainting work shall commence until all such DSD-4 adverse conditions and defects have been corrected and surfaces and conditions are acceptable to the Painting Subcontractor. The Painting Subcontractor shall not be responsible for the condition of the substrate or for correcting defects and deficiencies in the substrate, which may adversely affect the painting work except for minimal work normally performed by the Painting Subcontractor and as, indicated herein. It shall always, however, be the responsibility of the Painting Subcontractor to see that surfaces are properly prepared before any paint or coating is applied. It shall also be the Painting Subcontractor's responsibility to paint the surface as specified providing that the Wwner accepts responsibility for uncorrected DSD-4 substrate conditions.

3.3 **PREPARATION**

- .1 General:
 - .1 Clean substrate surfaces free from, dust, grease, soiling, or extraneous matter, which are detrimental to finish.
 - .2 Patch, repair, and smoothen minor substrate defects and deficiencies e.g. machine, tool and sand paper marks, shallow gouges, marks, and nibs.
 - .3 Clean, sweep, and vacuum floors and surfaces to be painted, debris and dustfree prior to painting.
 - .4 Refer to MPI Painting Specification Manual for surface preparation requirements of substrates not listed here.
- .2 Where finish hardware has been installed remove, store, re-install finish hardware, to accommodate painting. Do not clean hardware with solvent that will remove permanent lacquer finishes.
- .3 Alkali Content tests and neutralization:
 - .1 Test for ph level using litmus paper on dampened substrate.
 - .2 Neutralize surfaces over 8.5 ph with 4% solution of Zinc Sulphate for solvent based systems and tetrapotassium pyrophosphate for latex based systems, to below 8.0 ph, and allow to dry.
 - .3 Brush-off any residual Zinc Sulphate crystals.
 - .4 Coordinate paint system primer / sealer to be alkali-resistant.
- .4 Substrate moisture tests:
 - .1 Test for moisture content over entire surface to be painted, minimum one test/2 m2 in field areas and one test/600 mm along inside corners including at ceiling to wall juncture.
 - .2 If any test registers above 10% allow entire substrate surfaces, within the plane, to dry further before paint system application. Install temporary drying fans if necessary.
 - .3 Re-test employing same criteria.

- .5 Mildew removal: Scrub with solution of trisodium phosphate and sodium hypochlorite (Javex) bleach, rinse with water, and allow to dry completely.
- .6 Cementitious and masonry (existing): Clean existing surfaces by pressure washing where indicated on drawings with a TSP solution and pressure range of 1500 - 4000 PSI at 150 mm - 300 mm. Rinse areas with clean water and allow to thoroughly dry. Provide for collection and disposal of water.
- .7 Cementitious and masonry (Concrete, block):
 - .1 Allow 28 days cure before painting.
 - .2 Coordinate repair of protrusion-chipping and grinding, and honeycomb filling with responsible trades.
 - .3 Remove dirt, loose mortar, scale, powder, efflorescence, and other foreign matter.
 - .4 Remove form oil and grease with trisodium phosphate, rinse, and allow to dry thoroughly.
 - .5 Prepare surfaces in accordance with CAN/CGSB-85.100.
 - .6 Remove rust stains with solution of sodium metasilicate after thorough wetting;
 - .1 allow to dry thoroughly.
- .8 Metal Fabrications (existing): Scrape and either hand or power wire brush surfaces to remove mill and scale.
- .9 Galvanized steel sheet:
 - .1 Z275 (Satin & Spangled Sheet): SSPC SP7 brush blast.
 - .2 ZF075 (Wiped Coat): Remove contamination, wash with Xylene solvent.
 - .3 Touch-up damaged galvanized areas with organic zinc rich primer.
- .10 Galvanized iron and steel: Prepare galvanized and ungalvanized metal surfaces as
 - .1 Z275 (Satin & Spangled Sheet): SSPC SP7 brush blast.
 - .2 ZF075 (Wiped Coat): Remove contamination, wash with Xylene solvent.
 - .3 Touch-up damaged galvanized areas with organic zinc rich primer.
- .11 Galvanized iron and steel: Prepare galvanized and ungalvanized metal surfaces as follows:
 - .1 Unpassivated, unweathered and weathered: Remove contamination, wash with Xylene or Toluol solvent, allow to dry thoroughly. Make paint system primer/sealer an etching type primer.
 - .2 Manufacturer pre-treated (including passivated): SSPC SP7.
 - .3 Touch-up damaged galvanized areas with organic zinc rich primer.
- .12 Structural steel and miscellaneous metal fabrications:
 - .1 Coordinate the following with the responsible trades:
 - .1 Rust, mars, mill scale, and weld-burn touch-ups.

- .2 Oil, grease, weld flux and other residue removal.
 - .2 Prime paint items, not otherwise indicated to be primed as part of another Section.
 - .3 Touch-up damaged galvanized areas with organic zinc rich primer
- .13 Factory primed surfaces:
 - .1 Touch up damaged areas.
 - .2 Clean as required for top coat.
- .14 Gypsum board (existing):
 - .1 Remove dust, dirt, oil, grease, glue and all foreign material. Clean with stiff fibre brush prior to applying primer coat.
 - .2 Coordinate repairs and touch-ups with the responsible trade.
 - .3 Lightly sand surface to smooth out ridges and provide neat smooth surface.
- .15 Gypsum board:
 - .1 Apply primer/sealer paint to reveal defects and deficiencies and to equalize absorption areas.
 - .2 Coordinate repairs and touch-ups with the responsible trade.
 - .3 Re-prime repairs.
- .16 Coordinate with other trades to prevent:
 - .1 Damage, and inadvertent activation of fire and smoke detectors.
 - .2 Odour and dust distribution by permanent HVAC systems including fouling of ducts and filters.
- .17 Field-mix Products in accordance with manufacturer's written instructions.

3.4 **APPLICATION**

- .1 Apply painting systems in accordance with the MPI Painting Specification Manual. Apply each Product to manufacturer's recommended dry film thickness.
- .2 Method of application to be as approved by Consultant. Apply paint by brush, roller, air sprayer, airless sprayer. Conform to manufacturer's application instructions unless specified otherwise.
- .3 Brush and Roller Application:
 - .1 Apply paint in a uniform layer using brush and/or roller of types suitable for application.
 - .2 Work paint into cracks, crevices and corners.
 - .3 Brush and/or roll out runs and sags, and over-lap marks. Rolled surfaces shall be free of roller tracking and heavy stipple.
 - .4 Paint surfaces and corners not accessible to brush using spray, daubers and/or sheepskins. Paint surfaces and corners not accessible to roller using brush, daubers or sheepskins.
 - .5 Remove runs, sags and brush marks from finished work and repaint.

- .4 Spray application:
 - .1 Provide and maintain equipment that is suitable for intended purpose, capable of properly atomizing paint to be applied, and equipped with suitable pressure regulators and gauges.
 - .2 Keep paint ingredients properly mixed in containers during paint application either by continuous mechanical agitation or by intermittent agitation as frequently as necessary.
 - .3 Apply paint in a uniform layer, with overlapping at edges of spray pattern.
 - .4 Brush out immediately all runs and sags.
 - .5 Use brushes to work paint into cracks, crevices and places which are not adequately painted by spray.
- .5 Painting systems listed are required minima, apply additional coats if necessary to obtain substrate hiding acceptable to the Consultant.
- .6 Tint intermediate coats lighter than final top coats for identification of each succeeding coat and to facilitate inspections. Include only manufacturer's recommended reducing and tinting accessories. Do not add adulterants.
- .7 Primer to be specialized primer coating system as required by manufacturer for selected colour. Standard primer being tinted shall be tinted to a maximum of 1.5% by volume.
- .8 Sand lightly between coats to achieve a tooth or anchor for subsequent coats.
- .9 Apply paint uniformly in thickness, colour, texture, and gloss, as determined by the Consultant under adequate illumination and viewed at a distance of 1500 mm. Apply finishes free of defects in materials and application which, in the opinion of the Consultant, affect appearance and performance. Defects include, but are not limited to:
 - .1 Improper cleaning and preparation of surfaces.
 - .2 Entrapped dust, dirt, rust.
 - .3 Alligatoring, blisters, peeling.
 - .4 Scratches, blemishes.
 - .5 Uneven coverage, misses, drips, runs, and poor cutting in.
- .10 Do not apply coatings on substrates which are not sufficiently dry. Unless indicated otherwise, allow each painting system coat to cure dry and hard before following coats are applied.
- .11 Repaint entire areas of damaged or incompletely covered surfaces, to the nearest inside or outside corner; patching will not be permitted.
- .12 Miscellaneous painting requirements:
 - .1 Paint projecting ledges, and tops, bottoms and sides of doors both above and below sight lines to match adjacent surfaces.
 - .2 Paint door frames, access doors and frames, door grilles, prime coated butts, and prime coated door closers to match surface in which they occur.

- .3 Finish closets and alcoves as specified for adjoining rooms.
- .4 Paint light coves white whether a light lense is installed or not, unless otherwise indicated.
- .5 Paint interior columns to match walls of room.
- .6 Allow for:
 - .1 2 wall colours per room, one ceiling colour per room.
 - .2 Different door colours in each functionally different area.
 - .3 Different colours on both sides of same door.
- .13 Mechanical, electrical, refrigeration and other painting coordination:
 - .1 Coordinate painting of pipes, ducts, and coverings with the work to precede pipe colour banding, flow arrows, and other pipe identification labeling installation.
 - .2 Paint exposed conduit, pipes, hangers, ductwork, grilles, gratings, louvres, access panels, fire hose cabinets, registers, convector and radiator covers, enclosures, and other mechanical and electrical equipment including services concealed inside cupboard and cabinet work; apply colour and sheen to match adjacent surfaces, except as noted otherwise.
 - .3 Paint portions of surfaces such as duct interiors, piping, ductwork, hangers, insulation, walls, and similar items, visible through grilles, louvres, convector covers etc., colour as noted on drawings.
 - .4 Paint inside of ductwork where visible behind grilles, registers and diffusers with primer and one coat of matt black paint.
 - .5 Remove the following to accommodate painting, carefully store, clean, then reinstall on completion of each area and when dry:
 - .1 Switch and receptacle plates, fittings and fastenings, grilles, gratings, louvres, access panels, convector covers, and enclosures.
 - .6 Unless otherwise specified, paint finished area exposed conduits, piping, hangers, ductwork and other mechanical and electrical equipment with colour and finish to match adjacent surfaces, except as noted otherwise.
 - .7 Boiler room, mechanical and electrical rooms: paint exposed conduits, piping, hangers, ductwork and other mechanical and electrical equipment.
 - .8 Paint fire protection piping red.
 - .9 Paint disconnect switches for fire alarm system and exit light systems in red enamel.
 - .10 Paint natural gas piping yellow.
 - .11 Paint both sides and edges of backboards for telephone and electrical equipment before installation. Leave equipment in original finish except for touch-up as required, and paint conduits, mounting accessories and other unfinished items.

3.5 FIELD QUALITY CONTROL

- .1 Dry film thickness tests:
 - .1 Test for film thickness over entire surface to be painted, minimum one test 2m2 in field areas and one test/600 mm along inside corners including at ceiling to wall juncture.
 - .2 If any test registers below specified thickness, re-apply paint to entire surface to nearest inside and outside corners.
 - .3 If test registers more than 50% above specified thickness, consult with paint manufacturer, determine if problem exists, offer solutions to Consultant, and repair as directed.
 - .4 Re-test employing same criteria after repair.

3.6 RESTORATION

- .1 Clean and re-install all door hardware items removed before undertaken painting operations.
- .2 Remove protective coverings and warning signs as soon as practical after operations cease.
- .3 Remove paint splashings on exposed surfaces that were not painted. Remove smears and spatter immediately as operations progress, using compatible solvent.
- .4 Protect freshly completed surfaces from paint droppings and dust to approval of Consultant. Avoid scuffing newly applied paint.
- .5 Restore areas used for storage, cleaning, mixing and handling of paint to clean condition as approved by Departmental Representative.

3.7 CLEANING

- .1 Remove spilled, splashed, and spattered paint promptly as work proceeds and on completion of work. Clean surfaces soiled by paint spillage and paint spatters. Repair or replace damaged work, as directed by Consultant.

3.8 PROTECTION

- .1 Post Wet Paint signs during drying and restrict or prevent traffic where necessary.
- .2 Post sign, after Consultant's inspection and acceptance of each room, reading: PAINTING COMPLETE - NO ADMITTANCE WITHOUT CONTRACTOR'S PERMISSION.

END OF SECTION

- 1** General
- 1.1** **SECTION INCLUDES**
 - .1 Labour, Products equipment and services necessary for the laboratory fittings Work in accordance with the Contract Documents.
- 1.2** **REFERENCES**
 - .1 ASTM A 666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless-Steel Sheet, Strip, Plate, and Flat Bar; 2000.
 - .2 ASTM D 2240 - Standard Test Method for Rubber Property - Durometer Hardness; 2002.
- 1.3** **SUBMITTALS**
 - .1 Submit in accordance with Section 01 10 10.
 - .1 Product Data: Manufacturer's data sheets on each product to be used, including:
 - .2 Preparation instructions and recommendations.
 - .3 Storage and handling requirements and recommendations.
 - .4 Installation methods.
 - .1 Shop Drawings: Submit shop drawings in accordance with Section 01 10 10 indicating materials, thicknesses, sizes, finishes, profiles, connection attachments, shop jointing, field jointing, reinforcing, anchorage, fastener types and sizes, location of exposed fastenings, mechanical and electrical service routes, service outlets, cutout locations, and sizes. Include erection drawings, plans, elevations, sections, and details as applicable.
- 1.4** **DELIVERY, STORAGE, AND HANDLING**
 - .1 Store products in manufacturer's unopened packaging until ready for installation.
 - .2 Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.
- 1.5** **PROJECT CONDITIONS**
 - .1 Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.
- 1.6** **WARRANTY**
 - .1 Provide a written warranty that all work performed under this section shall be free from defect of materials, finish and workmanship for a period of five (5) years from date of shipment.
 - .2 The warranty of products of another manufacturer, and sold by Inter Dyne Systems Inc, are limited to the warranty extended by that manufacturer to Inter Dyne Systems Inc.
- 2** Products

2.1 **MANUFACTURER**

- .1 Acceptable Manufacturer: Inter Dyne Systems Inc.; 676 Ellis Rd.; Norton Shores, MI 49441. Tel: 231-799-8760. Email: request info (jack@interdynesystems.com). Web: www.interdynesystems.com or approved equivalent.

2.2 **COUNTERTOPS, SCULLERY UNITS AND SHELVING**

- .1 Countertops: 16-gauge (1.59 mm) type 304 or 316 stainless-steel with number 4 finish; one-piece construction where possible; turned down fronts; integral turned up backs to 3/8-inch (9.5 mm) radius; three formed channels placed underneath for support. All without solder. Provide factory punched service fixture holes.
 - .1 Sides: Weld turned up.
 - .2 Sides: Weld turned down.
 - .3 Sides: Weld as indicated on drawings.
 - .4 Include sound deadening compound on underside of countertop.
 - .5 Dimensions: As indicated on drawings.
- .2 Scullery sinks: not less than 14-gauge (1.90 mm) type 304 or 316 stainless steel w a number 4 finish; one piece construction where possible; fabricated with corners rounded and coved to 3/4-inch (.17-mm) . All seams provided are continuous welded butt joints. Sinks sloped to bottom with center punched 3 1/2" (88.9-mm) diameter drain outlet supplied with stainless steel strainer. All seams are polished to a uniform #4 finish free of cross scratches. Sinks to have a heavy duty 1/8 inch (3-mm) thick coating of heat resistant, sound deadening compound applied to under surface. Frame to be 2" 16-gauge wall square stainless-steel tube or 16-gauge wall 1-5/8" dia round tube with heavy duty adjustable bullet feet with 4" aprons and 1-1/2" tube style stretchers fully welded. Supplied with offset style wall clips to secure to wall at
- .3 Shelving: 18-gauge (1.27 mm) type 304 stainless steel with number 4 finish; formed return on bottom, front and side edges. Dimensions: As indicated on drawings.
 - .1 Dimensions: As indicated on drawings.
- .4 Wall Standards and Triangular Brackets: 304 stainless-steel with number 4 finish; brackets have tang on bottom for stability. 14-gauge, with countersunk installation holes on 1" returns. Heavy duty style is 12-gauge with the same dimensions.
 - .1 Standard Length: 2 feet (610 mm).
 - .2 Standard Length: 3 feet (914 mm).
 - .3 Standard Length: 4 feet (1219 mm).
 - .4 Standard Length: 6 feet (1829 mm).
 - .5 Bracket Size: 12 inches (305 mm); left side.
 - .6 Bracket Size: 12 inches (305 mm); right side.
 - .7 Bracket Size: 16 inches (406 mm); left side.
 - .8 Bracket Size: 16 inches (406 mm); right side.

2.3 WALL AND BASE CABINETS

- .1 Stainless steel: Commercial-quality, 304 stainless-steel, complying with ASTM A 366; satin brushed #4 finish; suitable for exposed applications; and stretcher leveled or roller leveled to stretcher-leveled flatness.
- .2 Minimum Stainless-steel Thickness: Provide stainless steel laboratory furniture components of the following minimum thicknesses:
 - .1 Sides, ends, fixed backs, bottoms, tops, soffits, and items not otherwise indicated: 0.0478 inch. Except for flammable liquid storage cabinets, bottoms may be 0.0359 inch if reinforced.
 - .2 Back side panels, doors, drawer fronts and bodies, and shelves: 0.0359 inch. For back panels and doors for flammable storage cabinets, use 0.0478 inch thick stainless steel. For shelves more than 36 inches long, use 0.0478 inch thick stainless steel or provide suitable reinforcement.
 - .3 Intermediate horizontal rails, table aprons and cross rails, center posts, and top gussets: 0.0598 inch.
 - .4 Drawer runners, sink supports, and hinge reinforcements: 0.0747 inch. Leveling and corner gussets: 0.1046 inch.
- .3 General: Complete assembly and finish work at point of manufacture. Perform assembly on precision jigs to provide units which are square; fully reinforced with angles, gussets, and channels; and integrally framed and welded to form a dirt and vermin-retardant enclosure. Where applicable, reinforce base cabinets for sink support. Maintain uniform clearance around door and drawer fronts of 1/16 to 3/32 inch.
- .4 Fabricate units on precision dies for interchangeability of like-size drawers, doors, and similar parts.
- .5 Flush Doors: Outer and inner pans formed and telescoped into box formation, with channel reinforcement full height on center of each pan. Fill doors solid with noncombustible, sound-deadening material.
- .6 Hinged Doors: Reinforce with formed angles on inner pans made with 1 piece of steel.
- .7 Drawers: Assemble fronts from telescoping outer pans, designed to eliminate raw edge of steel at top. Fabricate sides, back, and bottom of one piece with rolled or formed top of sides for stiffening and comfortable grasp for drawer removal.
- .8 Adjustable Shelves: Front, back, and ends formed down with returned lip at front and back.
- .9 Toe Space: Provide stainless steel toe space, fully enclosed, 4 inches high by 3 inches deep, with no open gaps or pockets.
- .10 Table Legs: Not less than 2-inch square, electrically welded tubing. Provide leg stretchers where necessary to comply with structural performance requirements. Weld or bolt leg stretchers to legs and cross-stretchers. Securely bolt legs to table aprons. Provide leveling device welded to bottom of each leg.
- .11 Leg Shoes: Vinyl or rubber, black, open-bottom type.

- .12 Utilities: Provide space, cutouts, and holes for pipes, conduits, and fitting in cabinet bodies to accommodate utility services and their support-strut assemblies.
- .13 Filler Strips: Provide as needed to close space between cabinets and walls, ceilings, and indicated equipment. Fabricate from the same material and with the same finish as cabinets.

2.4 CASEWORK HARDWARE

- .1 Hardware, General: Provide manufacturer's standard satin-finish, commercial quality, heavy-duty complying with requirements indicated for each type.
- .2 Hinges: Stainless-steel, 5-knuckle hinges complying with BHMA 156.9, Grade 1, with antifriction bearings and rounded tips. Provide 2 for doors less than 48 inches high and 3 for doors more than 48 inches high.
- .3 Pulls: Stainless-steel, fastened from back with 2 screws. For sliding doors, provide plastic, or aluminum flush pulls. Provide 2 pulls for drawers more than 24 inches wide. Recessed pulls available in gray polypropylene.
- .4 Door Catches: Nylon-roller spring catch or dual, self-aligning, permanent magnet catch. Provide 2 catches on doors more than 48 inches high.
- .5 Drawer Guides: Stainless-steel Full Extension Ball Bearing Drawer Slide complying with ANSI/BIFMA X5.5-2008, ANSI/KCMA a 161.1-2006, ANSI-BHMA a 156.9-2010, NSF/ANSI 2 Food Equipment, SEFA-8-2007, WI.
- .6 Label Holders: Stainless-steel or chrome-plated, sized to receive standard label cards approximately 1 by 2 inches, attached with screws or rivets.
 - .1 Provide on all drawers
- .7 Drawer and Cupboard Locks: Cylindrical type, with cam, cylinder exposed, chrome-plated finish, complying with BHMA A156.11, Grade 1.
 - .1 Provide minimum of 2 keys per lock.
 - .2 Provide on all drawers and doors.

2.5 PERFORMANCE REQUIREMENTS

- .1 Structural Performance: Provide stainless steel laboratory casework capable of withstanding the following loads without permanent deformation, excessive deflection, or binding of drawers and doors.
 - .1 Shelves of Base, Wall, and Storage Cabinets: 200 lbs.
 - .2 Drawers: 150 lbs.
 - .3 Wall Cabinets: 150lbs/ft.
 - .4 Floor-Supported Base Cabinets: 100-lbs/ft/ within cabinets, 75-lbs/ft. countertop.

3 Execution

3.1 EXAMINATION

- .1 Do not begin installation until substrates have been properly prepared.

- .2 If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding

3.2 PREPARATION

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

3.3 INSTALLATION

- .1 Install in accordance with manufacturer's instructions.

3.4 PROTECTION

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

END OF SECTION

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Appendix ME1 - Sheridan College Infrastructure Guidelines
Appendix ME2 - Sheridan College BAS Design Standard

Section 22 05 00

Common Work Results for Mechanical

Part 1 General

1.1 Action and informational submittals

1. Submit in accordance with Section 01 33 00 - Submittal Procedures.
2. Product Data:
 - 2.1. Submit manufacturer's instructions, printed product literature and data sheets for equipment, components and include product characteristics, performance criteria, physical size, finish and limitations.
3. Shop Drawings:
 - 3.1. Indicate on drawings:
 - 3.1.1. Mounting arrangements.
 - 3.1.2. Operating and maintenance clearances.
 - 3.2. Shop drawings and product data accompanied by:
 - 3.2.1. Detailed drawings of bases, supports, and anchor bolts.
 - 3.2.2. Acoustical sound power data, where applicable.
 - 3.2.3. Points of operation on performance curves.
 - 3.2.4. Manufacturer to certify current model production.
 - 3.2.5. Certification of compliance to applicable codes.
 - 3.3. In addition to transmittal letter referred to in Section 01 33 00 - Submittal Procedures: use MCAC "Shop Drawing Submittal Title Sheet". Identify section and paragraph number.

1.2 Closeout submittals

1. Submit in accordance with Section 01 78 00 - Closeout Submittals.
2. Operation and Maintenance Data: submit operation and maintenance data sheets for incorporation into manual.
 - 2.1. Operation data to include:
 - 2.1.1. Control schematics for systems including environmental controls.
 - 2.1.2. Description of systems and their controls.
 - 2.1.3. Description of operation of systems at various loads together with reset schedules and seasonal variances.
 - 2.1.4. Operation instruction for systems and component.
 - 2.1.5. Description of actions to be taken in event of equipment failure.
 - 2.1.6. Valves schedule and flow diagram.
 - 2.1.7. Colour coding chart.
 - 2.2. Maintenance data to include:
 - 2.2.1. Servicing, maintenance, operation and trouble-shooting instructions for each item of equipment.

- 2.2.2. Data to include schedules of tasks, frequency, tools required and task time.
- 2.3. Performance data to include:
 - 2.3.1. Equipment manufacturer's performance datasheets with point of operation as left after commissioning is complete.
 - 2.3.2. Equipment performance verification test results.
 - 2.3.3. Special performance data as specified.
 - 2.3.4. Testing, adjusting and balancing reports as specified in Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.
- 2.4. Additional data:
 - 2.4.1. Prepare and insert into operation and maintenance manual additional data when need for it becomes apparent during specified demonstrations and instructions.
- 2.5. Site records:
 - 2.5.1. Consultant will provide 1 set of reproducible mechanical drawings. Provide sets of white prints as required for each phase of work. Mark changes as work progresses and as changes occur. Include changes to existing mechanical systems, control systems and low voltage control wiring.
 - 2.5.2. Transfer information weekly to reproducibles, revising reproducibles to show work as actually installed.
 - 2.5.3. Use different colour waterproof ink for each service.
 - 2.5.4. Make available for reference purposes and inspection.
- 2.6. As-built drawings:
 - 2.6.1. Prior to start of Testing, Adjusting and Balancing for HVAC, finalize production of as-built drawings.
 - 2.6.2. Identify each drawing in lower right hand corner in letters at least 12 mm high as follows: - "AS BUILT DRAWINGS: THIS DRAWING HAS BEEN REVISED TO SHOW MECHANICAL SYSTEMS AS INSTALLED" (Signature of Contractor) (Date).
 - 2.6.3. Submit to Consultant for approval and make corrections as directed.
 - 2.6.4. Perform testing, adjusting and balancing for HVAC using as-built drawings.
 - 2.6.5. Submit completed reproducible as-built drawings with Operating and Maintenance Manuals.
- 2.7. Submit copies of as-built drawings for inclusion in final TAB report.

Part 2 Products

2.1 Not used

- 1. Not used.

Part 3 Execution

3.1 Examination

- 1. Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for mechanical installation in accordance with manufacturer's written instructions.
 - 1.1. Visually inspect substrate in presence of Consultant.
 - 1.2. Inform Consultant of unacceptable conditions immediately upon discovery.

- 1.3. Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Consultant.

3.2 Painting repairs and restoration

1. Do painting in accordance with Section 09 91 23 - Interior Painting.
2. Prime and touch up marred finished paintwork to match original.
3. Restore to new condition, finishes which have been damaged.

3.3 System cleaning

1. Clean interior and exterior of all systems including strainers. Vacuum interior of ductwork and air handling units.

3.4 Field quality control

1. Manufacturer's Field Services:
 - 1.1. Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS.
 - 1.2. Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

3.5 Demonstration

1. Supply tools, equipment and personnel to demonstrate and instruct operating and maintenance personnel in operating, controlling, adjusting, trouble-shooting and servicing of all systems and equipment during regular work hours, prior to acceptance.
2. Use operation and maintenance manual, as-built drawings, and audio visual aids as part of instruction materials.
3. Instruction duration time requirements as specified in appropriate sections.

3.6 Cleaning

1. Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning.
 - 1.1. Leave Work area clean at end of each day.
2. Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.

3.7 Protection

1. Protect equipment and systems openings from dirt, dust, and other foreign materials with materials appropriate to system.

3.8 Mounting

1. For all wall or ceiling mounted equipment or components weighting more than 30 kg, provide mounting design from professional engineer licensed to practice in Ontario. Submit sealed design documents prior to commencing installation.

End of Section

Section 22 10 00

Plumbing Piping

Part 1 General

1.1 Section includes

1. Pipe, pipe fittings, valves, and connections for piping systems sanitary sewer, domestic water..

1.2 Related requirements

1. Section 08 31 13 - Access Doors and Frames.
2. Section 09 91 00 - Painting.
3. Section 23 05 48 - Vibration Isolation.
4. Section 23 05 53 - Mechanical Identification.
5. Section 23 07 19 - Piping Insulation.
6. Section 26 05 83 - Equipment Wiring: Electrical characteristics and wiring connections.

1.3 Reference standards

1. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings.
2. ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
3. ASME B16.23 - Cast Copper Alloy Solder Joint Drainage Fittings - DWV.
4. ASME B16.26 - Cast Copper Alloy Fittings for Flared Copper Tubes.
5. ASME B16.29 - Wrought Copper And Wrought Copper Alloy Solder Joint Drainage Fittings - DWV.
6. ASME B16.50 - Wrought Copper and Copper Alloy Braze-Joint Pressure Fittings.
7. ASME B31.1/B31.3 - Power Piping and Process Piping (Set).
8. ASME B31.2 - Fuel Gas Piping.
9. ASME B31.9 - Building Services Piping.
10. ASME Boiler and Pressure Vessels Code, Section I - Rules for Construction of Power Boilers.
11. ASME Boiler and Pressure Vessels Code, Section IV - Rules for Construction of Heating Boilers.
12. ASME Boiler and Pressure Vessel Code, Section IX - Welding and Brazing Qualifications.
13. ASTM A53/A53M-22 Standard specification for pipe, steel, black and hot-dipped, zinc-coated, welded and seamless
14. ASTM A74-21 Standard specification for cast iron soil pipe and fittings
15. ASTM A234/A234M-23a Standard specification for piping fittings of wrought carbon steel and alloy steel for moderate and high temperature service
16. ASTM A312/A312M-22a Standard specification for seamless, welded, and heavily cold worked austenitic stainless steel pipes
17. ASTM A774/A774M-14(2019) Standard specification for as-welded wrought austenitic stainless steel fittings for general corrosive service at low and moderate temperatures
18. ASTM B32-20 Standard specification for solder metal

19. ASTM B75/B75M-20 Standard specification for seamless copper tube
20. ASTM B88M-20 Standard specification for seamless copper water tube (metric)
21. ASTM B88-22 Standard specification for seamless copper water tube
22. ASTM B280-23 Standard specification for seamless copper tube for air conditioning and refrigeration field service
23. ASTM B306-20 Standard specification for copper drainage tube (DWV)
24. ASTM B837-19 Standard specification for seamless copper tube for natural gas and liquefied petroleum (LP) gas fuel distribution systems
25. ASTM C14M-20 Standard specification for nonreinforced concrete sewer, storm drain, and culvert pipe (metric)
26. ASTM C14-20 Standard specification for nonreinforced concrete sewer, storm drain, and culvert pipe
27. ASTM C443M-21 Standard specification for joints for concrete pipe and manholes, using rubber gaskets (metric)
28. ASTM C443-21 Standard specification for joints for concrete pipe and manholes, using rubber gaskets
29. ASTM C564-20a Standard specification for rubber gaskets for cast iron soil pipe and fittings
30. ASTM C1053-00(2015) Standard specification for borosilicate glass pipe and fittings for drain, waste, and vent (DWV) applications (Withdrawn 2019)
31. ASTM D2235-22 Standard specification for solvent cement for acrylonitrile-butadiene-styrene (ABS) plastic pipe and fittings
32. ASTM D2241-20 Standard specification for poly(vinyl chloride) (PVC) pressure-rated pipe (SDR series)
33. ASTM D2464-23 Standard specification for threaded poly(vinyl chloride) (PVC) plastic pipe fittings, Schedule 80
34. ASTM D2513-20 Standard specification for polyethylene (PE) gas pressure pipe, tubing, and fittings
35. ASTM D2564-20 Standard specification for solvent cements for poly(vinyl chloride) (PVC) plastic piping systems
36. ASTM D2683-20 Standard specification for socket-type polyethylene fittings for outside diameter-controlled polyethylene pipe and tubing
37. ASTM D3138-21 Standard specification for solvent cements for transition joints between acrylonitrile-butadiene-styrene (ABS) and poly(vinyl chloride) (PVC) non-pressure piping components
38. ASTM E814-23a Standard test method for fire tests of penetration firestop systems
39. ASTM F708-92(2018)e1 Standard practice for design and installation of rigid pipe hangers
40. ASTM F1281-23a Standard specification for crosslinked polyethylene/aluminum/crosslinked polyethylene (PEX-AL-PEX) pressure pipe
41. ASTM G17-07(2020) Standard test method for penetration resistance of pipeline coatings (blunt rod)
42. Specification A5.8M/A5.8:2019 Specification for filler metals for brazing and braze welding
43. AWWA C105/A21.5-18 Polyethylene encasement for ductile-iron pipe systems
44. AWWA C651-14 Disinfecting water mains
45. CSA B70:19 Cast iron soil pipe, fittings, and means of joining
46. CSA B1800:21 Thermoplastic nonpressure piping compendium
47. CAN/ULC-S102.2 - Standard Method of Test for Surface Burning Characteristics of Flooring, Floor Coverings and Miscellaneous Materials and Assemblies.
48. ANSI Z21.22-2015/CSA 4.4:R2020 Relief valves for hot water supply systems
49. STD SP-110-2010 Ball valves threaded, socket-welding, solder joint, grooved and flared ends
50. STD SP-58-2018 Pipe hangers and supports - materials, design, manufacture, selection, application, and installation

51. STD SP-67-2022 Butterfly valves
52. STD SP-70-2011 Gray iron gate valves, flanged and threaded ends
53. STD SP-71-2018 Gray iron swing check valves, flanged and threaded ends
54. STD SP-78-2011 Gray iron plug valves, flanged and threaded ends
55. STD SP-80-2019 Bronze gate, globe, angle, and check valves
56. STD SP-85-2011 Gray iron globe and angle valves, flanged and threaded ends
57. NFPA 54/ANSI Z223.1 - National Fuel Gas Code.
58. NFPA 58 - Liquefied Petroleum Gas Code.
59. UL 1479 - Standard for Fire Tests of Through-Penetration Firestops.

1.4 Action submittals

1. Section 01 33 00: Submission procedures.
2. Product Data: Provide data on pipe materials, pipe fittings, valves, and accessories. Provide manufacturers catalogue information. Indicate valve data and ratings.

1.5 Closeout submittals

1. Section 01 78 00: Submission procedures.
2. Record Documentation: Record actual locations of valves.

1.6 Quality assurance

1. Products of This Section: Manufactured to ISO 9000 certification requirements.
2. Valves: Manufacturer's name and pressure rating marked on valve body.
3. Welding Materials and Procedures: Conform to ASME BPVC.IX.
4. Welder's Certification: To ASME BPVC.IX. Submit proof upon request.

1.7 Delivery, storage, and handling

1. Section 01 61 00: Transport, handle, store, and protect products.
2. Accept valves on site in shipping containers with labelling in place. Inspect for damage.
3. Provide temporary protective coating on cast iron and steel valves.
4. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
5. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

1.8 Site conditions

1. Ambient Conditions: Do not install underground piping when bedding is wet or frozen.

Part 2 Products

2.1 Description

1. Regulatory Requirements:

- 1.1. Perform Work to applicable plumbing code.
- 1.2. Conform to applicable code for installation of backflow prevention devices.
- 1.3. Provide certificate of compliance from authority having jurisdiction indicating approval of installation of backflow prevention devices.

2.2 Sanitary sewer piping, buried, inside building

1. Cast Iron Pipe: CAN/CSA-B70.
 - 1.1. Fittings: Cast iron, FSWW-P-401, hubless cast iron pipe fittings.
 - 1.2. Joints: ASTM C564, rubber or compression gaskets.
2. PVC Pipe: CAN/CSA-B1800, SDR 35 pipe.
 - 2.1. Fittings: ASTM D2468, ABS socket type, Schedule 40.
 - 2.2. Joints: ASTM D2564 solvent cement and primer.
3. Copper Tube: ASTM B306, DWV.
 - 3.1. Fittings: ASME B16.23, cast bronze.
 - 3.2. Joints: ASTM B32, soldered.

2.3 Sanitary sewer piping, above ground

1. Cast Iron Pipe: CAN/CSA-B70.
 - 1.1. Fittings: Hubless Cast Iron Pipe Fittings: FSWW-P-401.
 - 1.2. Joints: ASTM C564, rubber or compression gaskets.
2. Copper Tube: ASTM B306, DWV.
 - 2.1. Fittings: ASME B16.23 cast bronze.
 - 2.2. Joints: Joints: ASTM B32, soldered.

2.4 Domestic water piping, above ground

1. Copper Tubing: ASTM B88M, Type L, H (drawn) temper.
 - 1.1. Fittings: ASME B16.18 cast copper alloy.
 - 1.2. Joints: ASTM B32, soldered.

2.5 Flanges, unions, and couplings

1. Ferrous Pipe Size 75 mm and Under: Class 150 malleable iron threaded unions.
2. Copper Tube and Pipe Size 75 mm and Under: Class 150 bronze unions with soldered joints.
3. Ferrous Pipe Size Over 25 mm: Class 150 malleable iron threaded or forged steel slip-on flanges; preformed neoprene gaskets.
4. Copper Tube and Pipe Size Over 25 mm: Class 150 slip-on bronze flanges; preformed neoprene gaskets.
5. Grooved and Shouldered Pipe End Couplings:
 - 5.1. Housing: Malleable iron clamps to engage and lock, designed to permit some angular deflection, contraction, and expansion; steel bolts, nuts, and washers; galvanized for galvanized pipe.
 - 5.2. Sealing gasket: C-shape composition sealing gasket.

6. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.

2.6 Pipe hangers and supports

1. Plumbing Piping - Drain, Waste, and Vent:
 - 1.1. Conform to ASME B31.9.
 - 1.2. Hangers for Pipe Sizes 13 to 38 mm: Malleable iron, adjustable swivel, split ring.
 - 1.3. Hangers for Pipe Sizes 50 mm and Over: Carbon steel, adjustable, clevis.
 - 1.4. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
 - 1.5. Wall Support for Pipe Sizes to 75 mm: Cast iron hook.
 - 1.6. Wall Support for Pipe Sizes 100 mm and Over: Welded steel bracket and wrought steel clamp.
 - 1.7. Vertical Support: Steel riser clamp.
 - 1.8. Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
 - 1.9. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.
2. Plumbing Piping - Water:
 - 2.1. Conform to ASME B31.9.
 - 2.2. Hangers for Pipe Sizes 13 to 38 mm: Carbon steel, adjustable swivel, split ring.
 - 2.3. Hangers for Cold Pipe Sizes 50 mm and Over: Carbon steel, adjustable, clevis.
 - 2.4. Hangers for Hot Pipe Sizes 50 to 100 mm: Carbon steel, adjustable, clevis.
 - 2.5. Hangers for Hot Pipe Sizes 150 mm and Over: Adjustable steel yoke, cast iron pipe roll, double hanger.
 - 2.6. Multiple or Trapeze Hangers: Steel channels with welded supports or spacers and hanger rods.
 - 2.7. Multiple or Trapeze Hangers for Hot Pipe Sizes 150 mm and Over: Steel channels with welded supports or spacers and hanger rods, cast iron roll.
 - 2.8. Wall Support for Pipe Sizes to 75 mm: Cast iron hook.
 - 2.9. Wall Support for Pipe Sizes 100 mm and Over: Welded steel bracket and wrought steel clamp.
 - 2.10. Wall Support for Hot Pipe Sizes 150 mm and Over: Welded steel bracket and wrought steel clamp with adjustable steel yoke and cast iron pipe roll.
 - 2.11. Vertical Support: Steel riser clamp.
 - 2.12. Floor Support for Cold Pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
 - 2.13. Floor Support for Hot Pipe Sizes to 100 mm: Cast iron adjustable pipe saddle, locknut, nipple, floor flange, and concrete pier or steel support.
 - 2.14. Floor Support for Hot Pipe Sizes 150 mm and Over: Adjustable cast iron pipe roll and stand, steel screws, and concrete pier or steel support.
 - 2.15. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.

2.7 Ball valves

1. Ball Valves 100 mm and Smaller: MSS SP-110, Class 150, 2760 kPa CWP, bronze, two-piece body, chrome plated brass ball, regular port, teflon seats and stuffing box ring, blow-out proof stem, lever handle with balancing stops, solder ends with union, lead free.
 - 1.1. Product: 858/859 Series, manufactured by KITZ.

2.8 Swing check valves

1. Swing Check Valves Up To and Including 50 mm: MSS SP-80, Class 125, bronze body and cap, bronze swing disc with rubber seat, solder ends.
 - 1.1. Product: LFCV, manufactured by WATTS.
2. Swing Check Valves 50 mm and Larger: MSS SP-71, Class 125, iron body, bronze swing disc, renewable disc seal and seat, flanged ends.
 - 2.1. Product: 411, manufactured by WATTS.

2.9 Water pressure reducing valves

1. Water Pressure Reducing Valves Up to 50 mm: MSS SP-80, bronze body, stainless steel and thermoplastic internal parts, fabric reinforced diaphragm, strainer, threaded ends.
 - 1.1. Product: LF123LP, manufactured by WATTS.
2. Water Pressure Reducing Valves Over 50 mm: MSS SP-85, cast iron body, bronze fitted, elastomeric diaphragm and seat disc, flanged.
 - 2.1. Product: LFN223F, manufactured by WATTS.

2.10 Relief valves

1. Pressure Relief Valves: ANSI Z21.22/CSA 4.4, certified, bronze body, teflon seat, steel stem and springs, automatic, direct pressure actuated.
 - 1.1. Product: LF3L, manufactured by WATTS.
2. Temperature and Pressure Relief Valves: ANSI Z21.22/CSA 4.4 certified, bronze body, teflon seat, stainless steel stem and springs, automatic, direct pressure actuated, temperature relief maximum 98.9 degrees C, capacity ASME BPVC.IV certified and labelled.
 - 2.1. Product: LF100XL, manufactured by WATTS.

2.11 Strainers

1. Strainers 50 mm and Under: Class 150 threaded brass body for 1200 kPa CWP, Y pattern with 0.8 mm stainless steel perforated screen.
 - 1.1. Product: LF777, manufactured by WATTS.
2. Strainers 38 mm to 100 mm: Class 125, flanged iron body, Y pattern with 1.6 mm stainless steel perforated screen.
 - 2.1. Product: 77F-DI 125, manufactured by WATTS.
3. Strainers 125 mm and Larger: Class 125, flanged iron body, basket pattern with 3.2 mm stainless steel perforated screen.
 - 3.1. Product: 97FB-CI, manufactured by WATTS.

2.12 Fire stop systems

1. General Purpose Fire Stopping Sealant: Water based, nonslumping, premixed sealant with intumescent properties, rated for 3 hours to ASTM E814.
2. General Purpose Vibration Resistant Fire Stopping Sealant: Silicone based, nonslumping, premixed sealant with intumescent properties, vibration and moisture resistant, rated for three (3) hours per ASTM E814.
3. DWV Plastic Pipe Systems Fire Stopping Sealant: Silicone based, premixed sealant with intumescent properties, vibration and moisture resistant, rated for three (3) hours per ASTM E814 with metal collars.

Part 3 Execution

3.1 Examination

1. Section : Verify existing conditions before starting work.
2. Verify that excavations are to required grade, dry, and not over-excavated.

3.2 Preparation

1. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
2. Remove scale and dirt, on inside and outside, before assembly.
3. Prepare piping connections to equipment with flanges or unions.

3.3 Installation

1. Install to manufacturer's written instructions.
2. Provide non-conducting dielectric connections wherever jointing dissimilar metals.
3. Route piping in orderly manner and maintain gradient. Route parallel and perpendicular to walls.
4. Install piping to maintain headroom, conserve space, and not interfere with use of space.
5. Group piping whenever practical at common elevations.
6. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment. Refer to Section 23 05 16.
7. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings. Refer to Section 23 07 19.
8. Provide access where valves and fittings are not exposed. Coordinate size and location of access doors with Section 08 31 13.
9. Install vent piping penetrating roofed areas to maintain integrity of roof assembly.
10. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.
11. Provide support for utility meters to requirements of utility companies.
12. Prepare exposed, unfinished pipe, fittings, supports, and accessories ready for finish painting. Refer to Section 09 91 00.
13. Install bell and spigot pipe with bell end upstream.
14. Install valves with stems upright or horizontal, not inverted.
15. Pipe vents from gas pressure reducing valves to outdoors and terminate in weather proof hood.

16. Install water piping to ASME B31.9.
17. Sleeve pipes passing through partitions, walls and floors.
18. Inserts:
 - 18.1. Provide inserts for placement in concrete formwork.
 - 18.2. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
 - 18.3. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 100 mm.
 - 18.4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
 - 18.5. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut flush with top of slab.
19. Pipe Hangers and Supports:
 - 19.1. Install to ASME B31.9.
 - 19.2. Support horizontal piping as scheduled.
 - 19.3. Install hangers to provide minimum 15 mm space between finished covering and adjacent work.
 - 19.4. Place hangers within 300 mm of each horizontal elbow.
 - 19.5. Use hangers with 40 mm minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
 - 19.6. Support vertical piping at every other floor. Support riser piping independently of connected horizontal piping.
 - 19.7. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
 - 19.8. Provide copper plated hangers and supports for copper piping.
 - 19.9. Prime coat exposed steel hangers and supports. Refer to Section 09 91 00. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.
 - 19.10. Provide hangers adjacent to motor driven equipment with vibration isolation; refer to Section 23 05 48.
 - 19.11. Support cast iron drainage piping at every joint.

3.4 Application

1. Use grooved mechanical couplings and fasteners only in accessible locations.
2. Install unions downstream of valves and at equipment or apparatus connections.
3. Install brass male adapters each side of valves in copper piped system. Solder adapters to pipe.
4. Install ball valves for shut-off and to isolate equipment, part of systems, or vertical risers.
5. Install globe valves for throttling, bypass, or manual flow control services.
6. Provide lug end butterfly valves adjacent to equipment when provided to isolate equipment.
7. Provide spring loaded check valves on discharge of water pumps.
8. Provide plug valves in natural gas systems for shut-off service.
9. Provide flow controls in water recirculating systems where indicated.

3.5 Erection tolerances

1. Section 01 73 00: Tolerances.
2. Establish invert elevations, slopes for drainage to 1% minimum. Maintain gradients.
3. Slope water piping minimum 0.25% and arrange to drain at low points.

3.6 Disinfection of domestic water piping system

1. Disinfect water distribution system to Section 22 01 10.51.
2. Prior to starting work, verify system is complete, flushed and clean.
3. Ensure Ph of water to be treated is between 7.4 and 7.6 by adding alkali (caustic soda or soda ash) or acid (hydrochloric).
4. Inject disinfectant, free chlorine in liquid, powder, tablet or gas form, throughout system to obtain 50 to 80 mg/L residual.
5. Bleed water from outlets to ensure distribution and test for disinfectant residual at minimum 15% of outlets.
6. Maintain disinfectant in system for twenty-four (24) hours.
7. If final disinfectant residual tests less than 25 mg/L, repeat treatment.
8. Flush disinfectant from system until residual equal to that of incoming water or 1.0 mg/L.
9. Take samples no sooner than twenty-four (24) hours after flushing, from 2% of outlets and from water entry, and analyze to AWWA C651.

3.7 Service connections

1. Provide new sanitary sewer services. Before commencing work check invert elevations required for sewer connections, confirm inverts and ensure that these can be properly connected with slope for drainage and cover to avoid freezing.
2. Provide water service complete with approved backflow preventers and pressure reducing valve with bypass.
 - 2.1. Provide sleeve in wall for service main and support at wall with reinforced concrete bridge. Caulk enlarged sleeve and make watertight with pliable material. Anchor service main inside to concrete wall.
 - 2.2. Provide 1.2 mm galvanized sheet metal sleeve around service main to 150 mm above floor and 1800 mm minimum below grade. Size for minimum of 50 mm of loose batt insulation stuffing.

End of Section

Section 22 11 19

Domestic Water Piping Specialties

Part 1 General

1.1 Section includes

1. Cleanouts.
2. Hose bibs.
3. Backflow preventers.
4. Water hammer arrestors.
5. Thermostatic mixing valves.
6. Trap Seal Primers

1.2 Related requirements

1. Section 22 10 00 - Plumbing Piping.
2. Section 22 42 00 - Plumbing Fixtures.
3. Section 22 47 00 - Plumbing Equipment.
4. Section 26 05 83 - Equipment Wiring: Electrical characteristics and wiring connections.

1.3 Reference standards

1. ASTM C478/C478M-22 Standard specification for circular precast reinforced concrete manhole sections
2. AWWA C510-17 Double check-valve backflow prevention assembly
3. AWWA C511-17 Reduced-pressure principle backflow prevention assembly
4. ASSE 1011:2023 Performance requirements for hose connection vacuum breakers
5. ASSE 1012:2021 Backflow preventers with an intermediate atmospheric vent
6. ASSE 1013:2021 Performance requirements for backflow preventer with intermediate atmospheric vent
7. ASSE 1019:2011 Performance requirements for wall hydrant with backflow protection and freeze resistance
8. PDI Standard G101-2017 Testing and rating procedure for hydro mechanical grease interceptors with appendix of installation and maintenance
9. PDI Standard WH201-2017 Water hammer arresters

1.4 Action submittals

1. Section 01 33 00: Submission procedures.
2. Product Data: Provide component sizes, rough-in requirements, service sizes, and finishes.
3. Shop Drawings: Indicate dimensions, weights, and placement of openings and holes.

1.5 Informational submittals

1. Section 01 33 00: Submission procedures.

2. Certificates: Certify that grease interceptors meet or exceed specified requirements.
3. Installation Data: Manufacturer's special installation requirements including assembly and support requirements.

1.6 Closeout submittals

1. Section 01 78 00: Submission procedures.
2. Operation Data: Indicate frequency of treatment required for interceptors.
3. Maintenance Data: Include installation instructions, spare parts lists, exploded assembly views.

1.7 Quality assurance

1. Products of This Section: Manufactured to ISO 14000 certification requirements.
2. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three (3) years documented experience. Submit proof upon request.

1.8 Delivery, storage, and handling

1. Section 01 61 00: Transport, handle, store, and protect products.
2. Accept specialties on site in original factory packaging. Inspect for damage.

Part 2 Products

2.1 Cleanouts

1. Exterior Surfaced Areas (CO-1): Round cast nickel bronze access frame and non-skid cover.
2. Exterior Unsurfaced Areas (CO-2): Line type with lacquered cast iron body and round epoxy coated gasketed cover.
3. Interior Finished Floor Areas (CO-3): Galvanized cast iron body with anchor flange, reversible clamping collar threaded top assembly, and round gasketed scored cover in service areas and round gasketed depressed cover to accept floor finish in finished floor areas.
4. Interior Finished Wall Areas (CO-4): Line type with lacquered cast iron body and round epoxy coated gasketed cover, and round stainless steel access cover secured with machine screw.
5. Interior Unfinished Accessible Areas (CO-5): Caulked or threaded type with bolted stack cleanouts on vertical rainwater leaders.

2.2 Hose bibs

1. Interior: Bronze or brass with integral mounting flange, replaceable hexagonal disc, hose thread spout, handwheel, chrome plated where exposed and integral vacuum breaker to ASSE 1011.
 - 1.1. Manufacturers:
 - 1.1.1. SC8; Product: WATTS.

2.3 Backflow preventers

1. Reduced Pressure Backflow Preventers: ASSE 1013, bronze body with bronze internal parts and stainless steel springs, two (2) independently operating, spring loaded check valves and diaphragm type differential pressure relief valve located between check valves; third check valve that opens under back pressure in case of diaphragm failure.
 - 1.1. Non-threaded vent outlet.

- 1.2. Assembled with two (2) gate valves, strainer, and four test cocks.
- 1.3. 50mm and smaller: Series 009, manufactured by WATTS.
- 1.4. Above 50mm: Series LF909, manufactured by WATTS.

2.4 Water hammer arrestors

- 1. Copper construction with piston type sized to PDI WH-201 and pre-charged suitable for operation in temperature range -73 to 149 degrees C and maximum 1700 kPa working pressure.

2.5 Trap seal primers

- 1. Supply type, pressure activated.
 - 1.1. Manufacturers
 - 1.1.1. Jay R. Smith Mfg. Co.
 - MIFAB, Inc.
 - Precision Plumbing Products.

2.6 Thermostatic mixing valves

- 1. Chrome plated cast brass body, stainless steel or copper alloy bellows, integral temperature adjustment, check valve on inlets, volume control shut-off valve on outlet, stem thermometer on outlet and strainer stop checks on inlets.
 - 1.1. Cabinet: 1.5 mm, prime coated, for recessed mounting with keyed lock.

Part 3 Execution

3.1 Installation

- 1. Install to manufacturer's written instructions.
- 2. Extend cleanouts to finished floor or wall surface. Lubricate threaded cleanout plugs with mixture of graphite and linseed oil. Ensure clearance at cleanout for rodding of drainage system.
- 3. Encase exterior cleanouts in concrete flush with grade.
- 4. Install floor cleanouts at elevation to accommodate finished floor.
- 5. Install approved potable water protection devices on plumbing lines where contamination of domestic water may occur; on boiler feed water lines, janitor rooms, fire sprinkler systems, premise isolation, irrigation systems, flush valves, interior and exterior hose bibs.
- 6. Pipe relief from backflow preventer to nearest drain.
- 7. Install water hammer arrestors complete with accessible isolation valve on hot and cold water supply piping to sinks, washing machine outlets.
- 8. Install air chambers on hot and cold water supply piping to each fixture or group of fixtures (each washroom). Fabricate same size as supply pipe or 20 mm minimum, and minimum 450 mm long.

End of Section

Section 22 42 00

Commercial Plumbing Fixtures

Part 1 General

1.1 Section includes

1. Lavatories.
2. Sinks.
3. Service sinks.
4. Eye wash fountains.

1.2 Related requirements

1. Section 07 92 00 - Joint Sealants: Seal fixtures to walls and floors.
2. Section 23 05 29 - Supports And Anchors.
3. Section 22 10 00 - Plumbing Piping.
4. Section 22 11 19 - Plumbing Specialties.
5. Section 22 47 00 - Plumbing Equipment.
6. Section 26 05 83 - Equipment Wiring: Electrical characteristics and wiring connections.

1.3 Reference standards

1. ASME A112.6.1M - Floor Affixed Supports for Off-the-Floor Plumbing Fixtures for Public Use.
2. ASME A112.18.1-2012/CSA-B125.1-12 - Plumbing Supply Fittings.
3. ASME A112.19.1/CSA B45.2 - Enamelled Cast Iron and Enamelled Steel Plumbing Fixtures.
4. ASME A112.19.2/CSA-B45.1 - Ceramic Plumbing Fixtures. Includes Errata 10/2018.
5. ASME A112.19.3/CSA-B45.4 - Stainless Steel Plumbing Fixtures.
6. ASME A112.19.5-2017/CSA-B45.15-2017 - Flush Valves and Spuds for Water Closets, Urinals, and Tanks.
7. STD Z124-2022 Plastic plumbing fixtures
8. ANSI/ISEA Z358.1-2014 American national standard for emergency eyewash and shower equipment
9. NFPA 70 - National Electrical Code (NEC).
10. CSA (Canadian Standards Association).
11. UL (Underwriters Laboratories Inc.).

1.4 Action submittals

1. Section 01 33 00: Submission procedures.
2. Product Data: Provide catalogue illustrations of fixtures, sizes, rough-in dimensions, trim, utility sizes, finishes.

1.5 Informational submittals

1. Section 01 33 00: Submission procedures.

2. Manufacturer's Instructions: Indicate installation methods and procedures.

1.6 Closeout submittals

1. Section 01 78 00: Submission procedures.
2. Maintenance Data: Include fixture trim exploded view and replacement parts lists.
3. Warranty Documentation: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.7 Delivery, storage, and handling

1. Section 01 61 00: Transport, handle, store, and protect products.
2. Accept fixtures on site in factory packaging. Inspect for damage.
3. Protect installed fixtures from damage by securing areas and by leaving factory packaging in place to protect fixtures and prevent use.

Part 2 Products

2.1 Description

1. Regulatory Requirements:
 - 1.1. Products Requiring Electrical Connection: Listed and classified by CSA as suitable for the purpose specified and indicated.

Part 3 Execution

3.1 Examination

1. Section 01 71 00: Verify existing conditions before starting work.
2. Verify that walls and floor finishes are prepared and ready for installation of fixtures.
3. Verify that electric power is available and of the correct characteristics.
4. Confirm that millwork is constructed with adequate provision for the installation of counter top lavatories and sinks.

3.2 Preparation

1. Rough-in fixture piping connections to minimum sizes indicated in fixture rough-in schedule for particular fixtures.

3.3 Installation

1. Install to manufacturer's written instructions.
2. Install each fixture with trap, easily removable for servicing and cleaning.
3. Provide chrome plated rigid or flexible supplies to fixtures with loose key stops, reducers, and escutcheons.
4. Install components level and plumb.
5. Install and secure fixtures in place with wall supports and bolt, washer, nut fasteners.
6. Seal fixtures to wall and floor surfaces with sealant as specified in Section 07 92 00, colour to match fixture.
7. Solidly attach water closets to floor with lag screws. Lead flashing is not intended hold fixture in place.

3.4 Interface with other products

1. Review millwork shop drawings. Confirm location and size of fixtures and openings before rough-in and installation.

3.5 Adjusting

1. Adjust stops or valves for intended water flow rate to fixtures without splashing, noise, or overflow.

3.6 Cleaning

1. Section 01 74 10: Cleaning installed work.
2. Clean plumbing fixtures and equipment.

3.7 Protection

1. Section 01 78 23: Protecting installed work.
2. Do not permit use of fixtures.

End of Section

Section 23 05 13

Common Motor Requirements for HVAC Equipment

Part 1 General

1.1 Section includes

1. Single phase electric motors.
2. Three-phase electric motors.

1.2 Related requirements

1. Section 26 05 83 - Equipment Wiring: Electrical characteristics and wiring connections.

1.3 Reference standards

1. STD 9:2015 Load ratings and fatigue life for ball bearings
2. STD 11:2014 Load ratings and fatigue life for roller bearings
3. STD C22.2 NO. 100-14 Motors and generators
4. STD 112-2017 IEEE Standard test procedure for polyphase induction motors and generators
5. NEMA MG 1-2016 Motors and generators

1.4 Action submittals

1. Section 01 33 00: Submission procedures.
2. Product Data: Provide wiring diagrams with electrical characteristics and connection requirements.

1.5 Informational submittals

1. Section 01 33 00: Submission procedures.
2. Test Reports: Indicate test results verifying nominal efficiency and power factor for three-phase motors larger than 0.38 kW.
3. Certificate: Provide certificate of compliance from authority having jurisdiction indicating approval of high efficiency motors.
4. Installation Data: Indicate setting, mechanical connections, lubrication, and wiring instructions.

1.6 Closeout submittals

1. Section 01 78 00: Submission procedures.
2. Operation Data: Include instructions for safe operating procedures.
3. Maintenance Data: Include assembly drawings, bearing data including replacement sizes, and lubrication instructions.

1.7 Quality assurance

1. Products of This Section: Manufactured to ISO 9000 certification requirements.

2. Manufacturer: Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three (3) years documented product development, testing, and manufacturing experience. Submit proof upon request.

1.8 Delivery, storage, and handling

1. Section 01 61 00: Transport, handle, store, and protect products.
2. Protect motors stored on site from weather and moisture by maintaining factory covers and suitable weather-proof covering. For extended outdoor storage, remove motors from equipment and store separately.

Part 2 Products

2.1 Description

1. Regulatory Requirements:
 - 1.1. Conform to applicable code for energy efficiency.
 - 1.2. Products Requiring Electrical Connection: Listed and classified by CSA as suitable for the purpose specified and indicated.

2.2 General construction and requirements

1. Motors Less Than 250 Watts, for Intermittent Service: Equipment manufacturer's standard and need not conform to these specifications.
2. Electrical Service:
 - 2.1. Refer to Section 26 05 83 for required electrical characteristics.
3. Motor Type:
 - 3.1. Open drip-proof except where specifically noted otherwise.
 - 3.2. Design motors for continuous operation in 40 degrees C environment.
 - 3.3. Design for temperature rise to CSA-C22.2 No. 100 limits for insulation class, service factor, and motor enclosure type.
 - 3.4. Motors with frame sizes 254T and larger: Energy Efficient Type.
4. Explosion-Proof Motors: CSA approved and labelled for hazard classification, with over temperature protection.
5. Visible Nameplate: Indicating motor horsepower, voltage, phase, cycles, RPM, full load amps, locked rotor amps, frame size, manufacturer's name and model number, service factor, power factor, efficiency.
6. Wiring Terminations:
 - 6.1. Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized to code, threaded for conduit.
 - 6.2. For fractional horsepower motors where connection is made directly, provide threaded conduit connection in end frame.

Part 3 Execution

3.1 Installation

1. Install to manufacturer's written instructions.

2. Install securely on firm foundation. Mount ball bearing motors with shaft in any position.
3. Check line voltage and phase and ensure agreement with nameplate.

End of Section

Section 23 05 29

Hangers and Supports for Piping and Equipment

Part 1 General

1.1 Section includes

1. Pipe and equipment hangers and supports.
2. Equipment bases and supports.
3. Sleeves and seals.
4. Flashing and sealing equipment and pipe stacks.

1.2 Related requirements

1. Section 03 30 00 - Cast-in-place Concrete: Equipment bases.
2. Section 07 84 00 - Firestopping: Joint seals for piping and duct penetration of fire rated assemblies.
3. Section 09 91 00 - Painting.
4. Section 23 07 19 - Piping Insulation.
5. Section 22 10 00 - Plumbing Piping.
6. Section 23 21 00 - Hydronic Piping.
7. Section 23 23 00 - Refrigerant Piping And Specialties.

1.3 Reference standards

1. ASME B31.1-2014/B31.3-2016 - Power Piping and Process Piping (Set).
2. ASME B31.2-1968 (Not Active) - Fuel Gas Piping.
3. ASME B31.5-2019 - Refrigeration Piping and Heat Transfer Components.
4. ASME B31.9-2020 - Building Services Piping.
5. ASTM F708-92(2018)e1 Standard practice for design and installation of rigid pipe hangers
6. STD SP-58-2018 Pipe hangers and supports - materials, design, manufacture, selection, application, and installation
7. NFPA 13 - Standard for the Installation of Sprinkler Systems, 2022 Edition.
8. NFPA 14 - Standard for the Installation of Standpipe and Hose Systems, 2019 Edition.
9. UL 203-2020 - UL Standard for Safety Pipe Hanger Equipment for Fire Protection Service (11th Edition).

1.4 Action submittals

1. Section 01 33 00: Submission procedures.
2. Product Data: Provide manufacturers catalogue data including load capacity.
3. Shop Drawings: Indicate system layout with location and detail of trapeze hangers.

1.5 Informational submittals

1. Section 01 33 00: Submission procedures.

2. Design Data: Indicate load carrying capacity of trapeze, multiple pipe, and riser support hangers.
3. Installation Data: Indicate special installation procedures and assembly of components.

Part 2 Products

2.1 Description

1. Regulatory Requirements:
 - 1.1. Conform to applicable code for support of hydronic piping.
 - 1.2. Supports for Sprinkler Piping: To NFPA 13.
 - 1.3. Supports for Standpipes: To NFPA 14.

2.2 Pipe hangers and supports

1. Hydronic Piping:
 - 1.1. Conform to ASME B31.9.
 - 1.2. Hangers for Pipe Sizes 13 to 38 mm: Malleable iron, adjustable swivel, split ring.
 - 1.3. Hangers for Cold Pipe Sizes 50 mm and Over: Carbon steel, adjustable, clevis.
 - 1.4. Hangers for Hot Pipe Sizes 50 to 100 mm: Carbon steel, adjustable, clevis.
 - 1.5. Hangers for Hot Pipe Sizes 150 mm and Over: Adjustable steel yoke, cast iron roll, double hanger.
 - 1.6. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
 - 1.7. Multiple or Trapeze Hangers for Hot Pipe Sizes 150 mm and Over: Steel channels with welded spacers and hanger rods, cast iron roll.
 - 1.8. Wall Support for Pipe Sizes to 76 mm: Cast iron hook.
 - 1.9. Wall Support for Pipe Sizes 100 mm and Over: Welded steel bracket and wrought steel clamp.
 - 1.10. Wall Support for Hot Pipe Sizes 150 mm and Over: Welded steel bracket and wrought steel clamp with adjustable steel yoke and cast iron roll.
 - 1.11. Vertical Support: Steel riser clamp.
 - 1.12. Floor Support for Cold Pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
 - 1.13. Floor Support for Hot Pipe Sizes to 100 mm: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
 - 1.14. Floor Support for Hot Pipe Sizes 150 mm and Over: Adjustable cast iron roll and stand, steel screws, and concrete pier or steel support.
 - 1.15. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.
2. Refrigerant Piping:
 - 2.1. Conform to ASME B31.5.
 - 2.2. Hangers for Pipe Sizes 13 to 38 mm: Malleable iron adjustable swivel, split ring.
 - 2.3. Hangers for Pipe Sizes 50 mm and Over: Carbon steel, adjustable, clevis.
 - 2.4. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
 - 2.5. Wall Support for Pipe Sizes to 75 mm: Cast iron hook.

- 2.6. Wall Support for Pipe Sizes 100 mm and Over: Welded steel bracket and wrought steel clamp.
- 2.7. Vertical Support: Steel riser clamp.
- 2.8. Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
- 2.9. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.

2.3 Accessories

- 1. Hanger Rods: Mild steel threaded both ends, threaded one end, or continuous threaded.

2.4 Inserts

- 1. Inserts: Malleable iron case of galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.

2.5 Flashing

- 1. Metal Flashing: 0.50 mm galvanized steel.
- 2. Metal Counterflashing: 0.80 mm galvanized steel.
- 3. Lead Flashing:
 - 3.1. Waterproofing: 24.5 kg/sq m sheet lead.
 - 3.2. Soundproofing: 5 kg/sq m sheet lead.
- 4. Flexible Flashing: 1.2 mm thick sheet butyl; compatible with roofing.
- 5. Caps: Steel, 0.8 mm minimum; 1.5 mm at fire resistant elements.

2.6 Sleeves

- 1. Sleeves for Pipes Through Non-fire Rated Floors: 1.2 mm thick galvanized steel.
- 2. Sleeves for Pipes Through Non-fire Rated Beams, Walls, Footings, and Potentially Wet Floors: Steel pipe or 1.2 mm thick galvanized steel.
- 3. Sleeves for Pipes Through Fire Rated and Fire Resistive Floors and Walls, and Fire Proofing: Prefabricated fire rated sleeves including seals, UL listed, refer to Section 07 84 00.
- 4. Sleeves for Round Ductwork: Galvanized steel.
- 5. Sleeves for Rectangular Ductwork: Galvanized steel or wood.
- 6. Firestopping and stuffing Insulation: Glass fibre type, non-combustible; refer to Section 07 84 00.
- 7. Sealant: Acrylic, refer to Section 07 92 00.

Part 3 Execution

3.1 Installation

- 1. Install components to manufacturer's written instructions.

3.2 Inserts

- 1. Provide inserts for placement in concrete formwork.
- 2. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.

3. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 100 mm.
4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
5. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut recessed into and grouted flush with slab.

3.3 Pipe hangers and supports

1. Support horizontal piping as scheduled.
2. Install hangers to provide minimum 13 mm space between finished covering and adjacent work.
3. Place hangers within 300 mm of each horizontal elbow.
4. Use hangers with 38 mm minimum vertical adjustment.
5. Support horizontal cast iron pipe adjacent to each hub, with 1.5 m maximum spacing between hangers.
6. Support vertical piping at every other floor. Support vertical cast iron pipe at each floor at hub.
7. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
8. Support riser piping independently of connected horizontal piping.
9. Provide copper plated hangers and supports for copper piping.
10. Design hangers for pipe movement without disengagement of supported pipe.
11. Prime coat exposed steel hangers and supports as specified in Section 09 91 00. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.

3.4 Equipment bases and supports

1. Provide housekeeping pads of concrete, minimum 100 mm thick and extending 150 mm beyond supported equipment. Refer to Section 03 30 00.
2. Provide templates, anchor bolts, and accessories for mounting and anchoring equipment.
3. Construct supports of steel members. Brace and fasten with flanges bolted to structure.
4. Provide rigid anchors for pipes after vibration isolation components are installed.

3.5 Flashing

1. Provide flexible flashing and metal counterflashing where piping and ductwork penetrate weather or waterproofed walls, floors, and roofs.
2. Flash vent and soil pipes projecting 75 mm minimum above finished roof surface with lead worked 25 mm minimum into hub, 200 mm minimum clear on sides with 600 x 600 mm sheet size. For pipes through outside walls, turn flanges back into wall and caulk, metal counterflash, and seal.
3. Flash floor drains in floors with topping over finished areas with lead, 250 mm clear on sides with minimum 910 x 910 mm sheet size. Fasten flashing to drain clamp device.
4. Seal floor, shower, mop sink drains watertight to adjacent materials.
5. Provide acoustical lead flashing around ducts and pipes penetrating equipment rooms, installed to manufacturer's written instructions for sound control.
6. Provide curbs for mechanical roof installations 350 mm minimum high above roofing surface. Flash and counterflash with sheet metal; seal watertight. Attach counterflashing mechanical equipment and lap base flashing on roof curbs. Flatten and solder joints.

7. Adjust storm collars tight to pipe with bolts; caulk around top edge. Use storm collars above roof jacks. Screw vertical flange section to face of curb.

3.6 Sleeves

1. Set sleeves in position in formwork. Provide reinforcing around sleeves.
2. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.
3. Extend sleeves through floors 25 mm above finished floor level. Caulk sleeves.
4. Where piping or ductwork penetrates floor, ceiling, or wall, close off space between pipe or duct and adjacent work with stuffing or fire stopping insulation and caulk. Provide close fitting metal collar or escutcheon covers at both sides of penetration.
5. Install chrome plated steel escutcheons at finished surfaces.

End of Section

Section 23 05 53

Identification for HVAC Piping and Equipment

Part 1 General

1.1 Section includes

1. Nameplates.
2. Tags.
3. Pipe Markers.

1.2 Reference standards

1. ASME A13.1-2020 - Scheme for the Identification of Piping Systems.

1.3 Action submittals

1. Section 01 33 00: Submission procedures.
2. Product Data: Provide manufacturers catalogue literature for each product required.
3. Identification Information:
 - 3.1. Submit list of wording, symbols, letter size, and colour coding for mechanical identification.
 - 3.2. Submit valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.

1.4 Informational submittals

1. Section 01 33 00: Submission procedures.
2. Installation Data: Indicate special procedures, and installation.

1.5 Closeout submittals

1. Section 01 78 00: Submission procedures.
2. Record Documentation: Record actual locations of tagged valves.

Part 2 Products

2.1 Nameplates

1. Description: Laminated three-layer plastic with engraved black letters on light contrasting background colour.

2.2 Tags

1. Plastic Tags: Laminated three-layer plastic with engraved black letters on light contrasting background colour. Square tags, minimum size 10 mm.
2. Chart: Typewritten letter size list in anodized aluminum frame.

2.3 Pipe markers

1. Colour: Conform to ASME A13.1.
2. Plastic Pipe Markers: Factory fabricated, flexible, semi- rigid plastic, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and identification of fluid being conveyed.
3. Plastic Tape Pipe Markers: Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings.
4. Underground Plastic Pipe Markers: Bright coloured continuously printed plastic ribbon tape, minimum 150 mm wide by 0.10 mm thick, manufactured for direct burial service.

Part 3 Execution

3.1 Preparation

1. Degrease and clean surfaces to receive adhesive for identification materials.

3.2 Installation

1. Install plastic nameplates with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer.
2. Install tags with corrosion resistant chain.
3. Install plastic pipe markers to manufacturer's written instructions.
4. Install plastic tape pipe markers complete around pipe to manufacturer's written instructions.
5. Install underground plastic pipe markers 150 to 200 mm below finished grade, directly above buried pipe.
6. Identify air handling units, pumps, heat transfer equipment, tanks, and water treatment devices with plastic nameplates. Small devices, such as in-line pumps, may be identified with tags.
7. Identify control panels and major control components outside panels with plastic nameplates.
8. Identify thermostats relating to terminal boxes or valves with nameplates.
9. Identify valves in main and branch piping with tags.
10. Identify air terminal units and radiator valves with numbered tags.
11. Tag automatic controls, instruments, and relays. Key to control schematic.
12. Identify piping, concealed or exposed, with plastic tape pipe markers. Identify service, flow direction, and pressure. Install in clear view and align with axis of piping. Locate identification not to exceed 20 ft on straight runs including risers and drops, adjacent to each valve and Tee, at each side of penetration of structure or enclosure, and at each obstruction.
 - 12.1. Identify service, flow direction, and pressure. Install in clear view and align with axis of piping.
 - 12.2. Locate identification not to exceed 6 m on straight runs including risers and drops, adjacent to each valve and Tee, at each side of penetration of structure or enclosure, and at each obstruction.
13. Identify ductwork with stencilled painting. Identify with air handling unit identification number and area served. Locate identification at air handling unit, at each side of penetration of structure or enclosure, and at each obstruction.
14. Provide ceiling tacks to locate valves or dampers above T-bar type panel ceilings. Locate in corner of panel closest to equipment.

End of Section

Section 23 05 93

Testing, Adjusting, and Balancing for HVAC

Part 1 General

1.1 Section includes

1. Testing, adjustment, and balancing of air systems.
2. Testing, adjustment, and balancing of hydronic heating systems.
3. Measurement of final operating condition of HVAC systems.

1.2 Reference standards

1. National standards for total system balance
2. ADC 1062: GRD-84 - Test Code for Grilles, Registers and Diffusers.
3. STD 111:2008 Testing, adjusting, and balancing of building HVAC systems (ANSI approved)
4. Procedural standard for testing adjusting and balancing of environmental systems

1.3 Administrative requirements

1. Section 01 31 00: Project management and coordination procedures.
2. Pre-installation Meetings: Convene one (1) week before starting work of this section.
3. Sequencing: Sequence work to commence after completion of systems and schedule completion of work before Substantial Completion of Project.

1.4 Informational submittals

1. Section 01 33 00: Submission procedures.
2. Submit name of adjusting and balancing agency for approval within thirty (30) days after award of Contract.
3. Field Reports: Submit procedures for submitting Field Reports.
 - 3.1. Indicate deficiencies in systems that would prevent proper testing, adjusting, and balancing of systems and equipment to achieve specified performance.
 - 3.2. Prior to commencing work, submit report forms or outlines indicating adjusting, balancing, and equipment data required.
 - 3.3. Submit draft copies of report for review prior to final acceptance of Project. Provide final copies for Consultant and for inclusion in operating and maintenance manuals.
 - 3.4. Provide reports in soft cover, letter size, 3-ring binder manuals, complete with index page and indexing tabs, with cover identification at front and side. Include set of reduced drawings with air outlets and equipment identified to correspond with data sheets, and indicating thermostat locations.
 - 3.5. Include detailed procedures, agenda, sample report forms and copy of AABC National Project Performance Guaranty prior to commencing system balance.
4. Test Reports: Indicate data on AABC National Standards for Total System Balance forms. Submit data in SI (metric) units.

Part 2 Products - Not Used

Part 3 Execution

3.1 Examination

1. Verify that systems are complete and operable before commencing work. Ensure the following conditions:
 - 1.1. Systems are started and operating in a safe and normal condition.
 - 1.2. Temperature control systems are installed complete and operable.
 - 1.3. Proper thermal overload protection is in place for electrical equipment.
 - 1.4. Final filters are clean and in place. If required, install temporary media in addition to final filters.
 - 1.5. Duct systems are clean of debris.
 - 1.6. Fans are rotating correctly.
 - 1.7. Fire and volume dampers are in place and open.
 - 1.8. Air coil fins are cleaned and combed.
 - 1.9. Access doors are closed and duct end caps are in place.
 - 1.10. Air outlets are installed and connected.
 - 1.11. Duct system leakage is minimized.
 - 1.12. Hydronic systems are flushed, filled, and vented.
 - 1.13. Proper strainer baskets are clean and in place.
 - 1.14. Service and balance valves are open.
2. Submit field reports. Report defects and deficiencies noted during performance of services which prevent system balance.
3. Beginning of work means acceptance of existing conditions.

3.2 Preparation

1. Provide instruments required for testing, adjusting, and balancing operations. Make instruments available to Consultant to facilitate spot checks during testing.
2. Provide additional balancing devices as required.

3.3 Installation tolerances

1. Air Handling Systems: Adjust to within plus or minus 5% of design for supply systems and plus or minus 10% of design for return and exhaust systems.
2. Air Outlets and Inlets: Adjust total to within plus 10% and minus 5% of design to space. Adjust outlets and inlets in space to within plus or minus 10% of design.

3.4 Adjusting

1. Ensure recorded data represents actual measured or observed conditions.
2. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.

3. After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.
4. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.
5. At final inspection, recheck random selections of data recorded in report. Recheck points or areas as selected and witnessed by the Owner.
6. Check and adjust systems approximately six months after final acceptance and submit report.

3.5 Air system procedure

1. Adjust air handling and distribution systems to provide required or design supply, return, and exhaust air quantities at site altitude.
2. Make air quantity measurements in ducts by Pitot tube traverse of entire cross sectional area of duct.
3. Measure air quantities at air inlets and outlets.
4. Adjust distribution system to obtain uniform space temperatures free from objectionable drafts and noise.
5. Use volume control devices to regulate air quantities only to extend that adjustments do not create objectionable air motion or sound levels. Effect volume control by duct internal devices such as dampers and splitters.
6. Vary total system air quantities by adjustment of fan speeds. Provide drive changes required. Vary branch air quantities by damper regulation.
7. Provide system schematic with required and actual air quantities recorded at each outlet or inlet.
8. Measure static air pressure conditions on air supply units, including filter and coil pressure drops, and total pressure across the fan. Make allowances for 50% loading of filters.
9. Adjust outside air automatic dampers, outside air, return air, and exhaust dampers for design conditions.
10. Measure temperature conditions across outside air, return air, and exhaust dampers to check leakage.
11. Where modulating dampers are provided, take measurements and balance at extreme conditions. Balance variable volume systems at maximum air flow rate, full cooling, and at minimum air flow rate, full heating.
12. For variable air volume system powered units set volume controller to air flow setting indicated. Confirm connections properly made and confirm proper operation for automatic variable air volume temperature control.

3.6 Water system procedure

1. Adjust water systems to provide required or design quantities.
2. Use calibrated Venturi tubes, orifices, or other metered fittings and pressure gauges to determine flow rates for system balance. Where flow metering devices are not installed, base flow balance on temperature difference across various heat transfer elements in the system.
3. Adjust systems to provide specified pressure drops and flows through heat transfer elements prior to thermal testing. Perform balancing by measurement of temperature differential in conjunction with air balancing.
4. Effect system balance with automatic control valves fully open to heat transfer elements.
5. Effect adjustment of water distribution systems by means of balancing cocks, valves, and fittings. Do not use service or shut-off valves for balancing unless indexed for balance point.
6. Where available pump capacity is less than total flow requirements or individual system parts, full flow in one part may be simulated by temporary restriction of flow to other parts.

End of Section

Section 23 07 13 Duct Insulation

Part 1 General

1.1 Section includes

1. Duct work insulation.
2. Insulation jackets.

1.2 Related requirements

1. Section 23 05 53 - Mechanical Identification.
2. Section 23 31 00 - Duct Work: Duct liner.

1.3 Reference standards

1. ASTM B209/B209M-21a Standard specification for aluminum and aluminum-alloy sheet and plate
2. ASTM B210/B210M-19a Standard specification for aluminum and aluminum-alloy drawn seamless tubes
3. ASTM C1071-19 Standard specification for fibrous glass duct lining insulation (thermal and sound absorbing material)
4. ASTM C518-21 Standard test method for steady-state thermal transmission properties by means of the heat flow meter apparatus
5. ASTM C553-13(2019) Standard specification for mineral fiber blanket thermal insulation for commercial and industrial applications
6. ASTM C612-14(2019) Standard specification for mineral fiber block and board thermal insulation
7. ASTM C921-10(2015) Standard practice for determining the properties of jacketing materials for thermal insulation. (Withdrawn 2021)
8. ASTM E162-21 Standard test method for surface flammability of materials using a radiant heat energy source
9. ASTM E84-21a Standard test method for surface burning characteristics of building materials
10. ASTM E96/E96M-16 Standard test methods for water vapor transmission of materials
11. ASTM G21-15(2021)e1 Standard practice for determining resistance of synthetic polymeric materials to fungi
12. NAIMA - National Insulation Standards.
13. NFPA 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials, 2006 Edition.
14. HVAC duct construction standards - metal and flexible
15. UL 723-2018 - Tests for Surface Burning Characteristics of Building Materials (11th Edition).

1.4 Action submittals

1. Section 01 33 00: Submission procedures.
2. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.

1.5 Informational submittals

1. Section 01 33 00: Submission procedures.
2. Installation Data: Indicate installation procedures which ensure acceptable workmanship and installation standards will be achieved.

1.6 Quality assurance

1. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three (3) years documented experience. Submit proof upon request.
2. Installer Qualifications: Company specializing in performing the work of this section with minimum three (3) years documented experience and approved by the manufacturer. Submit proof upon request.

1.7 Delivery, storage, and handling

1. Section 01 61 00: Transport, handle, store, and protect products.
2. Accept materials on site in original factory packaging, labelled with manufacturer's identification, including product density and thickness.
3. Protect insulation from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original wrapping.

1.8 Site conditions

1. Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics, and insulation cements.
2. Maintain temperature during and after installation for minimum period of twenty-four (24) hours.

Part 2 Products

2.1 Description

1. Regulatory Requirements:
 - 1.1. Materials: Flame spread/smoke developed rating of 25/50 to ASTM E84.

2.2 Glass fibre, flexible

1. Insulation: ASTM C553; flexible, noncombustible blanket.
 - 1.1. Thermal Conductivity: ASTM C518, 0.045W/m.K at 24 degrees C.
 - 1.2. Maximum service temperature: 175 degrees C.
 - 1.3. Maximum moisture absorption: 0.50% by volume.
2. Vapour Barrier Jacket: Kraft paper with glass fibre yarn and bonded to aluminized film.
 - 2.1. Moisture vapour transmission: ASTM E96/E96M; 0.02 perm.
 - 2.2. Secure with pressure sensitive tape.
3. Vapour Barrier Tape:
 - 3.1. Kraft paper reinforced with glass fibre yarn and bonded to aluminized film, with pressure sensitive rubber based adhesive.
4. Outdoor Vapour Barrier Mastic:

- 4.1. Vinyl emulsion type acrylic or mastic, compatible with insulation, black colour.
- 5. Tie Wire: Annealed steel, 1.5 mm.

2.3 Glass fibre, rigid

- 1. Insulation: ASTM C612; rigid, noncombustible blanket.
 - 1.1. Thermal Conductivity: ASTM C518, 0.036W/m.K at 24 degrees C.
 - 1.2. Maximum service temperature: 176 degrees C.
 - 1.3. Maximum moisture absorption: 0.20% by volume.
 - 1.4. Density: 72 kg/cu m.
- 2. Vapour Barrier Jacket: Kraft paper with glass fibre yarn and bonded to aluminized film.
 - 2.1. Moisture vapour transmission: ASTM E96/E96M; 0.04 perm.
 - 2.2. Secure with pressure sensitive tape.
- 3. Vapour Barrier Tape:
 - 3.1. Kraft paper reinforced with glass fibre yarn and bonded to aluminized film, with pressure sensitive rubber based adhesive.
- 4. Indoor Vapour Barrier Finish:
 - 4.1. Vinyl emulsion type acrylic, compatible with insulation, white colour.

2.4 Jackets

- 1. Aluminum Jacket: ASTM B209M.
 - 1.1. Thickness: 0.40 mm sheet.
 - 1.2. Finish: Smooth.
 - 1.3. Joining: Longitudinal slip joints and 2 inch laps.
 - 1.4. Fittings: 0.40 mm thick die shaped fitting covers with factory attached protective liner.
 - 1.5. Metal Jacket Bands: 3/8 inch wide; 0.015 thick stainless steel.
- 2. All Service Jacket - White

2.5 Glass fibre duct liner, flexible

- 1. Manufacturers:
- 2. Insulation: ASTM C1071; flexible, noncombustible blanket with acrylic polymer meeting ASTM G21 impregnated surface and edge coat.
 - 2.1. Thermal Conductivity: Maximum 0.039 W/m.K at 24 degrees C.
 - 2.2. Maximum service temperature: 176 degrees C.
 - 2.3. Maximum Velocity on Coated Air Side: 25.4 m/s.
 - 2.4. Minimum Noise Reduction Criteria: ASTM C1071, 0.30 for 13 mm thickness.
- 3. Adhesive:
 - 3.1. Type: ASTM E162, fire-retardant.
- 4. Liner Fasteners: Galvanized steel, self-adhesive pad with integral head.

2.6 Glass fibre duct liner, rigid

1. Insulation: ASTM C612; rigid, noncombustible board with acrylic polymer meeting ASTM G21 impregnated surface and edge coat.
 - 1.1. Thermal Conductivity: 0.037 W/m.K at 24 degrees C maximum.
 - 1.2. Maximum service temperature: 176 degrees C.
 - 1.3. Maximum Velocity on Coated Air Side: 25.4 m/s.
 - 1.4. Minimum Noise Reduction Criteria: ASTM C1071, 0.55 for 25 mm thickness.
2. Adhesive:
 - 2.1. Type: ASTM E162, fire-retardant.
3. Liner Fasteners: Galvanized steel, self-adhesive pad with integral head.

Part 3 Execution

3.1 Examination

1. Section 01 71 00: Verify existing conditions before starting work.
2. Verify that duct work has been tested before applying insulation materials.
3. Verify that surfaces are clean, foreign material removed, and dry.

3.2 Installation

1. Install to NAIMA.
2. Insulated duct work conveying air below ambient temperature:
 - 2.1. Provide insulation with vapour barrier jackets.
 - 2.2. Finish with tape and vapour barrier jacket.
 - 2.3. Continue insulation through walls, sleeves, hangers, and other duct penetrations.
 - 2.4. Insulate entire system including fittings, joints, flanges, fire dampers, flexible connections, and expansion joints.
3. Insulated duct work conveying air above ambient temperature:
 - 3.1. Provide with or without standard vapour barrier jacket.
 - 3.2. Insulate fittings and joints. Where service access is required, bevel and seal ends of insulation.
4. Duct Work Exposed in Mechanical Equipment Rooms or Finished Spaces below roof deck above finished floor: Finish with all service jacket.
5. Exterior Applications: Provide insulation with vapour barrier jacket. Cover with with caulked aluminum jacket with seams located on bottom side of horizontal duct section.
6. External Duct Insulation Application:
 - 6.1. Secure insulation with vapour barrier with wires and seal jacket joints with vapour barrier adhesive or tape to match jacket.
 - 6.2. Install without sag on underside of duct work. Use adhesive or mechanical fasteners where necessary to prevent sagging. Lift duct work off trapeze hangers and insert spacers.
 - 6.3. Seal vapour barrier penetrations by mechanical fasteners with vapour barrier adhesive.

- 6.4. Stop and point insulation around access doors and damper operators to allow operation without disturbing wrapping.

End of Section

Section 23 07 19

HVAC Piping Insulation

Part 1 General

1.1 Section includes

1. Piping insulation.
2. Jackets and accessories.

1.2 Related requirements

1. Section 22 10 00 - Plumbing Piping: Placement of hangers and hanger inserts.
2. Section 23 05 53 - Mechanical Identification.
3. Section 23 21 00 - Hydronic Piping: Placement of hangers and hanger inserts.

1.3 Reference standards

1. ASTM B209/B209M-21a Standard specification for aluminum and aluminum-alloy sheet and plate
2. ASTM C177-19 Standard test method for steady-state heat flux measurements and thermal transmission properties by means of the guarded-hot-plate apparatus
3. ASTM C195-07(2019) Standard specification for mineral fiber thermal insulating cement
4. ASTM C335/C335M-17 Standard test method for steady-state heat transfer properties of pipe insulation
5. ASTM C449-07(2019) Standard specification for mineral fiber hydraulic-setting thermal insulating and finishing cement
6. ASTM C518-21 Standard test method for steady-state thermal transmission properties by means of the heat flow meter apparatus
7. ASTM C533-17 Standard specification for calcium silicate block and pipe thermal insulation
8. ASTM C534/C534M-20a Standard specification for preformed flexible elastomeric cellular thermal insulation in sheet and tubular form
9. ASTM C547-19 Standard specification for mineral fiber pipe insulation
10. ASTM C552-21a Standard specification for cellular glass thermal insulation
11. ASTM C578-19 Standard specification for rigid, cellular polystyrene thermal insulation
12. ASTM C585-10(2016) Standard practice for inner and outer diameters of thermal insulation for nominal sizes of pipe and tubing
13. ASTM C591-21 Standard specification for unfaced preformed rigid cellular polyisocyanurate thermal insulation
14. ASTM C610-17 Standard specification for molded expanded perlite block and pipe thermal insulation
15. ASTM C921-10(2015) Standard practice for determining the properties of jacketing materials for thermal insulation. (Withdrawn 2021)
16. ASTM D1056-20 Standard specification for flexible cellular materials - sponge or expanded rubber
17. ASTM D1667-17 - Standard Specification for Flexible Cellular Materials - Poly (Vinyl Chloride) Foam (Closed-Cell).

18. ASTM D2842-19 Standard test method for water absorption of rigid cellular plastics
19. ASTM E84-21a Standard test method for surface burning characteristics of building materials
20. ASTM E96/E96M-16 Standard test methods for water vapor transmission of materials
21. NFPA 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials, 2006 Edition.
22. UL 723-2018 - Tests for Surface Burning Characteristics of Building Materials (11th Edition).

1.4 Action submittals

1. Section 01 33 00: Submission procedures.
2. Product Data: Provide product description, list of materials and thickness for each service, and locations.

1.5 Informational submittals

1. Section 01 33 00: Submission procedures.
2. Installation Data: Manufacturer's special installation requirements including procedures which ensure acceptable workmanship and installation standards will be achieved.

1.6 Quality assurance

1. Materials: Flame spread/smoke developed rating of 25/50 or less to ASTM E84.
2. Applicator: Qualifications: Company specializing in performing the work of this section with minimum three (3) years documented experience and approved by the manufacturer.

1.7 Delivery, storage, and handling

1. Section 01 61 00: Transport, handle, store, and protect products.
2. Deliver materials to site in original factory packaging, labelled with manufacturer's identification, including product density and thickness.
3. Store insulation in original wrapping and protect from weather and construction traffic.
4. Protect insulation against dirt, water, chemical, and mechanical damage.

1.8 Site conditions

1. Ambient Condition:
 - 1.1. Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics, and insulation cements.
 - 1.2. Maintain temperature during and after installation for minimum period of twenty-four (24) hours.

Part 2 Products

2.1 Glass fibre

1. Insulation: ASTM C547, rigid moulded, noncombustible.
 - 1.1. Thermal Conductivity (K-factor): ASTM C335/C335M, 0.035 W/m.K at 24 degrees C.
 - 1.2. Maximum Moisture Absorption: 0.2% by volume.
2. Vapour Barrier Jacket:
 - 2.1. ASTM C921, White kraft paper reinforced with glass fibre yarn and bonded to aluminized film.

- 2.2. Moisture Vapour Transmission: ASTM E96/E96M, 0.03 ng/(Pa s sq m).
- 2.3. Secure with self sealing longitudinal laps and butt strips.
- 2.4. Secure with outward clinch expanding staples and vapour barrier mastic.
- 3. Tie Wire: 1.3 mm stainless steel with twisted ends on maximum 300 mm centres.
- 4. Vapour Barrier Lap Adhesive:
 - 4.1. Compatible with insulation.
- 5. Insulating Cement/Mastic:
 - 5.1. ASTM C195, hydraulic setting on mineral wool.
- 6. Indoor Vapour Barrier Finish:
 - 6.1. Vinyl emulsion type acrylic, compatible with insulation, white colour.
- 7. Outdoor Vapour Barrier Mastic:
 - 7.1. Vinyl emulsion type acrylic, compatible with insulation, white colour.

2.2 Cellular foam

- 1. Insulation: ASTM C534/C534M, flexible, cellular elastomeric, moulded or sheet.
 - 1.1. Thermal Conductivity (K-factor): ASTM C518, 0.04 W/m.K at 24 degrees C.
 - 1.2. Minimum Service Temperature: -40 degrees C.
 - 1.3. Maximum Service Temperature: 104 degrees C.
 - 1.4. Maximum Moisture Absorption: ASTM C1056, 1% (pipe) by volume, 1% (sheet) by volume.
 - 1.5. Moisture Vapour Transmission: ASTM E96/E96M, 0.17 perm inches.
 - 1.6. Maximum Flame Spread: ASTM E84, 25.
 - 1.7. Maximum Smoke Developed: ASTM E84, 50.
 - 1.8. Connection: Waterproof vapour barrier adhesive.
- 2. Elastomeric Foam Adhesive:
 - 2.1. Air dried, contact adhesive, compatible with insulation.

2.3 Jackets

- 1. PVC Plastic:
 - 1.1. Jacket: ASTM C921, One-piece moulded type fitting covers and sheet material, off white colour.
 - 1.1.1. Moisture Vapour Transmission: ASTM E96/E96M; 0.002 perm inches.
 - 1.1.2. Maximum Flame Spread: ASTM E84, 25.
 - 1.1.3. Maximum Smoke Developed: ASTM E84, 50.
 - 1.2. Covering Adhesive Mastic: Compatible with insulation.
- 2. Aluminum Jacket: ASTM B209M.
 - 2.1. Thickness: 0.40 mm sheet.
 - 2.2. Finish: Embossed.
 - 2.3. Joining: Longitudinal slip joints and 50 mm laps.
 - 2.4. Fittings: 0.40 mm thick die shaped fitting covers with factory attached protective liner.

2.5. Metal Jacket Bands: 10 mm wide; 0.25 mm thick stainless steel.

Part 3 Execution

3.1 Examination

1. Section 01 71 00: Verify existing conditions before starting work.
2. Verify that piping has been tested before applying insulation materials.
3. Verify that surfaces are clean, foreign material removed, and dry.

3.2 Installation

1. Install materials to manufacturer's written instructions.
2. On exposed piping, locate insulation and cover seams in least visible locations.
3. Insulated dual temperature pipes or cold pipes conveying fluids below ambient temperature:
 - 3.1. Provide vapour barrier jackets, factory applied or field applied.
 - 3.2. Insulate fittings, joints, and valves with moulded insulation of like material and thickness as adjacent pipe.
 - 3.3. Finish with glass cloth and vapour barrier adhesive.
 - 3.4. PVC fitting covers may be used.
 - 3.5. Continue insulation through walls, sleeves, pipe hangers, and other pipe penetrations.
 - 3.6. Insulate entire system including fittings, valves, unions, flanges, strainers, flexible connections, pump bodies and expansion joints.
4. For insulated pipes conveying fluids above ambient temperature:
 - 4.1. Provide standard jackets, with or without vapour barrier, factory applied or field applied.
 - 4.2. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe.
 - 4.3. Finish with glass cloth and adhesive.
 - 4.4. PVC fitting covers may be used.
 - 4.5. For hot piping conveying fluids 140 degrees F or less, do not insulate flanges and unions at equipment, but bevel and seal ends of insulation.
 - 4.6. For hot piping conveying fluids over 140 degrees F, insulate flanges and unions at equipment.
5. Finish insulation at supports, protrusions, and interruptions.
6. For pipe exposed in mechanical equipment rooms or in finished spaces below 10 ft above finished floor, finish with PVC jacket and fitting covers.
7. For exterior applications, provide vapour barrier jacket. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe, and finish with glass mesh reinforced vapour barrier cement. Cover with aluminum jacket with seams located on bottom side of horizontal piping.

3.3 Tolerance

1. Substituted insulation materials: Thermal resistance within 10% at normal conditions, as materials indicated.

End of Section

Section 23 21 00 Hydronic Piping

Part 1 General

1.1 Section includes

1. Pipe and pipe fittings for:
 - 1.1. Heating water piping system.
 - 1.2. Equipment drains and overflows.
2. Valves:
 - 2.1. Globe or angle valves.
 - 2.2. Ball valves.
 - 2.3. Check valves.

1.2 Related requirements

1. Section 23 05 53 - Mechanical Identification.
2. Section 23 05 48 - Vibration Isolation.
3. Section 23 07 19 - Piping Insulation.
4. Section 23 21 16 - Hydronic Specialties.
5. Section 23 25 00 - Chemical Treatment for Piping: for Piping.
6. Section 26 05 83 - Equipment Wiring: Electrical characteristics and wiring connections.

1.3 Reference standards

1. ASME Boiler and Pressure Vessel Code-2021, Section IX - Welding and Brazing Qualifications.
2. ASME B16.18-2021 - Cast Copper Alloy Solder Joint Pressure Fittings.
3. ASME B16.22-2021 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
4. ASME B31.9-2020 - Building Services Piping.
5. ASTM A53/A53M-20 Standard specification for pipe, steel, black and hot-dipped, zinc-coated, welded and seamless
6. ASTM A234/A234M-19 Standard specification for piping fittings of wrought carbon steel and alloy steel for moderate and high temperature service
7. ASTM B32-20 Standard specification for solder metal
8. ASTM B88M-20 Standard specification for seamless copper water tube (metric)
9. ASTM B88-20 Standard specification for seamless copper water tube
10. ASTM D1785-21a Standard specification for poly(vinyl chloride) (PVC) plastic pipe, Schedules 40, 80, and 120
11. ASTM D2235-21 Standard specification for solvent cement for acrylonitrile-butadiene-styrene (abs) plastic pipe and fittings
12. ASTM D2241-20 Standard specification for poly(vinyl chloride) (PVC) pressure-rated pipe (SDR series)

13. ASTM D2310-06(2012) Standard classification for machine-made "fiberglass" (glass-fiber-reinforced thermosetting-resin) pipe. (Withdrawn 2017)
14. ASTM D2466-21 Standard specification for poly(vinyl chloride) (PVC) plastic pipe fittings, Schedule 40
15. ASTM D2467-20 Standard specification for poly(vinyl chloride) (PVC) plastic pipe fittings, Schedule 80
16. ASTM D2680-20 Standard specification for acrylonitrile-butadiene-styrene (ABS) and poly(vinyl chloride) (PVC) composite sewer piping
17. ASTM D2683-20 Standard specification for socket-type polyethylene fittings for outside diameter-controlled polyethylene pipe and tubing
18. ASTM D2751-05 Standard specification for acrylonitrile-butadiene-styrene (abs) sewer pipe and fittings. (Withdrawn 2014)
19. ASTM D2855-20 Standard practice for the two-step (primer and solvent cement) method of joining poly (vinyl chloride) (PVC) or chlorinated poly (vinyl chloride) (CPVC) pipe and piping components with tapered sockets
20. ASTM F477-14(2021) Standard specification for elastomeric seals (gaskets) for joining plastic pipe
21. ASTM F876-22 Standard specification for crosslinked polyethylene (PEX) tubing
22. ASTM F877-20 Standard specification for crosslinked polyethylene (PEX) hot- and cold-water distribution systems
23. Specification A5.8M/A5.8:2019 Specification for filler metals for brazing and braze welding
24. Specification D1.1/D1.1M:2020 Structural welding code - steel
25. AWWA C105/A21.5-18 Polyethylene encasement for ductile-iron pipe systems
26. AWWA C110/A21.10-12 Ductile-iron and gray-iron fittings
27. AWWA C111/A21.11-17 Rubber-gasket joints for ductile-iron pressure pipe and fittings
28. AWWA C151/A21.51-17 Ductile-iron pipe, centrifugally cast
29. STD SP-58-2018 Pipe hangers and supports - materials, design, manufacture, selection, application, and installation

1.4 Action submittals

1. Section 01 33 00: Submission procedures.
2. Product Data: Include data on pipe materials, pipe fittings, valves, and accessories. Provide manufacturers catalogue information. Indicate valve data and ratings.

1.5 Informational submittals

1. Section 01 33 00: Submission procedures.
2. Installation Data: Manufacturer's special installation requirements including hanging and support methods, joining procedures.

1.6 Closeout submittals

1. Section 01 78 00: Submission procedures.
2. Maintenance Data: Include installation instructions, spare parts lists, exploded assembly views.
3. Record Documentation: Record actual locations of valves.

1.7 Delivery, storage, and handling

1. Section 01 61 00: Transport, handle, store, and protect products.

2. Accept valves on site in shipping containers with labeling in place. Inspect for damage.
3. Provide temporary protective coating on cast iron and steel valves.
4. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
5. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

1.8 Site conditions

1. Ambient Conditions: Do not install underground piping when bedding is wet or frozen.

Part 2 Products

2.1 Description

1. System Description:
 - 1.1. Use unions, flanges, and couplings downstream of valves and at equipment or apparatus connections. Do not use direct welded or threaded connections to valves, equipment or other apparatus.
 - 1.2. Use non-conducting dielectric connections whenever jointing dissimilar metals in open systems.
 - 1.3. Provide pipe hangers and supports to ASME B31.9 unless indicated otherwise.
 - 1.4. Use ball valves for shut-off and to isolate equipment, part of systems, or vertical risers.
 - 1.5. Use butterfly valves in heating, chilled water systems interchangeably with gate and globe valves.
 - 1.6. Use lug end butterfly valves to isolate equipment.
 - 1.7. Use 20 mm, ball valves with cap for drains at main shut-off valves, low points of piping, bases of vertical risers, and at equipment. Pipe to nearest floor drain.
2. Regulatory Requirements:
 - 2.1. Conform to ASME B31.9 code for installation of piping system.

2.2 Heating water piping, above ground

1. Steel Pipe: ASTM A53/A53M, Schedule 40, 10 mm for wall for sizes 300 mm and over, black.
 - 1.1. Fittings: ASME B16.3, malleable iron or ASTM A234/A234M, forged steel welding type fittings.
 - 1.2. Joints: Threaded, or AWS D1.1/D1.1M, welded.
2. Copper Tubing: ASTM B88, Type L, H(drawn) temper.
 - 2.1. Fittings: ASME B16.18, cast brass, or ASME B16.22, solder wrought copper.
 - 2.2. Tee Connections: Mechanically extracted collars with notched and dimpled branch tube.
 - 2.3. Joints:
 - 2.3.1. Solder, lead free, ASTM B32 tin-antimony, or tin and silver, with melting range 220-280 degrees C.
 - 2.3.2. Braze, AWS A5.8/A5.8M BCuP silver/phosphorus/copper alloy with melting range 640-805 degrees C.

2.3 Equipment drains and overflows

1. PVC Pipe: ASTM D1785, Schedule 40, and Schedule 80 for sizes 200 mm and larger or ASTM D2241, SDR 21 or 26.

- 1.1. Fittings: ASTM D2466, PVC.
- 1.2. Joints: ASTM D2855, solvent weld.

2.4 Pipe hangers and supports

- 1. Conform to ASME B31.9.
- 2. Hangers for Pipe Sizes 13 to 38 mm: Carbon steel, adjustable swivel, split ring.
- 3. Hangers for Cold Pipe Sizes 50 mm and Over: Carbon steel, adjustable, clevis.
- 4. Vertical Support: Steel riser clamp.
- 5. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.
- 6. Hanger Rods: Mild steel threaded both ends, threaded one end, or continuous threaded.
- 7. Inserts: Malleable iron case of galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.

2.5 Unions, flanges, and couplings

- 1. Unions for Pipe 50 mm and Under:
 - 1.1. Ferrous Piping: 1034 kPa malleable iron, threaded.
 - 1.2. Copper Pipe: Bronze, soldered joints.
- 2. Flanges for Pipe Over 50 mm:
 - 2.1. Ferrous Piping: 1034 kPa forged steel, slip-on.
 - 2.2. Copper Piping: Bronze.
 - 2.3. Gaskets: 1.6 mm thick preformed neoprene.
- 3. Grooved and Shouldered Pipe End Couplings:
 - 3.1. Housing Clamps: Malleable iron galvanized to engage and lock, designed to permit some angular deflection, contraction, and expansion.
 - 3.2. Sealing Gasket: C-shape elastomer composition for operating temperature range from -34 degrees C to 110 degrees C.
 - 3.3. Accessories: Steel bolts, nuts, and washers.
- 4. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.

2.6 Ball valves

- 1. Up To and Including 50 mm:
 - 1.1. Manufacturers:
 - 1.1.1. KITZ; Product: 58/59 Series.
 - 1.2. Bronze, one (1) piece body, chrome plated brass ball, teflon seats and stuffing box ring, lever handle with balancing stops, solder ends with union.

2.7 Butterfly valves

- 1. Manufacturers:
 - 1.1. KITZ; Product: DJ Series.

2. Body: Cast or ductile iron with resilient replaceable EPDM seat, wafer or lug ends, extended neck.
3. Disc: Aluminum bronze.
4. Operator: 10 position lever handle.

2.8 Swing check valves

1. Up To and Including 50 mm:
 - 1.1. Manufacturers:
 - 1.1.1. WATTS; Product: CV.
 - 1.2. Bronze body, bronze trim, bronze rotating swing disc, with composition disc, solder ends.
2. Over 50 mm:
 - 2.1. Manufacturers:
 - 2.1.1. WATTS; Product: 411.
 - 2.2. Iron body, bronze trim, bronze or bronze faced rotating swing disc, renewable disc and seat, flanged ends.

Part 3 Execution

3.1 Preparation

1. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
2. Remove scale and dirt on inside and outside before assembly.
3. Prepare piping connections to equipment with flanges or unions.
4. Keep open ends of pipe free from scale and dirt. Protect open ends with temporary plugs or caps.
5. After completion, fill, clean, and treat systems. Refer to Section 23 25 00.

3.2 Installation

1. Install to manufacturer's written instructions.
2. Install heating water, glycol, chilled water condenser water, and engine exhaust piping to ASME B31.9. Install chilled water piping to ASME B31.5.
3. Route piping in orderly manner, parallel to building structure, and maintain gradient.
4. Install piping to conserve building space, and not interfere with use of space.
5. Group piping whenever practical at common elevations.
6. Sleeve pipe passing through partitions, walls and floors.
7. Slope piping and arrange to drain at low points.
8. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment. Refer to Section 23 05 16.
9. Inserts:
 - 9.1. Provide inserts for placement in concrete formwork.
 - 9.2. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
 - 9.3. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches.
 - 9.4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.

- 9.5. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut above slab.
10. Pipe Hangers and Supports:
- 10.1. Install to ASME B31.9.
 - 10.2. Support horizontal piping as scheduled.
 - 10.3. Install hangers to provide minimum 13 mm space between finished covering and adjacent work.
 - 10.4. Place hangers within 300 mm of each horizontal elbow.
 - 10.5. Use hangers with 38 mm minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
 - 10.6. Support vertical piping at every other floor. Support riser piping independently of connected horizontal piping.
 - 10.7. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
 - 10.8. Provide copper plated hangers and supports for copper piping.
 - 10.9. Prime coat exposed steel hangers and supports. Refer to Section 09 91 00. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.
11. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings. Refer to Section 23 07 19.
12. Provide access where valves and fittings are not exposed. Coordinate size and location of access doors with Section 08 31 13.
13. Slope piping and arrange systems to drain at low points. Use eccentric reducers to maintain top of pipe level.
14. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welds.
15. Prepare unfinished pipe, fittings, supports, and accessories, ready for finish painting. Refer to Section 09 91 00.
16. Install valves with stems upright or horizontal, not inverted.

End of Section

Section 23 21 16

Hydronic Piping Specialties

Part 1 General

1.1 Section includes

1. Expansion tanks.
2. Air vents.
3. Air separators.
4. Strainers.
5. Pump suction fittings.
6. Combination fittings.
7. Flow indicators, controls, meters.
8. Relief valves.
9. Glycol specialties.

1.2 Related requirements

1. Section 22 11 19 - Plumbing Specialties: Backflow Preventers.
2. Section 23 21 00 - Hydronic Piping.
3. Section 23 25 00 - Chemical Treatment for Piping: Pipe Cleaning.

1.3 Reference standards

1. ASME Boiler and Pressure Vessels Code-2021, Section VIII, Division 1 - Rules for Construction of Pressure Vessels.

1.4 Action submittals

1. Section 01 33 00: Submission procedures.
2. Product Data: Provide product data for manufactured products and assemblies required for this project. Include component sizes, rough-in requirements, service sizes, and finishes. Include product description, model and dimensions.

1.5 Informational submittals

1. Section 01 33 00: Submission procedures.
2. Certificates: Submit inspection certificates for pressure vessels from authority having jurisdiction.
3. Installation Data: Indicate hanging and support methods, joining procedures.

1.6 Closeout submittals

1. Section 01 78 00: Submission procedures.
2. Maintenance Data: Include installation instructions, assembly views, lubrication instructions, and replacement parts list.

3. Record Documentation: Record actual locations of flow controls.

1.7 Quality assurance

1. Products of This Section: Manufactured to ISO 9000 certification requirements.
2. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three (3) years documented experience.

1.8 Delivery, storage, and handling

1. Section 01 61 00: Transport, handle, store, and protect products.
2. Accept valves on site in shipping containers with labeling in place. Inspect for damage.
3. Provide temporary protective coating on cast iron and steel valves.
4. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
5. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

Part 2 Products

2.1 Air vents

1. Manual Type: Short vertical sections of 50 mm diameter pipe to form air chamber, with 3 mm brass needle valve at top of chamber.
2. Float Type:
 - 2.1. Brass or semi-steel body, copper, polypropylene, or solid non-metallic float, stainless steel valve and valve seat; suitable for system operating temperature and pressure; with isolating valve.
 - 2.2. Cast iron body and cover, float, bronze pilot valve mechanism suitable for system operating temperature and pressure; with isolating valve.
3. Washer Type:
 - 3.1. Brass with hydroscopic fibre discs, vent ports, adjustable cap for manual shut-off, and integral spring loaded ball check valve.

2.2 Strainers

1. Strainers: Size 50 mm and Under:
 - 1.1. Manufacturers:
 - 1.1.1. LF777; Product: WATTS.
 - 1.2. Screwed brass or iron body for 1200 kPa working pressure, Y pattern with 0.8 mm stainless steel perforated screen.
2. Strainers: Size 65 mm to 100 mm:
 - 2.1. Manufacturers:
 - 2.1.1. 77 Series; Product: WATTS.
 - 2.2. Flanged iron body for 1200 kPa working pressure, Y pattern with 1.2 mm stainless steel perforated screen.
3. Strainers: Size 125 mm and Larger:
 - 3.1. Manufacturers:

3.1.1. 77 Series; Product: WATTS.

3.2. Flanged iron body for 1200 kPa working pressure, basket pattern with 3.2 mm stainless steel perforated screen.

2.3 Flow controls

1. Construction: Brass or bronze body with union on inlet, temperature and pressure test plug on inlet and outlet.
2. Calibration: Control flow within 5% of selected rating, over operating pressure range of 10 times minimum pressure required for control, maximum minimum pressure 24 kPa.
3. Control Mechanism: Stainless steel or nickel plated brass piston or regulator cup, operating against stainless steel helical or wave formed spring.
4. Accessories: In-line strainer on inlet and ball valve on outlet.

2.4 Relief valves

1. Bronze body, teflon seat, stainless steel stem and springs, automatic, direct pressure actuated, capacities ASME BPVC certified and labelled.

Part 3 Execution

3.1 Installation

1. Install specialties to manufacturer's written instructions.
2. Where large air quantities can accumulate, provide enlarged air collection standpipes.
3. Provide manual air vents at system high points and as indicated.
4. For automatic air vents in ceiling spaces or other concealed locations, provide vent tubing to nearest drain.
5. Provide air separator on suction side of system circulation pump and connect to expansion tank.
6. Provide valved drain and hose connection on strainer blow down connection.
7. Provide pump suction fitting on suction side of base mounted centrifugal pumps where indicated. Remove temporary strainers after cleaning systems.
8. Provide combination pump discharge valve on discharge side of base mounted centrifugal pumps where indicated.
9. Support pump fittings with floor mounted pipe and flange supports.

End of Section

Section 23 31 00

HVAC Ducts and Casings

Part 1 General

1.1 Section includes

1. Metal duct work.

1.2 Related requirements

1. Section 23 37 00 - Air Outlets And Inlets.
2. Section 23 05 93 - Testing, Adjusting, And Balancing.

1.3 Reference standards

1. ASTM A90/A90M-21 Standard test method for weight [mass] of coating on iron and steel articles with zinc or zinc-alloy coatings
2. ASTM A167-99(2004) Standard specification for stainless and heat-resisting chromium-nickel steel plate, sheet, and strip. (Withdrawn 2014)
3. ASTM A568/A568M-19a Standard specification for steel, sheet, carbon, structural, and high-strength, low-alloy, hot-rolled and cold-rolled, general requirements for
4. ASTM A653/A653M-20 Standard specification for steel sheet, zinc-coated (galvanized) or zinc-iron alloy-coated (galvannealed) by the hot-dip process
5. ASTM A1018/A1018M-18 Standard specification for steel, sheet and strip, heavy-thickness coils, hot-rolled, carbon, commercial, drawing, structural, high-strength low-alloy, high-strength low-alloy with improved formability, and ultra-high strength
6. ASTM A1011/A1011M-18a Standard specification for steel, sheet and strip, hot-rolled, carbon, structural, high-strength low-alloy, high-strength low-alloy with improved formability, and ultra-high strength
7. ASTM B209/B209M-21a Standard specification for aluminum and aluminum-alloy sheet and plate
8. ASTM C14M-20 Standard specification for nonreinforced concrete sewer, storm drain, and culvert pipe (metric)
9. ASTM C14-20 Standard specification for nonreinforced concrete sewer, storm drain, and culvert pipe
10. ASTM C443M-21 Standard specification for joints for concrete pipe and manholes, using rubber gaskets (metric)
11. ASTM C443-21 Standard specification for joints for concrete pipe and manholes, using rubber gaskets
12. NFPA 90A -Standard for Installation of Air Conditioning and Ventilating Systems, 2021 Edition.
13. NFPA 90B - Standard Installation of Warm Air Heating and Air-Conditioning Systems, 2021 Edition.
14. NFPA 96 - Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations, 2021 Edition.
15. SMACNA 1884-2003 - Fibrous Glass Duct Construction Standards, 7th Edition.
16. SMACNA 016-2012 - HVAC Air Duct Leakage Test Manual, 2nd Edition.
17. HVAC duct construction standards - metal and flexible
18. UL 181-2013 - Standard for Factory-Made Air Ducts and Air Connectors (11th Edition).

1.4 Informational submittals

1. Test Reports: Indicate pressure tests performed. Include date, section tested, test pressure, and leakage rate, following SMACNA 1966.
2. Installation Data: Manufacturer's special installation requirements including special procedures for glass fibre ducts.

1.5 Closeout submittals

1. Section 01 78 00: Submission procedures.
2. Record Documentation: Record actual locations of ducts and duct fittings. Record changes in fitting location and type. Show additional fittings used.

1.6 Quality assurance

1. Perform Work to - HVAC Duct Construction Standards - Metal and Flexible.

1.7 Site conditions

1. Ambient Conditions:
 - 1.1. Do not install duct sealants when temperatures are less than those recommended by sealant manufacturers.
 - 1.2. Maintain temperatures during and after installation of duct sealants.

Part 2 Products

2.1 Performance / design criteria

1. No variation of duct configuration or sizes permitted except by written permission. Size round ducts installed in place of rectangular ducts to ASHRAE table of equivalent rectangular and round ducts.

2.2 Materials

1. Galvanized Steel Ducts: ASTM A653/A653M galvanized steel sheet, lock-forming quality, having G90 zinc coating tested to ASTM A90/A90M.
2. Fasteners: Rivets, bolts, or sheet metal screws.
3. Sealant:
 - 3.1. Non-hardening, water resistant, fire resistive, compatible with mating materials; liquid used alone or with tape, or heavy mastic.
4. Hanger Rod: ASTM A36/A36M, steel galvanized; threaded both ends, threaded one end, or continuously threaded.

2.3 Duct work fabrication

1. Fabricate and support to SMACNA 1966, and as indicated. Provide duct material, gauges, reinforcing, and sealing for operating pressures indicated.
2. Construct T's, bends, and elbows with radius of not less than 1-1/2 times width of duct on centreline. Where not possible and where rectangular elbows are used, provide air foil turning vanes. Where acoustical lining is indicated, provide turning vanes of perforated metal with glass fibre insulation.
3. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible; maximum 30 degrees divergence upstream of equipment and 45 degrees convergence downstream.

4. Provide standard 45 degree lateral wye takeoffs unless otherwise indicated where 90 degree conical tee connections may be used.

Part 3 Execution

3.1 Installation

1. Install to manufacturer's written instructions.
2. Install and seal ducts to SMACNA 1966.
3. Duct Sizes are inside clear dimensions. For lined ducts, maintain sizes inside lining.
4. Provide openings in duct work where required to accommodate thermometers and controllers. Provide pilot tube openings where required for testing of systems, complete with metal can with spring device or screw to ensure against air leakage. Where openings are provided in insulated duct work, install insulation material inside a metal ring.
5. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.
6. Use crimp joints with or without bead for joining round duct sizes 8 inch and smaller with crimp in direction of air flow.
7. Use double nuts and lock washers on threaded rod supports.
8. Connect diffusers or light troffer boots to low pressure ducts directly or with 1.5 m maximum length of flexible duct held in place with strap or clamp.
9. Connect flexible ducts to metal ducts with adhesive plus sheet metal screws.
10. During construction provide temporary closures of metal or taped polyethylene on open duct work to prevent construction dust from entering duct work system.

End of Section

Section 23 33 00

Air Duct Accessories

Part 1 General

1.1 Section includes

1. Duct access doors.
2. Duct test holes.
3. Flexible duct connections.

1.2 Related requirements

1. Section 23 05 48 - Vibration Isolation.
2. Section 23 31 00 - Duct Work.
3. Section 23 36 00 - Air Terminal Units: Pressure regulating damper assemblies.
4. Section 26 05 83 - Equipment Wiring: Electrical characteristics and wiring connections.

1.3 Reference standards

1. NFPA 90A -Standard for Installation of Air Conditioning and Ventilating Systems, 2021 Edition.
2. NFPA 92 - Standard for Smoke Control Systems, 2021 Edition.
3. HVAC duct construction standards - metal and flexible
4. UL 33-2021 - Standard for Heat Responsive Links for Fire-Protection Service (9th Edition).
5. UL 555-2010 - Standard for Fire Dampers (7th Edition).
6. UL 555S-2014 - Standard for Smoke Dampers (5th Edition).
7. CSA (Canadian Standards Association).
8. UL (Underwriters Laboratories Inc.).

1.4 Action submittals

1. Section 01 33 00: Submission procedures.
2. Product Data: Provide for shop fabricated assemblies including duct test holes, duct access doors, duct test holes, hardware used. Include electrical characteristics and connection requirements.
3. Shop Drawings: Indicate for shop fabricated assemblies including volume control dampers, duct access doors, duct test holes.

1.5 Informational submittals

1. Section 01 33 00: Submission procedures.
2. Installation Data: Manufacturer's special installation requirements including fire dampers, combination fire and smoke dampers.

1.6 Closeout submittals

1. Record Documentation: Record actual locations of access doors.

1.7 Quality assurance

1. Products of This Section: Manufactured to ISO 14000 certification requirements.
2. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three (3) years documented experience. Submit proof upon request.

1.8 Delivery, storage, and handling

1. Section 01 61 00: Transport, handle, store, and protect products.
2. Protect dampers from damage to operating linkages and blades.

Part 2 Products

2.1 Description

1. Regulatory Requirements:
 - 1.1. Products Requiring Electrical Connection: Listed and classified by CSA as suitable for the purpose specified and indicated.

2.2 Air turning devices/extractors

1. Multi-blade device with blades aligned in short dimension; steel construction; with individually adjustable blades, mounting straps.
2. Multi-blade device with radius blades attached to pivoting frame and bracket, steel construction, with the following:
 - 2.1. Push-pull operator strap.
 - 2.2. Ceiling mounted rotary operator knob.
 - 2.3. Worm drive mechanism with 450 mm long removable key operator.

2.3 Duct access doors

1. Fabricate to SMACNA 1966, and as indicated.
2. Fabrication: Rigid and close-fitting of galvanized steel with sealing gaskets and quick fastening locking devices. For insulated duct work, install minimum one inch thick insulation with sheet metal cover.
 - 2.1. Less Than 300 mm Square: Secure with sash locks.
 - 2.2. Up to 450 mm Square: Provide two (2) hinges and two (2) sash locks.
 - 2.3. Up to 600 x 1200 mm: Three (3) hinges and two (2) compression latches with outside and inside handles.
3. Access doors with sheet metal screw fasteners are not acceptable.

2.4 Duct test holes

1. Temporary Test Holes: Cut or drill in ducts as required. Cap with neat patches, neoprene plugs, threaded plugs, or threaded or twist-on metal caps.

2.5 Flexible duct connections

1. Fabricate to SMACNA 1966, and as indicated.
2. Connector: Fabric crimped into metal edging strip.
 - 2.1. Fabric: UL listed fire-retardant neoprene coated woven glass fibre fabric to NFPA 90A, minimum density 1.0 kg/sq m.
 - 2.2. Net Fabric Width: Approximately 50 mm wide.
 - 2.3. Metal: 75 mm wide, galvanized steel.

Part 3 Execution

3.1 Preparation

1. Verify that electric power is available and of the correct characteristics.

3.2 Installation

1. Install accessories to manufacturer's written instructions, NFPA 90A, and follow SMACNA 1966. Refer to Section 23 31 00 for duct construction and pressure class.
2. Provide backdraft dampers on exhaust fans or exhaust ducts nearest to outside and where indicated.
3. Provide duct access doors for inspection and cleaning before and after filters, coils, fans, automatic dampers, at fire dampers, combination fire and smoke dampers, and elsewhere as indicated. Provide for cleaning kitchen exhaust duct work to NFPA 96. Provide minimum 200 x 200 mm size for hand access, 450 x 450 mm size for shoulder access, and as indicated. Provide 100 x 100 mm for balancing dampers only. Review locations prior to fabrication.
4. Provide duct test holes where indicated and required for testing and balancing purposes.
5. Provide fire dampers combination fire and smoke dampers at locations indicated, where ducts and outlets pass through fire rated components and where required by authorities having jurisdiction. Install with required perimeter mounting angles, sleeves, breakaway duct connections, corrosion resistant springs, bearings, bushings and hinges.
6. Demonstrate re-setting of fire dampers to Owner's representative.
7. Provide flexible connections immediately adjacent to equipment in ducts associated with fans and motorized equipment and supported by vibration isolators. Refer to Section 23 05 48. For fans developing static pressures of 1250 Pa and over, cover connections with leaded vinyl sheet, held in place with metal straps
8. Provide balancing dampers on high velocity systems where indicated. Refer to Section 23 36 00.
9. Provide balancing dampers on duct take-off to diffusers, grilles, and registers, regardless of whether dampers are specified as part of the diffuser, grille, or register assembly.

End of Section

Section 23 34 23 HVAC Fans

Part 1 General

1.1 Section includes

1. Exhaust Fans

1.2 Related requirements

1. Section 23 31 00 - Duct Work.
2. Section 26 05 83 - Equipment Wiring: Electrical characteristics and wiring connections.

1.3 Reference standards

1. STD 210-16 ANSI/AMCA 210-16 / ASHRAE Standard 51-16 Laboratory methods of testing fans for aerodynamic performance rating
2. STD 300-14 ANSI/AMCA Standard 300-14 Reverberant room method for sound testing of fans
3. STD 301-14 ANSI/AMCA Standard 301-14 Methods for calculating fan sound ratings from laboratory test data
4. STD 99-16 ANSI/AMCA Standard 99-16 Standards handbook
5. NFPA 96 - Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations, 2017 Edition.
6. UL 705-2017 - Standard for Power Ventilators (7th Edition).

1.4 Action submittals

1. Section 01 33 00: Submission procedures.
2. Product Data: Provide data on fans and accessories including fan curves with specified operating point clearly plotted, sound power levels at rated capacity, and electrical characteristics and connection requirements.

1.5 Informational submittals

1. Section 01 33 00: Submission procedures.
2. Installation Data: Manufacturer's special installation requirements.

1.6 Closeout submittals

1. Section 01 78 00: Submission procedures.
2. Maintenance Data: Include instructions for lubrication, motor and drive replacement, spare parts list, and wiring diagrams.

Part 2 Products - Not Used

Part 3 Execution

3.1 Installation

1. Install to manufacturer's written instructions.
2. Install flexible connections specified in Section 23 33 00 between fan inlet and ductwork. Ensure metal bands of connectors are parallel with minimum 25 mm flex between ductwork and fan while running.
3. Provide sheaves required for final air balance.
4. Do not operate fans for any purpose until ductwork is clean, filters in place, bearings lubricated, and fan has been test run under observation.

End of Section

Section 23 36 00

Air Terminal Units

Part 1 General

1.1 Section includes

1. Variable volume terminal units.
2. Integral coils.
3. Integral controls.

1.2 Related requirements

1. Section 01 11 00 - Summary of Work: Owner provided air terminal units (excess stock).
2. Section 23 05 13 - Motors.
3. Section 23 21 16 - Hydronic Specialties: Connections to heating coils.
4. Section 23 21 00 - Hydronic Piping: Connections to heating coils.
5. Section 23 31 00 - Duct Work.
6. Section 23 33 00 - Duct Work Accessories.
7. Section 23 37 00 - Air Outlets and Inlets.
8. Section 26 05 83 - Equipment Wiring: Electrical characteristics and wiring connections.

1.3 Reference standards

1. ADC 1062: GRD-84 - Test Code for Grilles, Registers and Diffusers.
2. NFPA 90A -Standard for Installation of Air Conditioning and Ventilating Systems, 2018 Edition.
3. UL 181-2013 - Standard for Factory-Made Air Ducts and Air Connectors (11th Edition).
4. CSA (Canadian Standards Association).
5. UL (Underwriters Laboratories Inc.).

1.4 Action submittals

1. Section 01 33 00: Submission procedures.
2. Product Data: Provide data indicating configuration, general assembly, and materials used in fabrication. Include catalogue performance ratings which indicate air flow, static pressure, and NC designation. Include electrical characteristics and connection requirements.
3. Shop Drawings: Indicate configuration, general assembly, and materials used in fabrication, and electrical characteristics and connection requirements.

1.5 Informational submittals

1. Section 01 33 00: Submission procedures.
2. Include schedules listing discharge and radiated sound power level for each of second through sixth octave bands at inlet static pressures of 250 to 1000 Pa.

3. Installation Data: Manufacturer's special installation requirements including support and hanging details, and service clearances required.

1.6 Closeout submittals

1. Section 01 78 00: Submission procedures.
2. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, maintenance and repair data, and parts lists. Include directions for resetting constant volume regulators.
3. Warranty Documentation.

Part 2 Products

2.1 Description

1. Regulatory Requirements:
 - 1.1. Products Requiring Electrical Connection: Listed and classified by CSA as suitable for the purpose specified and indicated.

2.2 Single duct variable volume units

1. Basic Assembly:
 - 1.1. Casings: Minimum 0.8 mm galvanized steel.
 - 1.2. Lining: Minimum 13 mm thick neoprene or vinyl coated fibrous glass insulation, 24 g/L density, meeting NFPA 90A requirements and UL 181 erosion requirements. Face lining with 3 mm, mylar film.
 - 1.3. Plenum Air Inlets: Round stub connections for duct attachment.
 - 1.4. Plenum Air Outlets: S slip and drive connections.
2. Basic Unit:
 - 2.1. Configuration: Air volume damper assembly inside unit casing. Locate control component inside protective metal shroud.
 - 2.2. Volume Damper: Construct of galvanized steel with peripheral gasket and self lubricating bearings; maximum damper leakage: 2% of design air flow at 0.25 kPa, rated inlet static pressure.
 - 2.3. Mount damper operator to position damper normally open.
3. Attenuator Section: Line attenuator sections with 50 mm thick insulation.
4. Hot Water Heating Coil:
 - 4.1. Construction: 13 mm copper tube mechanically expanded into aluminum plate fins, leak tested under water to 10380 kPa pressure, factory installed.

Part 3 Execution

3.1 Installation

1. Install to manufacturer's written instructions.
2. Support units individually from structure. Do not support from adjacent ductwork.
3. Connect to ductwork to Section 23 31 00.
4. Verify that electric power is available and of the correct characteristics.

3.2 Adjusting

1. Adjust work to Section 01 78 00.

End of Section

Section 23 37 00

Air Outlets and Inlets

Part 1 General

1.1 Section includes

1. Diffusers.
2. Registers/grilles.
3. Louvres.

1.2 Reference standards

1. ADC 1062: GRD-84 - Test Code for Grilles, Registers and Diffusers.
2. STD 500-L-12 ANSI/AMCA Standard 500-L-12 Laboratory methods of testing louvers for rating
3. STD 500-D-18 ANSI/AMCA Standard 500-D-18 Laboratory methods of testing dampers for rating
4. STD 70:2006 Method of testing the performance of air outlets and air inlets (ANSI approved)
5. NFPA 90A -Standard for Installation of Air Conditioning and Ventilating Systems, 2018 Edition.
6. HVAC duct construction standards - metal and flexible

1.3 Action submittals

1. Section 01 33 00: Submission procedures.
2. Product Data: Provide data for equipment required for this project. Review outlets and inlets as to size, finish, and type of mounting prior to submission. Submit schedule of outlets and inlets showing type, size, location, application, and noise level.

1.4 Informational submittals

1. Section 01 33 00: Submission procedures.
2. Installation Data: Manufacturer's special installation requirements.

1.5 Closeout submittals

1. Section 01 78 00: Submission procedures.
2. Record Documentation: Record actual locations of air outlets and inlets.

1.6 Quality assurance

1. Test and rate air outlet and inlet performance to ASHRAE 70.
2. Test and rate louvre performance to AMCA 500-L.

Part 2 Products

2.1 Rectangular ceiling diffusers

1. Type: Square and rectangular, multi-louvred, adjustable pattern diffuser to discharge air in 360 degree pattern with sectorizing baffles where indicated.
2. Frame: Inverted T-bar type. In plaster ceilings, provide plaster frame and ceiling frame.
3. Fabrication: Steel with baked enamel off-white finish.
4. Accessories: Radial opposed blade damper and multi-louvred equalizing grid with damper adjustable from diffuser face.

2.2 Ceiling exhaust and return registers/grilles

1. Type: Streamlined blades, 19 mm minimum depth, 19 mm maximum spacing, with blades set at 45 degrees, vertical face.
2. Frame: 32 mm margin with countersunk screw mounting.
3. Fabrication: Steel with 0.9 mm minimum frames and 0.8 mm minimum blades, steel and aluminum with 0.9 mm minimum frame, or aluminum extrusions, with factory off-white enamel finish colour to be selected.
4. Damper: Integral, gang-operated, opposed blade type with removable key operator, operable from face where not individually connected to exhaust fans.
5. Gymnasiums: Provide front pivoted or welded in place blades, securely fastened to be immobile.

2.3 Louvres

1. Type: 100 mm deep with blades on 45 degree slope with centre baffle and return bend, heavy channel frame, birdscreen with 13 mm square mesh for exhaust and 19 mm for intake.
2. Fabrication: Welded assembly, with factory prime coat finish; colour to be selected.
 - 2.1. 1.5 mm thick galvanized steel.
 - 2.2. 2.5 mm thick extruded aluminum.
3. Mounting: Provide with interior flat flange for installation.

Part 3 Execution

3.1 Installation

1. Install to manufacturer's written instructions.
2. Check location of outlets and inlets and make necessary adjustments in position to conform with architectural features, symmetry, and lighting arrangement.
3. Install diffusers to duct work with air tight connection.
4. Provide balancing dampers on duct take-off to diffusers, and grilles and registers, despite whether dampers are specified as part of the diffuser, or grille and register assembly.
5. Paint ductwork visible behind air outlets and inlets matte black. Refer to Section 09 91 00.

End of Section

Section 23 82 00

Convection Heating and Cooling Units

Part 1 General

1.1 Section includes

1. Convectors.
2. Electric heaters.

1.2 Related requirements

1. Section 23 21 16 - Hydronic Specialties.
2. Section 23 21 00 - Hydronic Piping.
3. Section 26 05 83 - Equipment Wiring: Electrical characteristics and wiring connections.

1.3 Reference standards

1. CSA (Canadian Standards Association).
2. UL (Underwriters Laboratories Inc.).

1.4 Action submittals

1. Section 01 33 00: Submission procedures.
2. Product Data: Provide typical catalogue of information including arrangements.
3. Shop Drawings:
 - 3.1. Indicate cross sections of cabinets, grilles, bracing and reinforcing, and typical elevations.
 - 3.2. Submit schedules of equipment and enclosures typically indicating length and number of pieces of element and enclosure, corner pieces, end caps, cap strips, access doors, pilaster covers, and comparison of specified heat required to actual heat output provided.
 - 3.3. Indicate mechanical and electrical service locations and requirements.

1.5 Informational submittals

1. Section 01 33 00: Submission procedures.
2. Installation Data: Manufacturer's special installation requirements and recommendations.

1.6 Closeout submittals

1. Section 01 78 00: Submission procedures.
2. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, installation instructions, maintenance and repair data, and parts listings.
3. Warranty Documentation: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

4. Record Documentation: Record actual locations of components and locations of access doors in radiation cabinets required for access or valving.

1.7 Maintenance material submittals

1. Section 01 78 23: Maintenance and extra material requirements.

1.8 Quality assurance

1. Products of This Section: Manufactured to ISO 9000 certification requirements.
2. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three (3) years documented experience.

Part 2 Products

2.1 Hydronic radiant heaters

1. Ceiling Panels: Constructed of modular aluminum extrusions with interlocking edges; manufactured and assembled to sizes and configurations indicated.
2. Pipe Coil: 150 mm module to incorporate extruded void into which continuous 15 mm copper pipe is rolled and thermally bonded. Provide return bends for two water connections to each panel.
3. Cross brace entire assembly with structural members and insulate with 25 mm thick fibreglass insulation. Configure panels within T-bar ceiling module and run wall to wall.

Part 3 Execution

3.1 Installation

1. Install to manufacturer's written instructions.
2. Install equipment exposed to finished areas after walls and ceiling are finished and painted. Avoid damage.
3. Protection: Provide finished cabinet units with protective covers during balance of construction.
4. Hydronic Units: Provide with shut-off valve on supply and lockshield balancing valve on return piping. If not easily accessible, extend vent to exterior surface of cabinet for easy servicing. For cabinet unit heaters, fan coil units, and unit heaters, provide float operated automatic air vents with stop valve.

3.2 Cleaning

1. Section 01 74 10: Cleaning installed work.
2. After construction is completed, including painting, clean exposed surfaces of units. Vacuum clean coils and inside of cabinets.
3. Touch-up marred or scratched surfaces of factory-finished cabinets, using finish materials provided by manufacturer.
4. Install new filters.

End of Section

Section 25 05 00

Common Work Results for Integrated Automation

Part 1 General

1.1 Summary

1. Section Includes:
 - 1.1. Common work results and general provisions to establish a fully operational integrated automation system dedicated for the control, supervision, and management of building systems.
 - 1.2. Common requirements to Division 25, including:
 - 1.2.1. Submittal procedures required to conduct a review of integrated automation as a whole.
 - 1.2.2. Coordination activities for systems and equipment that forms the integrated automation system.
 - 1.2.3. Common product requirements that apply to the entire integrated automation installation.
 - 1.2.4. Quality assurance requirements and procedures.
 - 1.2.5. Demonstration and training requirements for the integrated automation system as a whole.
 - 1.2.6. Requirements and procedures for closeout documents and operation and maintenance (O&M) manuals, related to integrated automation and other systems interfaced.

1.2 Definitions

1. Master Systems Integrator: Specialist responsible for coordinating and executing the integration work required for the integrated automation system. Responsibilities include coordinating interfaces between equipment, managing network and connection requirements, supervising devices/systems interconnections, and overseeing the overall integration process.
2. Point: May be logical or physical.
 - 2.1. Logical points: Values computed by the system such as setpoints, totals, counts, and derived corrections. Includes results of statements in control descriptive logic.
 - 2.2. Physical points: Inputs or outputs connected to hardware wired to controllers. These inputs measure physical properties or provide status conditions of contacts or relays, facilitating interaction with related equipment, such as starting or stopping, and valve or damper actuators.

1.3 Reference standards

1. American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE):
 - 1.1. ANSI/ASHRAE 135-2020, BACnet – A Data Communication Protocol for Building Automation and Control Networks
2. Electrical and Electronic Manufacturers Association (EEMAC):
 - 2.1. EEMAC 2Y-1-1958, Light Grey Colour for Indoor Switch Gear
3. ULC Standards (ULC):
 - 3.1. CAN/ULC-S102.4:2017, Standard Method of Test for Fire and Smoke Characteristics of Electrical Wiring, Cables and Non-Metallic Raceways

4. Sheridan BAS Design Standard

1.4 Administrative requirements

1. Controls Contractor for Decommissioning of Existing Siemens BAS
 - 1.1. Siemens: Guy Blackadar - Guy.blackadar@siemens.com
2. Sheridan College Master Integrator for BAS Upgrades and Commissioning (Delta Controls System)
 - 2.1. Ainsworth: Chris Bachour – Chris.Bachour@ainsworth.com
3. Coordination:
 - 3.1. Coordinate integration of components, equipment, software, applications, and third-party systems to meet the functionalities of the integrated automation system.
 - 3.2. Coordinate engagement of Subcontractors, manufacturers, and suppliers in:
 - 3.2.1. Verifying work conforms to the established integration standards.
 - 3.2.2. Reviewing submittals and installation requirements for system interfaces.
 - 3.2.3. Assisting testing and demonstration activities related to their work.
4. Integrated Automation Meetings: Arrange meetings to be attended by Consultant, Owner's Representative, and affected Subcontractors to:
 - 4.1. Coordination of integration:
 - 4.1.1. Review and coordinate equipment controls and interface requirements for integration with systems provided under Division 25.
 - 4.2. Before starting work:
 - 4.2.1. Review mock-up requirements.
 - 4.2.2. Review manufacturer literature and installation manuals related to systems, components, and equipment provided with built-in controls and interfaces.
 - 4.2.3. Coordinate and review network requirements, including network performance, data communication protocols used, location of connection points, and network security policies.
 - 4.3. During execution of work but before start of commissioning activities:
 - 4.3.1. Debug issues related to systems integration.
 - 4.3.2. Review as-built records and final integration configuration/settings.
5. Sequencing:
 - 5.1. Integrated systems: Test integrated systems only after testing for each individual system forming part of the integrated automation system has been completed.

1.5 Action and informational submittals

1. Submit in accordance with Sheridan BAS Design Standard 1.7
2. Product Data: Product literature and data sheets, including product characteristics, performance criteria, and limitations for:
 - 2.1. Submit product data for:
 - 2.1.1. Main system architecture components: Servers, workstations, operator interfaces, and related software.

- 2.1.2. Instrumentation: Field instrumentation and control devices, actuators and operators, smart sensors, metering systems, and accessories.
- 2.1.3. Networking equipment.
- 2.2. Submit with the related Shop Drawings for verification of compliance with the Specifications.
- 3. Shop Drawings:
 - 3.1. Preliminary Shop Drawings:
 - 3.1.1. Review critical products proposed for integrated automation and establish conformance with overall design philosophy, system performance, and capabilities.
 - 3.1.2. Submit preliminary Shop Drawings within 10 Working Days of award of Contract. Include:
 - 3.1.2.1. Product data and certificates of proposed building automation controllers, as specified in COM EMCS Master Spec Section 25 30 01 – Building Automation Controllers.
 - 3.1.2.2. Product data and certificates of proposed software and applications for the centralized BMS, as specified in COM EMCS Master Spec Section 25 30 01 – Building Automation Controllers.
 - 3.1.2.3. Sketch of site-specific system architecture.
 - 3.1.2.4. Description of software programs provided.
 - 3.2. Detailed Shop Drawings:
 - 3.2.1. Submit Detailed Shop Drawings within 30 Working Days after award of Contract and before start of installation.
 - 3.2.1.1. Include corrected and updated versions of submissions made during preliminary review.
 - 3.2.2. System architecture diagram: Submit detailed network architecture diagram showing all main components, control devices, and communication links of the integrated automation.
 - 3.2.2.1. Include:
 - 3.2.2.1.1. Components forming the centralized BMS, such as servers, operator workstation (OWS), operator interfaces, and data storage systems.
 - 3.2.2.1.2. Building automation controllers.
 - 3.2.2.1.3. Third-party control devices and interfaces.
 - 3.2.2.1.4. Network equipment.
 - 3.2.2.1.5. Communication links to show primary Ethernet transmission control protocol/internet protocol (TCP/IP) links and secondary buses. For each link, indicate data communication protocol used and cable type.
 - 3.2.3. Floor plans: Indicate locations of controllers, auxiliary control cabinets, components of the centralized BMS, and network equipment.
 - 3.2.3.1. Show cable routings for power supply network and indicate locations of local distribution panels and transformers.
 - 3.2.4. Equipment Schedules:
 - 3.2.4.1. Control valves: Schedule listing with designation, service, manufacturer, model, point ID, design flow rate, design pressure drop, valve's flow coefficient (Cv) (required and actual), valve size, spring range, pilot range, torque (required and actual), close-off pressure (required and actual), and actuator details.

- 3.2.4.2. Damper actuators: Schedule listing with designation, manufacturer, model, point ID, associated system ID, damper assembly dimensions, damper blade type, design airflow rate, normal position, spring requirements, torque (required and actual), power supply, and control signal type.
- 3.2.4.3. Flow measuring stations: Schedule listing with designation, service, point ID, manufacturer, model, size, velocity at design flow rate, and operational range of transmitters.
- 3.2.5. Building Controller Schedules: Points list indicating all points associated with each controller.
 - 3.2.5.1. Include:
 - 3.2.5.1.1. Point name, point ID, point description, sensor/transmitter type and range, signal type, and wiring termination details.
 - 3.2.5.1.2. Spare point capacity of each controller by number and type.
- 3.2.6. Control schematics: For each building system or equipment under control of the integrated automation system.
 - 3.2.6.1. Include:
 - 3.2.6.1.1. System schematic (for example, ventilation/hydronic diagram) showing location of instrumentation, control devices, and system interface complete with point name and ID.
 - 3.2.6.1.2. Wiring diagrams.
 - 3.2.6.1.3. Interface wiring diagrams showing termination connections and signal levels for equipment supplied by other Divisions.
- 3.2.7. Sequences of operation: For each control schematic in narrative format. Include description of automatic control required to achieve proper operation under normal conditions, on alarm detection, during a power failure, a fire alarm condition, and under complete failure of building automation controller.
 - 3.2.7.1. Include software and programming details such as time of day schedules, setpoints, and alarm limits (high and low, critical or non-critical).
 - 3.2.7.2. Cross-reference sequences of operation with control schematics, using the same point IDs and point names.
- 3.2.8. Electrical system: Submit conduit layout for system wiring.
- 4. Test and Evaluation Reports:
 - 4.1. Existing products intended for reuse: Test report within 40 Working Days of award of Contract listing each component to be reused and indicating whether it is in good conditions or requires repair.
- 5. Manufacturer's Instructions:
 - 5.1. Special delivery, storage, and handling requirements.
 - 5.2. Installation instructions.
 - 5.3. Recommended sequencing.
- 6. Material Delivery Schedule: In accordance with [Section 01 32 16.16 - Construction Progress Schedule - Critical Path Method (CPM)][Section 01 32 16.19 - Construction Progress Schedule - Bar (Gantt) Chart].
 - 6.1. Submit within 2 weeks of award of Contract.
- 7. Training Program:
 - 7.1. Proposed training program and materials as specified in TRAINING in this section.
 - 7.2. Training agenda detailing hour-by-hour schedule and including brief content overview of each segment:

- 7.2.1. List name of trainers and participants from project team, including the Consultant.
 - 7.2.1.1. The Owner will provide a list of participants that will attend training.
- 7.2.2. Indicate type of visual and audio aids to be used during training.
- 7.2.3. Indicate coordinated interface with other mechanical and electrical training programs.
- 7.2.4. Submit minimum 30 days before beginning of training.
- 7.3. Submit training completion report within [1] week after completion of complete training program stating satisfactorily training completion.

1.6 Closeout submittals

1. Submit in accordance with Sheridan BAS Design Standard 1.7.15.
 - 1.1. Submit minimum 2 weeks before beginning training.
2. Operation and Maintenance Data:
 - 2.1. Include, in the operation and maintenance manual, manufacturer's maintenance and operating instructions.
 - 2.2. Use concise language and common terminology of functional and operational requirements of system, for clear understanding by operating personnel. Assume readers to have basic working knowledge of computers, electronics, or in-depth control theory.
 - 2.3. Include information related to systems forming the integrated automation system and subjects referred to in this section.
 - 2.3.1. Indicate name, address, and telephone number of each Subcontractor involved in the equipment installation and local representative for each item of equipment and system.
 - 2.4. Functional description to include:
 - 2.4.1. system operation;
 - 2.4.2. design philosophy and specific functions and systems;
 - 2.4.3. detailed data communication procedures, including data protocols used, data processing and data link components, interfaces, integration equipment, and procedures for checking data link integrity;
 - 2.4.4. detailed hardware and software functions, interfaces, and requirements for components in functions and operating modes; and
 - 2.4.5. detailed procedures for human-machine interactions (HMIs) required to supplement system description, known or established constraints on system operation, operation sequences, and operating procedures currently implemented or planned for implementation in automatic mode.
 - 2.5. System operation description to include:
 - 2.5.1. detailed step-by-step procedures for system operation, including required actions at each interface (servers, OWS, HMIs);
 - 2.5.2. operation of computer peripherals, input and output formats;
 - 2.5.3. emergency, alarm, and failure recovery procedures and actions; and
 - 2.5.4. step-by-step instructions for start-up, back-up equipment operation, execution of systems functions, and operating modes. Include keystrokes for each command, allowing to easily reference the required keystrokes to call up display or to input command.
 - 2.6. Software description to include:
 - 2.6.1. software requirements and capabilities;

- 2.6.2. data required for modification, relocation, reprogramming, and new and existing software modules to respond to changing system functional requirements without disrupting normal operation;
- 2.6.3. comprehensive program cross-reference, including linking, data exchange, and data file requirements, necessary subroutine lists, and other essential information for loading, integrating, interfacing, and program execution;
- 2.6.4. software for each controller, including a summary for controller common parameters and functions; and
- 2.6.5. requirements for software updates, security patches and recommended update intervals, and software maintenance schedule.
- 2.7. Maintenance procedures to include:
 - 2.7.1. document procedures for inspection, periodic preventive maintenance, fault diagnosis, and repair or replacement of defective components;
 - 2.7.2. calibration, maintenance, and repair of sensors, transmitters, transducers, controllers, and interface firmware; and
 - 2.7.3. diagnostics and repair or replacement of system hardware.
- 2.8. System configuration to include:
 - 2.8.1. provisions and procedures for planning, implementing, and recording hardware and software modifications required during operating lifetime of system; and
 - 2.8.2. information for coordination of hardware and software changes, data link or message format/content changes, and sensor or control changes in event that system modifications are required.
- 3. Record Documentation:
 - 3.1. Submit updated version of documents generated during the detailed Shop Drawing review. Include:
 - 3.1.1. modifications made to installation, system configuration, control devices, and operation sequences through the course of the Project:
 - 3.1.1.1. change orders and other modifications to Contract;
 - 3.1.1.2. modifications to interface wiring;
 - 3.1.1.3. changes to cable routing and equipment location;
 - 3.1.1.4. changes made during commissioning process to meet the required performance;
 - 3.1.2. listing of alarm messages;
 - 3.1.3. Control Panel Schedule showing power source used. Indicate local distribution panel ID, circuit number, and source type (normal, emergency, or uninterruptible power supply (UPS));
 - 3.1.4. complete system control descriptive logics (CDLs) and include English explanations on same sheet, in different font and italics. Indicate specified energy optimization programs.
 - 3.1.5. Record important settings and parameters configured during construction progress such as minimum damper positions and supply air static pressure setpoints.
- 4. Certificates and Test Reports:
 - 4.1. Test procedures and reports: Provide records of start-up procedures, test procedures, checkout tests, and final commissioning reports as specified in Sheridan BAS Design Standard.
 - 4.2. Calibration certificates for metering systems and equipment.

Part 2 Products

2.1 Description

1. Work covered in Division 25 provides a fully operational integrated automation system and a unified automation environment designed to consolidate various automation systems, control devices, software, and applications to promote data exchange, data collection, and optimization of building operations.
2. The integrated automation system, as a whole, consists of components that control and manage building systems. This system includes products specified in Sheridan BAS Design Standard and third-party components described in other Divisions, consisting of:
 - 2.1. Building controllers: Network of building automation controllers as specified in Sheridan BAS Design Standard
 - 2.2. Field instrumentation and control devices as specified in Sheridan BAS Design Standard
 - 2.3. Centralized BMS: Software-based platform to provide a user interface for integrated automation.
 - 2.4. Servers, operator workstations, operator interfaces, and database storage to support the centralized BMS.
 - 2.5. Interface of third-party systems and components.
 - 2.6. Network infrastructure to support integrated automation.
 - 2.7. Data analytics software.

2.2 Performance/design criteria

1. Design Criteria:
 - 1.1. Equip each system or component interfaced to the integrated automation system with the necessary hardware and software to operate independently and perform their basic control functions.
 - 1.1.1. Building automation controllers perform direct control and supervision of selected systems and equipment.
 - 1.1.2. Supply third-party systems and components with built-in controls and interface to allow the integrated automation system to poll data and modify control functions and settings.
 - 1.1.3. Use data exchange for data collection, to perform optimization control and display system data at user interfaces.
 - 1.2. The integrated automation environment prioritizes the use of internet protocol (IP) communications to enable data exchange between system components (communications at system level) and data exchange between systems (cross-system communications).
 - 1.2.1. Perform communication at other levels (secondary buses) through integration panels, building automation controllers equipped with router or gateway functions.
 - 1.2.2. Perform exchange between software through the centralized BMS by using a database interface such as an application programming interface (API).
2. Provide equipment, components, and software specifically developed to operate in accordance with ANSI/ASHRAE 135. Prioritize products that use communication interfaces that conform with the Ethernet standard, the IP protocol suite, and BACnet/IP in accordance with ANSI/ASHRAE 135, Annex J.
3. System Database:
 - 3.1. Integrated automation relies on the centralized BMS to host the system database. System data (for example, control points, historical data, parameters) must reside in a SQL based database as specified in Section 25 45 00 – Centralized Building Management System.

- 3.2. Data exchange with other software applications, at an enterprise-level, is possible through the system database using a connector tool such as the following APIs:
 - 3.2.1. Microsoft Open Database Connectivity (ODBC); or
 - 3.2.2. Java Database Connectivity (JDBC).
- 4. Language Operating Requirements: Provide text in English.
 - 4.1. Graphic terminal displays: Use non-linguistic symbols for displays on graphic terminals whenever possible.
 - 4.2. Operating system executive: Provide primary hardware-to-software interface as part of hardware purchase, with associated documentation in English.
 - 4.3. System manager software: Include system definition point database, additions, deletions or modifications, control loop statements, use of high-level programming languages, report generator utility, and other operating system utilities necessary for maintaining optimal operating efficiency.
 - 4.4. Input and output commands: Input and output commands and messages from operator-initiated functions as defined in CDL's or assigned limits (such as commands relating to day-to-day operating functions and not to system modifications, additions, or logic redefinitions).
 - 4.5. Graphic "display" functions, point commands to turn systems on/off, and manual overrides of automatic control for specified hardware points to be available in English at specified OWS.
 - 4.5.1. System to be able to operate one terminal in English and another in French simultaneously.
 - 4.5.2. Provide point name expansions in both languages.
 - 4.6. Reporting function such as trend log, trend graphics, alarm report logs, energy report logs, and maintenance generated logs.
- 5. Electrical:
 - 5.1. Provide complete conduit system for system wiring.
 - 5.1.1. Provide separate conduit systems for line-voltage power wiring and for instrumentation and communication wiring.
 - 5.1.2. Conduit sizes to suit wiring requirements and to allow for future expansion capabilities specified for systems.
 - 5.1.3. Conduit fill: Maximum of 40%.
 - 5.2. Provide utility power and emergency power to components of the integrated automation system from dedicated circuits in local distribution panels as indicated on Drawings.
 - 5.3. Provide power from local UPS distribution panels for selected components as indicated in Division 25.
 - 5.4. Power supply and conditioning equipment: Provide all transformers, DC power supplies, and low voltage power networks required to power local controllers, field instrumentation, and control devices.
 - 5.4.1. Power supplies complete with over-voltage protection module and sized for two times the connected load.

2.3 Wiring

- 1. 70 V and Above: Copper conductors in accordance with Division 26.
- 2. Under 70V: Use FT6-rated wiring where wiring is not run in conduit, and FT4-wiring in other cases, in accordance with CAN/ULC-S102.4.
- 3. Sizes:
 - 3.1. 120 V power supply: Match or exceed the current rating of the breaker.

- 3.1.1. Minimum wire size: #12 AWG.
- 3.2. Wiring for safeties and interlocks: For starters and motor control centres.
 - 3.2.1. Minimum wire size: #12 AWG.
- 3.3. Field wiring: Shielded wire.
 - 3.3.1. Minimum wire size: #18 AWG solid copper.
- 3.4. Power loss through conductor not to exceed 5%.
- 4. Colour coding and cable jacket colours: In accordance with Section 25 05 53 – Identification for Integrated Automation.

2.4 Source quality control

- 1. Provide equipment and material from manufacturer's regular production, CSA certified, and manufactured to specified standards and requirements.
- 2. Where CSA certified equipment is not available, submit equipment to AHJ for special inspection and approval before delivery to site.
- 3. Submit proof of compliance to specified standards with Shop Drawings and product data. Label or listing of specified organization is acceptable evidence.
- 4. Provide calibration certificates for products that require certificates after production or when installed and started-up at the site.
- 5. If the original documentation cannot be provided, submit certificate from testing organization, acceptable to the Consultant, certifying that item was tested in accordance with their test methods and conforms to their standards and codes.
- 6. For material not regulated by the organization's own listing or labeling, provide a certificate stating that the material complies with the applicable reference standards, specifications, and codes specified in Section 01 41 00 – Regulatory Requirements.

Part 3 Execution

3.1 Installation

- 1. Install and configure components in accordance with manufacturer's recommendations.
- 2. Install equipment and components so that manufacturers and CSA labels are visible and legible after commissioning is complete.
- 3. Electrical:
 - 3.1. Install electrical components in accordance with requirements in Division 26.
 - 3.2. Modify existing starters to provide integrated automation control as indicated on the Drawings. Refer to electrical control schematics included as part of control schematics [on the Drawings].
 - 3.3. Terminate wires with screw terminal type connectors suitable for wire size and number of terminations.
 - 3.4. Provide grounding for the integrated automation installation and components in accordance with Division 26 requirements.
 - 3.5. Wiring in conduits:
 - 3.5.1. Install all wiring in electrical metallic tubing (EMT) conduit.
 - 3.5.2. To be continuous without joints.

- 3.5.3. Install conduits parallel or perpendicular to building lines to conserve headroom and minimize interference.
- 3.5.4. Avoid running exposed conduits in normally occupied spaces unless impossible to do otherwise.
 - 3.5.4.1. When impossible to do otherwise, obtain written authorization the from Consultant before starting work.
 - 3.5.4.2. Enclose wiring in conduit in mechanical and service rooms, as well as any exposed wiring.
- 3.6. Wiring outside conduits:
 - 3.6.1. FT6 plenum-rated wiring may run without conduits in accessible ceiling space to connect building controllers and their components. This includes wiring for:
 - 3.6.1.1. low-voltage power supply and communication links; or
 - 3.6.1.2. field instrumentation, operators, and actuators.
 - 3.6.2. Run wiring parallel or perpendicular to building lines. Secure wiring with cable supports every 2 m.
 - 3.6.2.1. Cable supports: Reconfigurable system such as telecommunications hooks. Avoid using tape or tie-wraps.
 - 3.6.3. Wiring to be continuous without joints.
 - 3.6.4. Fix cable supports to building structure. Avoid attaching wiring to building systems, such as electrical conduits, ductwork, piping, or their associated hangers.
 - 3.6.5. For wall-mounted components, run wiring in conduit inside the wall and up to the ceiling space. At the end of the conduit, install a plastic ring to protect wiring against abrasion.

3.2 Programming and configuration

- 1. All programming performed in Division 25 to be self-documenting.
- 2. Programs of similar systems to be standardized and follow a common structure.
- 3. The Consultant has the right to revise the sequence or subsequent CDL before software finalization without incurring additional costs.
- 4. Configuration Standards:
 - 4.1. Configure systems and components forming part of the integrated automation in accordance with Section 25 05 00 – Integrated Automation Interoperability Requirements. Follow requirements for:
 - 4.1.1. object naming and tagging;
 - 4.1.2. device naming and addressing;
 - 4.1.3. Data sharing properties;
 - 4.1.4. trending configuration; and
 - 4.1.5. alarm/event management.
- 5. Record Documentation: Enter soft copy submission of O&M manuals and record documentation at each server and OWS.

3.3 Painting

- 1. Paint in accordance with Section 09 91 23 - Interior Painting, and:
 - 1.1. Clean and touch up damaged or scratched surfaces of factory-finished equipment to match original finish.
 - 1.2. Restore extensively damaged finished surfaces to be primed and touched up.

- 1.3. Clean and prime exposed hangers, racks, fastenings, and other support components.
- 1.4. Paint unfinished equipment installed indoors in accordance with EEMAC 2Y-1.

3.4 Adjusting

- 1. Corrections: Provide equipment, materials, and labour as required to correct installation or equipment deficiencies identified through the commissioning process.

End of Section

Section 26 05 19

Low-Voltage Electrical Power Conductors and Cables

Part 1 General

1.1 Section includes

1. Building wire and cable.
2. Wiring connectors and connections.

1.2 Related requirements

1. Section 26 05 53 - Electrical Identification.

1.3 Reference standards

1. CSA C22.1:21 Canadian electrical code, Part I (25th edition), safety standard for electrical installations
2. STD C22.2 NO. 0.3-09 Test methods for electrical wires and cables
3. CAN/CSA C22.2 NO. 65-18 Wire connectors (Tri-national standard, with UL 486A-486B and NMX-J-543-ANCE)
4. STD C22.2 NO. 75-17 Thermoplastic insulated wires and cables (Trinational standard with UL 83 and NMX-J-010-ANCE-2017)
5. STD ANSI/NETA ATS-2021 Standard for acceptance testing specifications for electrical power equipment and systems
6. CSA (Canadian Standards Association).
7. UL (Underwriters Laboratories Inc.).
8. Ontario Electrical Safety Code (OESC) 28th Edition, 2021

1.4 Administrative requirements

1. Coordination:
 - 1.1. Coordinate with other work having a direct bearing on work of this section.
 - 1.2. Where wire and cable destination is indicated and routing is not shown, determine exact routing and lengths required.

1.5 Action submittals

1. Product Data: Provide for each cable assembly type.

1.6 Informational submittals

1. Test Reports: Indicate procedures and values obtained.
2. Design Data: Indicate voltage drop and ampacity calculations for aluminum conductors substituted for copper conductors.
3. Installation Data: Indicate application conditions and limitations of use stipulated by product testing agency specified under Regulatory Requirements.

1.7 Closeout submittals

1. Record Documentation: Record actual locations of components and circuits.

1.8 Site conditions

1. Conductor sizes are based on copper unless indicated as aluminum or "AL".
2. Wire and cable routing indicated is approximate unless dimensioned. Include wire and cable lengths within 3 m of length shown.

Part 2 Products

2.1 Description

1. Regulatory Requirements:
 - 1.1. Conform to OESC-2021.
 - 1.2. Most authorities having jurisdiction with respect to electrical code enforcement accept listing and classification as evidence that a product meets adequate safety standards and, in the case of classification, is suitable for the classified environment or application.
 - 1.3. Provide products listed and classified by CSA as suitable for the purpose specified and indicated.

2.2 Conductors

1. Conductor: Copper.
2. Insulation Voltage Rating: 600 volts.
3. Insulation: Type RW.
4. Insulation: Thermosetting material rated 90 degrees C.

2.3 Raceways

1. Provide EMT raceways for all conductors other than armoured cable.

Part 3 Execution

3.1 Examination

1. Verify that interior of building has been protected from weather.
2. Verify that mechanical work likely to damage wire and cable has been completed.
3. Verify that raceway installation is complete and supported.

3.2 Preparation

1. Completely and thoroughly swab raceway before installing wire.

3.3 Wiring methods

1. Concealed Dry Interior Locations: Use only building wire Type RW.
2. Use Type RW conductors in EMT raceway except where otherwise specifically permitted or required.

3.4 Installation

1. Install wire and cable to manufacturer's written instructions.
2. Route wire and cable as required to meet project conditions.
3. Install cable to the OESC-2021.
4. Use solid conductor for feeders and branch circuits 10 AWG and smaller.
5. Use stranded conductors for control circuits.
6. Use conductor not smaller than 12 AWG for power and lighting circuits.
7. Use 10 AWG conductors for 20 ampere, 120 volt branch circuits longer than 75 ft.
8. Pull all conductors into raceway at same time.
9. Use suitable wire pulling lubricant for building wire 4 AWG and larger.
10. Protect exposed cable from damage.
11. Support cables above accessible ceiling, using spring metal clips or metal cable ties to support cables from structure or ceiling suspension system. Do not rest cable on ceiling panels.
12. Use suitable cable fittings and connectors.
13. Neatly train and lace wiring inside boxes, equipment, and panelboards.
14. Clean conductor surfaces before installing lugs and connectors.
15. Make splices, taps, and terminations to carry full ampacity of conductors with no perceptible temperature rise.
16. Use insulated spring wire connectors with plastic caps for copper conductor splices and taps, 10 AWG and smaller.
17. Identify and colour code wire and cable to Section 26 05 53. Identify each conductor with its circuit number or other designation indicated.

End of Section

Section 26 05 26

Grounding and Bonding for Electrical Systems

Part 1 General

1.1 Section includes

1. Bonding.

1.2 Reference standards

1. CSA C22.1:21 Canadian electrical code, Part I (25th edition), safety standard for electrical installations
2. STD ANSI/NETA ATS-2021 Standard for acceptance testing specifications for electrical power equipment and systems
3. NFPA 70 - National Electrical Code (NEC), 2017 Edition.
4. NFPA 99 - Health Care Facilities, 2018 Edition.
5. CSA (Canadian Standards Association).
6. UL (Underwriters Laboratories Inc.).
7. Ontario Electrical Safety Code (OESC) 28th Edition, 2021.

Part 2 Products

2.1 Description

1. Regulatory Requirements:
 - 1.1. Products: Listed and classified by CSA as suitable for the purpose specified and indicated.

2.2 Performance / design criteria

1. Grounding System Resistance: 5 ohms.

Part 3 Execution

3.1 Installation

1. Install to manufacturer's written instructions.
2. Provide bonding to meet Regulatory Requirements.
3. Interface with site grounding system.

End of Section

Section 26 05 29

Hangers and Supports for Electrical Systems

Part 1 General

1.1 Section includes

1. Conduit and equipment supports.
2. Anchors and fasteners.

1.2 Reference standards

1. CSA C22.1:21 Canadian electrical code, Part I (25th edition), safety standard for electrical installations
2. CECA (Canadian Electrical Contractors Association).
3. CSA (Canadian Standards Association).
4. UL (Underwriters Laboratories Inc.).
5. Ontario Electrical Safety Code (OESC) 28th Edition, 2021.

Part 2 Products

2.1 Description

1. Regulatory Requirements:
 - 1.1. Provide products listed and classified by CSA as suitable for purpose specified and shown.

2.2 Product requirements

1. Materials and Finishes: Provide adequate corrosion resistance.
2. Provide materials, sizes, and types of anchors, fasteners and supports to carry the loads of equipment and conduit. Consider weight of wire in conduit when selecting products.
3. Anchors and Fasteners:
 - 3.1. Concrete Structural Elements: Use powder actuated anchors.
 - 3.2. Steel Structural Elements: Use beam clamps.
 - 3.3. Concrete Surfaces: Use self-drilling anchors.
 - 3.4. Hollow Masonry, Plaster, and Gypsum Board Partitions: Use toggle bolts.
 - 3.5. Solid Masonry Walls: Use expansion anchors.
 - 3.6. Sheet Metal: Use sheet metal screws.
 - 3.7. Wood Elements: Use wood screws.

Part 3 Execution

3.1 Installation

1. Install products to manufacturer's written instructions.

2. Provide anchors, fasteners, and supports to OESC.
3. Do not fasten supports to pipes, ducts, mechanical equipment, and conduit.
4. Do not use powder-actuated anchors.
5. Obtain permission from Consultant before using powder-actuated anchors.
6. Do not drill or cut structural members.
7. Obtain permission from Consultant before drilling or cutting structural members.
8. Fabricate supports from structural steel or steel channel. Rigidly weld members or use hexagon head bolts to present neat appearance with adequate strength and rigidity. Use spring lock washers under all nuts.
9. Install surface-mounted cabinets and panelboards with minimum of four anchors.
10. In wet and damp locations use steel channel supports to stand cabinets and panelboards 25 mm off wall.
11. Use sheet metal channel to bridge studs above and below cabinets and panelboards recessed in hollow partitions.

End of Section

Section 26 05 33.13

Conduit for Electrical Systems

Part 1 General

1.1 Section includes

1. Liquid tight flexible metal conduit.
2. Electrical metallic tubing.

1.2 Related requirements

1. Section 07 85 00 - Firestopping.
2. Section 26 05 26 - Grounding And Bonding.
3. Section 26 05 29 - Electrical Supporting Devices.
4. Section 26 05 53 - Electrical Identification.

1.3 Reference standards

1. CSA C22.1:21 Canadian electrical code, Part I (25th edition), safety standard for electrical installations
2. STD C22.2 NO. 45.1-07 Electrical rigid metal conduit - steel (Tri-National standard, with UL 6 and NMX-J-534-ANCE-2007)
3. CSA C22.2 NO. 45.2:08 Electrical rigid metal conduit - aluminum, red brass, and stainless steel (Tri-national standard, with NMX-J-576-ANCE and UL 6A)
4. STD C22.2 NO. 56-17 Flexible metal conduit and liquid-tight flexible metal conduit
5. STD C22.2 NO. 83.1-07 Electrical metallic tubing - steel (Tri-National Standard, with UL 797 and NMX-J-536-ANCE-2007)
6. STD C22.2 NO. 211.1-06 Rigid types EB1 and DB2/ES2 PVC conduit
7. STD C22.2 NO. 211.2-06 Rigid PVC (unplasticized) conduit
8. CSA C22.2 NO. 227.1:19 Electrical nonmetallic tubing (Binational standard with UL 1653)
9. NFPA 70 - National Electrical Code (NEC), 2017 Edition.
10. CSA (Canadian Standards Association).
11. UL (Underwriters Laboratories Inc.).
12. Ontario Electrical Safety Code (OESC) 28th Edition, 2021.

Part 2 Products

2.1 Description

1. Regulatory Requirements:
 - 1.1. Design conduit size to OESC.
 - 1.2. Provide products listed and classified by CSA as suitable for purpose specified and shown.

2.2 Conduit requirements

1. Minimum Size: 3/4 inch unless otherwise specified.
2. Wet and Damp Locations: Use liquid tight flexible conduit.
3. Dry Locations:
 - 3.1. Concealed: Use electrical metallic tubing.
 - 3.2. Exposed: Use electrical metallic tubing.

2.3 Liquid tight flexible metal conduit

1. Description: Interlocked steel construction with PVC jacket.
2. Fittings: CSA-C22.2 No. 56.

2.4 Electrical metallic tubing (emt)

1. Description: CSA-C22.2 No. 83.1; galvanized tubing.
2. Fittings and Conduit Bodies: CSA-C22.2 No. 83.1; steel, compression type.

Part 3 Execution

3.1 Examination

1. Verify that field measurements are as shown on Drawings.
2. Verify routing and termination locations of conduit prior to rough-in.
3. Conduit routing is shown on Drawings in approximate locations unless dimensioned. Route as required to complete wiring system.

3.2 Installation

1. Install conduit to OESC.
2. Arrange supports to prevent misalignment during wiring installation.
3. Support conduit using coated steel or malleable iron straps, lay-in adjustable hangers, clevis hangers, and split hangers.
4. Group related conduits; support using conduit rack.
5. Construct rack using steel channel provide space on each for 25% additional conduits.
6. Fasten conduit supports to building structure and surfaces to Section 26 05 29.
7. Do not support conduit with wire or perforated pipe straps. Remove wire used for temporary supports.
8. Do not attach conduit to ceiling support wires.
9. Arrange conduit to maintain headroom and present neat appearance.
10. Route exposed conduit parallel and perpendicular to walls.
11. Maintain adequate clearance between conduit and piping.
12. Maintain 12 inch clearance between conduit and surfaces with temperatures exceeding 40 degrees C.
13. Cut conduit square using saw or pipe cutter; de-burr cut ends.
14. Bring conduit to shoulder of fittings; fasten securely.

15. Install no more than equivalent of three 90-degree bends between boxes.
 - 15.1. Use conduit bodies to make sharp changes in direction, as around beams.
16. Avoid moisture traps; provide junction box with drain fitting at low points in conduit system.
17. Provide suitable fittings to accommodate expansion and deflection where conduit crosses seismic joints.
18. Provide suitable pull string in each empty conduit except sleeves and nipples.
19. Use suitable caps to protect installed conduit against entrance of dirt and moisture.
20. Ground and bond conduit to Section 26 05 26.
21. Identify conduit to Section 26 05 53.

End of Section

Section 26 05 33.16

Boxes for Electrical Systems

Part 1 General

1.1 Section includes

1. Pull and junction boxes.

1.2 Related requirements

1. Section 26 27 26 - Wiring Devices: Wall plates in finished areas ,floor box service fittings.

1.3 Reference standards

1. CSA C22.1:21 Canadian electrical code, Part I (25th edition), safety standard for electrical installations
2. STD C22.2 NO. 18.1-13 Metallic outlet boxes (Tri-national standard, with UL 514A and ANCE NMX- J-023/1)
3. CSA C22.2 NO. 85:14 Rigid PVC boxes and fittings
4. CSA (Canadian Standards Association).
5. UL (Underwriters Laboratories Inc.).
6. Ontario Electrical Safety Code (OESC) 28th Edition, 2021.

Part 2 Products

2.1 Description

1. Regulatory Requirements:
 - 1.1. Provide products listed and classified by CSA as suitable for the purpose specified and indicated.

2.2 Outlet boxes

1. Sheet Metal Outlet Boxes: CSA-C22.2 No. 18.1, galvanized steel.

2.3 Pull and junction boxes

1. Sheet Metal Boxes: CSA-C22.2 No. 18.1, galvanized steel.
2. Hinged Enclosures.

Part 3 Execution

3.1 Examination

1. Verify locations of floor boxes and outlets in work areas prior to rough-in.

3.2 Installation

1. Install boxes to CSA-C22.1.

2. Install in locations as shown on drawings, and as required for splices, taps, wire pulling, equipment connections and compliance with regulatory requirements.
3. Set wall mounted boxes at elevations to accommodate mounting heights indicated.
4. Electrical boxes are shown on drawings in approximate locations unless dimensioned. Adjust box location up to 10 ft if required to accommodate intended purpose.
5. Orient boxes to accommodate wiring devices oriented as specified in Section 26 27 26.
6. Maintain headroom and present neat mechanical appearance.
7. Install pull boxes and junction boxes above accessible ceilings and in unfinished areas only.
8. Inaccessible Ceiling Areas: Install outlet and junction boxes no more than 6 inches from ceiling access panel or from removable recessed luminaire.
9. Coordinate mounting heights and locations of outlets mounted above counters, benches, and backsplashes.
10. Locate outlet boxes to allow luminaires positioned as shown on reflected ceiling plan.
11. Align adjacent wall mounted outlet boxes for switches, thermostats, and similar devices.
12. Secure flush mounting box to interior wall and partition studs. Accurately position to allow for surface finish thickness.
13. Use stamped steel bridges to fasten flush mounting outlet box between studs.
14. Install flush mounting box without damaging wall insulation or reducing its effectiveness.
15. Use adjustable steel channel fasteners for hung ceiling outlet box.
16. Do not fasten boxes to ceiling support wires.
17. Support boxes independently of conduit.
18. Use gang box where more than one device is mounted together. Do not use sectional box.
19. Use gang box with plaster ring for single device outlets.
20. Set floor boxes level.
21. Large Pull Boxes: Use hinged enclosure in interior dry locations, surface-mounted cast metal box in other locations.

3.3 Adjusting

1. Adjust flush-mounting outlets to make front flush with finished wall material.
2. Install knockout closures in unused box openings.

3.4 Cleaning

1. Clean interior of boxes to remove dust, debris, and other material.
2. Clean exposed surfaces and restore finish.

End of Section

Section 26 05 33.23

Surface raceways for Electrical Systems

Part 1 General

1.1 Section includes

1. Surface metal raceways.
2. Multi-outlet assemblies.

1.2 Related requirements

1. Section 26 05 39 - Underfloor Ducts: Trench duct.
2. Section 26 27 26 - Wiring Devices: Receptacles.

1.3 Reference standards

1. CSA (Canadian Standards Association).
2. CSA C22.1:24 Canadian electrical code, Part I (26th edition), safety standard for electrical installations
3. CSA C22.2 NO. 62.1:15 Nonmetallic surface raceways and fittings (Bi-national standard with UL 5A)
4. CSA C22.2 NO. 62-93 Surface raceway systems
5. UL (Underwriters Laboratories Inc.).

1.4 Action submittals

1. Section 01 33 00: Submission procedures.
2. Product Data: Provide dimensions, knockout sizes and locations, materials, fabrication details, finishes, and accessories.

1.5 Informational submittals

1. Section 01 33 00: Submission procedures.
2. Installation Data: Indicate application conditions and limitations of use stipulated by product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

Part 2 Products

2.1 Description

1. Regulatory Requirements:
 - 1.1. Provide products listed and classified by CSA as suitable for purpose specified and shown.

Part 3 Execution

3.1 Installation

1. Install products to manufacturer's written instructions.
2. Use flat head screws, clips, and straps to fasten raceway channel to surfaces. Mount plumb and level.
3. Use suitable insulating bushings and inserts at connections to outlets and corner fittings.
4. Wireway Supports: Provide steel channel as specified in Section 26 05 29.
5. Close ends of wireway and unused conduit openings.
6. Ground and bond raceway to Section 26 05 26.

End of Section

Section 26 05 53

Identification for Electrical Systems

Part 1 General

1.1 Section includes

1. Nameplates and labels.
2. Wire markers.

1.2 Reference standards

1. CSA (Canadian Standards Association).
2. UL (Underwriters Laboratories Inc.).

Part 2 Products

2.1 Nameplates and labels

1. Nameplates: Engraved three-layer laminated plastic, black letters on white background.
2. Locations:
 - 2.1. Each electrical distribution and control equipment enclosure.
3. Labels: Embossed adhesive tape, with 5 mm white letters on black background. Use only for identification of individual wall switches and receptacles, control device stations.

2.2 Wire markers

1. Description: Tape type wire markers.
2. Locations: Each conductor at panelboard gutters and each load connection.
3. Legend:
 - 3.1. Power and Lighting Circuits: Branch circuit or feeder number indicated on drawings.

Part 3 Execution

3.1 Preparation

1. Degrease and clean surfaces to receive nameplates and labels.

3.2 Application

1. Install nameplate and label parallel to equipment lines.
2. Secure nameplate to equipment front using adhesive.

End of Section

Section 26 05 83 Wiring Connections

Part 1 General

1.1 Section includes

1. Electrical connections to equipment specified under other sections.

1.2 Reference standards

1. CSA C22.1:21 Canadian electrical code, Part I (25th edition), safety standard for electrical installations
2. NEMA WD 6-2016 Wiring devices - dimensional specifications
3. NEMA WD 1-1999 General color requirements for wiring devices
4. NFPA 70 - National Electrical Code (NEC), 2017 Edition.
5. CSA (Canadian Standards Association).
6. UL (Underwriters Laboratories Inc.).
7. Ontario Electrical Safety Code (OESC) 28th Edition, 2021.

1.3 Administrative requirements

1. Coordination:
 - 1.1. Coordinate with other work having a direct bearing on work of this section.
 - 1.2. Obtain and review shop drawings, product data, and manufacturer's instructions for equipment provided under other sections.
 - 1.3. Determine connection locations and requirements.
2. Sequencing:
 - 2.1. Sequence rough-in of electrical connections to coordinate with installation schedule for equipment.
 - 2.2. Sequence electrical connections to coordinate with start-up schedule for equipment.

1.4 Action submittals

1. Product Data: Provide wiring device manufacturer's catalogue information showing dimensions, configurations, and construction.

1.5 Informational submittals

1. Installation Data: Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of Product.

Part 2 Products

2.1 Description

1. Regulatory Requirements:

- 1.1. Provide products listed and classified by CSA as suitable for purpose specified and shown.

Part 3 Execution

3.1 Examination

1. Section 01 71 00: Verify existing conditions before starting work.
2. Verify that equipment is ready for electrical connection, wiring, and energization.

3.2 Electrical connections

1. Make electrical connections to equipment manufacturer's written instructions.
2. Make conduit connections to equipment using flexible conduit. Use liquid-tight flexible conduit with watertight connectors in damp or wet locations.
3. Make wiring connections using wire and cable with insulation suitable for temperatures encountered in heat producing equipment.
4. Provide receptacle outlet where connection with attachment plug is indicated. Provide cord and cap where field-supplied attachment plug is indicated.
5. Provide suitable strain-relief clamps and fittings for cord connections at outlet boxes and equipment connection boxes.
6. Install disconnect switches, controllers, control stations, and control devices as indicated.
7. Modify equipment control wiring with terminal block jumpers as indicated.
8. Provide interconnecting conduit and wiring between devices and equipment where indicated.

End of Section

Section 26 09 43 Lighting Controls

Part 1 General

1.1 Reference standards

1. OESC-21: Ontario Electrical Safety Code
2. CSA Group (CSA):
 - 2.1. CSA C22.1:18, Canadian Electrical Code, Part I (24th Edition), Safety Standard for Electrical Installations

1.2 Administrative

1. Sheridan Expansion and Commissioning for DALI FifthLight Lighting Controls
 - 1.1. Cooper Lighting: Derek Zwiep (Cooper Lighting) – derek.zwiep@cooperlighting.com, Rick Salisbury (Cooper Lighting) – rick.salisbury@cooperlighting.com

1.3 Action and informational submittals

1. Product Data:
 - 1.1. Submit manufacturer's instructions, product literature and data sheets for lighting controls and include product characteristics, performance criteria, physical size, finish and limitations.
2. Shop Drawings:

Part 2 Products

2.1 Components

1. Refer to components indicated on drawings. Refer to Owner's standard.

Part 3 Execution

3.1 Examination

1. Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for network lighting controls installation in accordance with manufacturer's instructions.

3.2 Installation

1. Install system and components in accordance with manufacturer's instructions.

3.3 Site quality control

1. Refer to Electrical Contractor Testing Protocol Production Check List for Fifthlight technology.

End of Section

Section 26 24 16 Panelboards

Part 1 General

1.1 Section includes

1. Distribution panelboards.
2. Branch circuit panelboards.
3. Load centres.

1.2 Related requirements

1. Section 26 05 26 - Grounding and Bonding.
2. Section 26 05 53 - Electrical Identification.

1.3 Reference standards

1. CSA C22.1:24 Canadian electrical code, Part I (26th edition), safety standard for electrical installations
2. CSA C22.2 NO. 5:16 Molded-case circuit breakers, molded-case switches and circuit-breaker enclosures (Trinational standard with UL 489 and NMX-J-266-ANCE-2016)
3. STD C22.2 NO. 29-15 Panelboards and enclosed panelboards
4. NEMA ICS 2-2000 Industrial control and systems - controllers, contactors and overload relays rated 600 V
5. NEMA KS 1-2013 Heavy duty enclosed and dead-front switches (600 Volts maximum)
6. ANSI/NETA ATS-2021 Standard for acceptance testing specifications for electrical power equipment and systems
7. CSA (Canadian Standards Association).
8. UL (Underwriters Laboratories Inc.).
9. OESC-2021 - Ontario Electrical Safety Code, 28th Edition - 2021

1.4 Action submittals

1. Section 01 33 00: Submission procedures.
2. Shop Drawings: Indicate outline and support point dimensions, voltage, main bus ampacity, integrated short circuit ampere rating, circuit breaker and fusible switch arrangement and sizes.

1.5 Informational submittals

1. Section 01 33 00: Submission procedures.
2. Installation Data: Indicate application conditions and limitations of use stipulated by product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

1.6 Closeout submittals

1. Section 01 78 00: Submission procedures.

2. Maintenance Data: Include spare parts listing; source and current prices of replacement parts and supplies; and recommended maintenance procedures and intervals.
3. Record Documentation: Record actual locations of panelboards and record actual circuiting arrangements in project record documents.

1.7 Maintenance material submittals

1. Section 01 78 23: Maintenance and extra material requirements.
2. Extra Stock Materials: Provide two (2) of each panelboard key.

1.8 Quality assurance

1. Products of This Section: Manufactured to ISO 9000 certification requirements.
2. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three (3) years documented experience. Submit proof upon request.

Part 2 Products

2.1 Description

1. Regulatory Requirements:
 - 1.1. Products: Listed and classified by CSA as suitable for the purpose specified and indicated.

2.2 Distribution panelboards

1. Manufacturers:
 - 1.1. Siemens
 - 1.2. Eaton
 - 1.3. Schneider
2. Description: CSA-C22.2 No. 29, circuit breaker type.
3. Panelboard Bus: Copper ratings as indicated. Provide copper ground bus in each panelboard.
4. Minimum integrated short circuit rating: as indicated.
5. Fusible Switch Assemblies: NEMA KS 1, quick-make, quick-break, load interrupter enclosed knife switch with externally operable handle. Provide interlock to prevent opening front cover with switch in ON position. Handle lockable in OFF position. Fuse clips: Designed to accommodate Class J fuses.
6. Moulded Case Circuit Breakers: CSA-C22.2 No. 5, circuit breakers with integral thermal and instantaneous magnetic trip in each pole. Provide circuit breakers listed as Type HACR for air conditioning equipment branch circuits.
7. Moulded Case Circuit Breakers with Current Limiters: CSA-C22.2 No. 5, circuit breakers with replaceable current limiting elements, in addition to integral thermal and instantaneous magnetic trip in each pole.
8. Current Limiting Moulded Case Circuit Breakers: CSA-C22.2 No. 5, circuit breakers with integral thermal and instantaneous magnetic trip in each pole, coordinated with automatically resetting current limiting elements in each pole. Interrupting rating 100,000 symmetrical amperes, let-through current and energy level less than permitted for same size Class RK-5 fuse.
9. Controllers: NEMA ICS 2, AC general-purpose Class A magnetic controller for induction motors rated in horsepower, with bimetal overload relay. Coil operating voltage: 120 volts, 60 Hz. Size as shown on Drawings.

Provide unit mounted control power transformer, HAND-OFF-AUTO selector switch, GREEN indicating light in front cover.

10. Circuit Breaker Accessories: Trip units and auxiliary switches as indicated.
11. Enclosure: NEMA Type 1 sprinkler proof unless otherwise indicated.
12. Cabinet Front: Surface type, fastened with screws, hinged door with flush lock finished in manufacturer's standard gray enamel.

2.3 Branch circuit panelboards

1. Manufacturers:
 - 1.1. Same as distribution panelboards.
2. Description: CSA-C22.2 No. 29, circuit breaker type, lighting and appliance branch circuit panelboard.
3. Panelboard Bus: Copper ratings as indicated. Provide copper ground bus in each panelboard; provide insulated ground bus where scheduled.
4. Minimum Integrated Short Circuit Rating: as indicated.
5. Moulded Case Circuit Breakers: CSA-C22.2 No. 5, plug-on type thermal magnetic trip circuit breakers, with common trip handle for all poles, listed as Type SWD for lighting circuits, Type HACR for air conditioning equipment circuits, Class A ground fault interrupter circuit breakers where scheduled. Do not use tandem circuit breakers.
6. Current Limiting Moulded Case Circuit Breakers: CSA-C22.2 No. 5, circuit breakers with integral thermal and instantaneous magnetic trip in each pole, coordinated with automatically resetting current limiting elements in each pole. Interrupting rating 100,000 symmetrical amperes, let-through current and energy level less than permitted for same size Class RK-5 fuse.
7. Enclosure: NEMA 3R.
8. Cabinet Front: Flush cabinet front with concealed trim clamps, concealed hinge, metal directory frame, and flush lock all keyed alike. Finish in manufacturer's standard gray enamel.

Part 3 Execution

3.1 Installation

1. Install panelboards as indicated, to manufacturer's instructions, and OESC-21.
2. Install panelboards plumb. Install recessed panelboards flush with wall finishes.
3. Height: 6 ft to top of panelboard; install panelboards taller than 6 ft with bottom no more than 4 inches above floor.
4. Provide filler plates for unused spaces in panelboards.
5. Provide typed or neatly handwritten circuit directory for each branch circuit panelboard. Revise directory to reflect circuiting changes required to balance phase loads.
6. Provide engraved plastic nameplates under the provisions of Section 26 05 53.
7. Provide spare conduits out of each recessed panelboard to an accessible location above ceiling. Minimum spare conduits: five (5) empty 1 inch. Identify each as SPARE.
8. Ground and bond panelboard enclosure according to Section 26 05 26.

3.2 Field quality control

1. Inspection and Testing:
 - 1.1. Perform inspections and tests listed in NETA ATS for switches and circuit breakers.

3.3 Adjusting

1. Measure steady state load currents at each panelboard feeder; rearrange circuits in the panelboard to balance the phase loads to within 20% of each other.
2. Maintain proper phasing for multi-wire branch circuits.

End of Section

Section 26 27 26 Wiring Devices

Part 1 General

1.1 Section includes

1. Receptacles.
2. Voice and data wall plates.

1.2 Reference standards

1. CSA C22.1:21 Canadian electrical code, Part I (25th edition), safety standard for electrical installations
2. CSA C22.2 NO. 42:10 General use receptacles, attachment plugs, and similar wiring devices
3. CSA C22.2 NO. 42.1:13 Cover plates for flush-mounted wiring devices (Bi-national standard, with UL 514D)
4. CSA (Canadian Standards Association).
5. UL (Underwriters Laboratories Inc.).

1.3 Action submittals

1. Product Data: Provide manufacturer's catalogue information showing dimensions, colours, and configurations.

1.4 Informational submittals

1. Installation Data: Submit manufacturer's installation instructions.

Part 2 Products

2.1 Description

1. Regulatory Requirements:
 - 1.1. Provide products listed and classified by CSA as suitable for the purpose specified and indicated.

2.2 Receptacles

1. Description: CSA-C22.2 No. 42, Heavy-Duty general use receptacle.
2. Device Body: Ivory plastic.
3. Configuration: Type as specified and indicated.

2.3 Voice and data wall plates

1. 1-gang faceplates with quantity of ports indicated and ability to accept keystone modules of required data or voice connections.
2. Faceplates mount to standard NEMA box.
3. Provide blank plates for unused ports.
4. Keystone Modules

- 4.1. IDC-termination technology. The eight position modules (six position for RJ11) shall be used in all work areas and shall meet the connector requirements of the applicable TIA/EIA standard. Termination shall be accomplished by use of an insulation displacement connection termination. The wiring scheme label shall be available with both T568A and T568B wiring schemes. All terminations for this project shall use the T568B (A) wiring scheme. The modules shall terminate four pair (3 pair for RJ11) 24 AWG and 22 AWG 100 ohm solid unshielded twisted pair cable. The modules shall be universal in design, including complying with the intermateability standard IEC 60603-7 for backward compatibility. Modules shall have UL and CSA approval. The modules shall have ETL verified performance to their specification and ISO Class E (Cat6) performance as defined in ISO/IEC 11801 in both the basic and channel links. They shall be universal in design, accepting six or eight pair modular plugs without damage to the outer module contacts. The modules shall be able to be re-terminated a minimum of 10 times. The module shall snap into all outlets and patch panels. The module shall have a colour coded base to signify performance
- 4.2. Eight position modules (six position for RJ11) shall be used in all work areas and shall meet the connector requirements of the applicable TIA/EIA standard.
- 4.3. Termination shall be accomplished by use of an insulation displacement connection termination.
- 4.4. The wiring scheme label shall be available with both T568A and T568B wiring schemes.
- 4.5. The modules shall terminate four pair (3 pair for RJ11) 24 AWG and 22 AWG 100 ohm solid unshielded twisted pair cable.
- 4.6. The modules shall be universal in design, including complying with the intermateability standard IEC 60603-7 for backward compatibility.
- 4.7. Modules shall have UL and CSA approval. The modules shall have ETL verified performance to their specification and ISO Class E (Cat6) performance as defined in ISO/IEC 11801 in both the basic and channel links.
- 4.8. Modules shall be universal in design, accepting six or eight pair modular plugs without damage to the outer module contacts, shall be able to be re-terminated a minimum of 10 times.
- 4.9. The module shall snap into all outlets and patch panels. The module shall have a colour coded base to signify performance.

Part 3 Execution

3.1 Examination

1. Verify that outlet boxes are installed at proper height.
2. Verify that wall openings are neatly cut and will be completely covered by wall plates.
3. Verify that floor boxes are adjusted properly.
4. Verify that branch circuit wiring installation is completed, tested, and ready for connection to wiring devices.
5. Verify that openings in access floor are in proper locations.

3.2 Preparation

1. Provide extension rings to bring outlet boxes flush with finished surface.
2. Clean debris from outlet boxes.

3.3 Installation

1. Install to OESC.
2. Install devices plumb and level.
3. Install receptacles with grounding pole on bottom.
4. Connect wiring device grounding terminal to branch circuit equipment grounding conductor.
5. Install decorative plates on switch, receptacle, and blank outlets in finished areas.
6. Connect wiring devices by wrapping conductor around screw terminal.
7. Install galvanized steel plates on outlet boxes and junction boxes in unfinished areas, above accessible ceilings, and on surface mounted outlets.

3.4 Interface with other products

1. Coordinate locations of outlet boxes provided under Section 26 05 33.16 to obtain mounting heights specified and indicated on Drawings.
2. Install convenience receptacle 450 mm above finished floor.
3. Install convenience receptacle 150 mm above workstation.

3.5 Field quality control

1. Inspection and Testing:
 - 1.1. Inspect each wiring device for defects.
 - 1.2. Verify that each receptacle device is energized.
 - 1.3. Test each receptacle device for proper polarity.

3.6 Adjusting

1. Adjust devices and wall plates to be flush and level.

3.7 Cleaning

1. Clean exposed surfaces to remove splatters and restore finish.

End of Section

Section 26 28 16.02

Moulded Case Circuit Breakers

Part 1 General

1.1 Related requirements

1.2 Reference standards

1. CSA Group (CSA):
 - 1.1. CSA C22.2 No. 5-16, Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures (tri-national standard with UL 489 and NMX-J-266-ANCE-2016)
 - 1.2. CAN/CSA-C22.2 No. 144-M91, Ground Fault Circuit Interrupters
 - 1.3. CSA C22.2 No.144.1-16, Ground-Fault Circuit-Interrupters (tri-national standard with UL 943 and NMX-J-520-ANCE)

1.3 Action and informational submittals

1. Submit in accordance with Section 01 33 00 - Submittal Procedures.
2. Product Data:
 - 2.1. Submit manufacturer's instructions, product literature, and data sheets for circuit breakers. Include product characteristics, performance criteria, physical sizes, finishes, and limitations.
 - 2.2. Include time-current characteristic curves for breakers with interrupting capacity of 22 000 A symmetrical rms and over at system voltage.

1.4 Delivery, storage, and handling

1. Deliver, store, and handle materials in accordance with Section 01 61 00 - Common Product Requirements.
2. Storage and Handling Requirements:
 - 2.1. Store circuit breakers off ground indoors in a clean, dry, well-ventilated location, and in accordance with manufacturer's recommendations.
 - 2.2. Store and protect circuit breakers from damage that impairs function or lifespan.

Part 2 Products

2.1 Breakers - general

1. Circuit Breakers, and Ground-Fault Circuit Interrupters: To CSA C22.2 No. 5.
2. Bolt-on Moulded Case Circuit Breakers: Over-centre, trip-free toggle-operating mechanism to provide quick-make, quick-break contact action, for manual and automatic operation with temperature compensation for 40°C ambient.
3. Common-Trip Breakers: With single handle for multi-pole applications.
4. Magnetic instantaneous trip elements in circuit breakers to operate only when value of current reaches setting.
 - 4.1. Trip settings on breakers with adjustable trips to range from 3 to 8 times current rating.
5. Circuit breakers with interchangeable trips as indicated.

6. Provide red toggle handles on breakers for fire alarm and exit lighting.

2.2 Thermal magnetic breakers

1. Moulded case circuit breaker to operate automatically by means of thermal and magnetic tripping devices to provide inverse time current tripping and instantaneous tripping for short-circuit protection.

2.3 Instantaneous-trip breakers

1. Moulded case circuit breaker to operate automatically by means of magnetic tripping devices to provide instantaneous tripping for short-circuit protection.
2. Instantaneous-trip circuit breaker to be used only as part of a combination motor starter or controller that also provides overload protection.

2.4 Series-rated thermal magnetic breakers

1. Series-rated breakers to be manufacturer tested and listed.
 - 1.1. Breakers applied following manufacturer's guidelines and accepted best practice.

2.5 Solid-state trip breakers

1. Moulded case circuit breaker to operate by means of solid-state trip unit with associated current sensors and self-powered shunt trip to provide inverse time current trip under overload conditions, and long-time, short-time, instantaneous tripping for ground fault short-circuit protection.

2.6 Ground fault circuit interrupter breakers

1. Ground fault circuit interrupter (GFCI) breakers: To CAN/CSA-C22.2 No. 144 and 144.1, Class A Type, single-pole GFCI breakers, rating as scheduled, complete with test and reset facilities.

2.7 Additional features

1. Include:
 - 1.1. Shunt trip.
 - 1.2. Auxiliary switch.
 - 1.3. Motor-operated mechanism with time delay unit.
 - 1.4. Under-voltage release.
 - 1.5. On-off locking device.
 - 1.6. Handle mechanism.

2.8 Enclosure

1. Provide breakers compatible with existing panelboards.
2. Provide breakers compatible with panelboards specified in Section 26 24 16.01 – Panelboards – Breaker Type.

Part 3 Execution

3.1 Installation

1. Install circuit breakers as indicated.

End of Section

Section 26 28 23

Disconnect Switches - Fused and Non-Fused

Part 1 General

1.1 Reference standards

1. CSA Group
 - 1.1. CAN/CSA-C22.2 No.4-04(R2009), Enclosed and Dead-Front Switches (Tri-National Standard, with ANCE NMX-J-162-2004 and UL 98).
 - 1.2. CSA C22.2 No.39-13, Fuseholder Assemblies.

1.2 Action and informational submittals

1. Submit in accordance with Section 01 33 00 - Submittal Procedures.
2. Product Data:
 - 2.1. Submit manufacturer's instructions, printed product literature and data sheets for disconnect switches - fused and non-fused and include product characteristics, performance criteria, physical size, finish and limitations.

Part 2 Products

2.1 Disconnect switches

1. Fusible, Non-fusible, Horsepower rated disconnect switch in CSA enclosure to, CAN/CSA-C22.2 No.4 size as indicated.
2. Provision for padlocking in on-off switch position by 3 locks.
3. Mechanically interlocked door to prevent opening when handle in ON position.
4. Fuses: size as indicated.
5. Fuseholders: CSA C22.2 No.39 suitable without adaptors, for type and size of fuse indicated.
6. Quick-make, quick-break action.
7. ON-OFF switch position indication on switch enclosure cover.

2.2 Equipment identification

1. Indicate name of load controlled on size 4 nameplate.

Part 3 Execution

3.1 Installation

1. Install disconnect switches complete with fuses if applicable.

End of Section

Section 26 51 13

Interior Lighting

Part 1 General

1.1 Section includes

1. Interior luminaires and accessories.

1.2 Reference standards

1. CSA C22.1:21 Canadian electrical code, Part I (25th edition), safety standard for electrical installations
2. STD C22.2 NO. 9.0-96 General requirements for luminaires
3. CSA C22.2 NO. 141:15 Emergency lighting equipment
4. CSA C22.2 NO. 250.0:21 Luminaires (Trinational standard with UL 1598 and NMX-J-307/1-ANCE)
5. CAN/CSA E920-98 Ballasts for tubular fluorescent lamps - general and safety requirements (Adopted IEC 920:1990, first edition, including Amendment 1:1993 and Amendment 2:1995, with Canadian deviations)
6. CAN/CSA E61347-2-3A-03 Amendment 1:2005 to CAN/CSA-E61347-2-3-03, lamp controlgear - Particular requirements for A.C. applied electronic ballasts for fluorescent lamps (adopted amendment 1:2004 to CEI/IEC 61347-2-3:2000)
7. NEMA WD 6-2016 Wiring devices - dimensional specifications
8. STD C78.379:2006 Electric lamps - classification of the beam patterns of reflector lamps
9. CSA (Canadian Standards Association).
10. OESC-2021 - Ontario Electrical Safety Code, 28th Edition - 2021

1.3 Action submittals

1. Section 01 33 00: Submission procedures.
2. Shop Drawings: Indicate dimensions and components for each luminaire that is not a standard product of the manufacturer.
3. Product Data: Provide dimensions, ratings, and performance data.

1.4 Informational submittals

1. Section 01 33 00: Submission procedures.
2. Installation Data: Submit data indicating application conditions and limitations of use stipulated by product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

1.5 Closeout submittals

1. Section 01 78 00: Submission procedures.
2. Operation and Maintenance Data: Submit manufacturer's operation and maintenance instructions for each product.

1.6 Maintenance material submittals

1. Section 01 78 23: Maintenance and extra material requirements.
2. Extra Stock Materials:
 - 2.1. Provide two (2) of each plastic lens type.
 - 2.2. Provide one (2) replacement lamps for each lamp type.
 - 2.3. Provide two (2) of each ballast type.

1.7 Quality assurance

1. Products of This Section: Manufactured to ISO 9000 certification requirements.
2. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three (3) years documented experience. Submit proof upon request.

Part 2 Products

2.1 Description

1. Regulatory Requirements:
 - 1.1. Conform to requirements of CSA-C22.1.
 - 1.2. Products: Listed and classified by CSA as suitable for the purpose specified and indicated.

2.2 Luminaires

1. As indicated.

Part 3 Execution

3.1 Installation

1. Install suspended luminaires using pendants supported from swivel hangers. Provide pendant length required to suspend luminaire at indicated height.
2. Support luminaires larger than 24 x 48 inch size independent of ceiling framing.
3. Locate recessed ceiling luminaires as indicated on reflected ceiling plan.
4. Install surface mounted luminaires and exit signs plumb and adjust to align with building lines and with each other. Secure to prevent movement.
5. Exposed Grid Ceilings: Support surface mounted luminaires on grid ceiling directly from building structure.
6. Install recessed luminaires to permit removal from below.
7. Install recessed luminaires using accessories and firestopping materials to meet regulatory requirements for fire rating.
8. Install clips to secure recessed grid-supported luminaires in place.
9. Install accessories provided with each luminaire.
10. Make wiring connections to branch circuit using building wire with insulation suitable for temperature conditions within luminaire.
11. Bond products and metal accessories to branch circuit equipment grounding conductor.

12. Install specified lamps in each luminaire.

3.2 Interface with other products

1. Interface with air handling accessories provided and installed under Section 23 36 00.

3.3 Field quality control

1. Inspection and Testing:
 - 1.1. Operate each luminaire after installation and connection. Inspect for proper connection and operation.

3.4 Adjusting

1. Aim and adjust luminaires as directed.
2. Position exit sign directional arrows as indicated.

3.5 Cleaning

1. Section 01 74 10: Cleaning installed work.
2. Clean electrical parts to remove conductive and deleterious materials.
3. Remove dirt and debris from enclosures.
4. Clean photometric control surfaces as recommended by manufacturer.
5. Clean finishes and touch up damage.

3.6 Closeout activities

1. Demonstration: Demonstrate luminaire operation for minimum two (2) hours.

3.7 Protection

1. Section 01 78 23: Protecting installed work.
2. Re-lamp luminaires that have failed lamps and at Substantial Completion.

End of Section

Section 27 05 00

Communications systems

Part 1 General

1.1 Section includes

1. Voice and data cabling.

1.2 Related requirements

1. Section 26 05 33.13 Conduit.
2. Section 26 27 26 Wiring Devices: Voice and data jacks.

1.3 Reference standards

1. Sheridan Master Guidelines for Communications Infrastructure
2. ANSI/TIA-568.0-D, Generic Telecommunications Cabling for Customer Premises
3. ANSI/TIA-568.1-D, Commercial Building Telecommunications Cabling Standard
4. ANSI/TIA-568.2-D, Balanced Twisted-Pair Telecommunications Cabling and Components
5. ANSI/TIA-568.3-D, Optical Fiber Cabling Components Standard
6. ANSI/TIA-569-E, Telecommunications Pathways and Spaces
7. ANSI/TIA-606-D, Administration Standard for Telecommunications Infrastructure
8. ANSI/TIA-607-D, Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises
9. BICSI TDMM, Telecommunications Distribution Methods Manual (TDMM), 14th Edition
10. CSA C22.1:21, Canadian Electrical Code (CEC), Part I (25th Edition), Safety Standard for Electrical Installations

1.4 Informational submittals

1. Installation Data: Manufacturer's special installation requirements.
2. Product Data: Manufacturer product sheets.

1.5 Closeout submittals

1. Record Documentation: Record actual locations and sizes of pathways and outlets.

Part 2 Products

2.1 Description

1. Regulatory Requirements:
 - 1.1. Products Requiring Electrical Connection: Listed and classified by CSA as suitable for the purpose specified and indicated.

2.2 Voice and data cable

1. Data Cable: Four-pair, 100 ohm balanced unshielded twisted pair (UTP), flame test classification FT6 to CSA-C22.2 No. 214, Category 6 to TIA/EIA-568-B.2, jacket to Owner requirements.
Manufacturer: Belden

Part 3 Execution

3.1 Installation

1. Install wire and cable to manufacturer's instructions and to EIA/TIA 568.
2. Installation and labelling conventions to Sheridan Master Guidelines for Communications Infrastructure. Coordinate all installation with Sheridan IT.

3.2 Testing

1. Provide a complete testing report utilizing a testing device as specified in the applicable ANSI/TIA standard with the correct adapter and test. All copper tests shall be compliant to current ANSI/TIA standards: Perm Link or Channel. The summary report shall provide "Pass/Fail" status of each port. The detailed report shall be provided in PDF format.

End of Section

Section 28 15 00

Access Control Systems and Devices

Part 1 General

1.1 Section includes

1. Security access devices.
2. Access control panel.

1.2 Related requirements

1. Section 08 71 00 - Door Hardware - General.

1.3 Action submittals

1. Product Data: Provide electrical characteristics and connection requirements.
2. Shop Drawings: Provide system wiring diagram showing each device and wiring connection required.

1.4 Informational submittals

1. Section 01 33 00: Submission procedures.
2. Test Reports: Indicate satisfactory completion of required tests and inspections.
3. Installation Data: Manufacturer's special installation requirements.
 - 3.1. Indicate application conditions and limitations of use stipulated by Product testing agency.
 - 3.2. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of Product.

1.5 Closeout submittals

1. Section 01 78 00: Submission procedures.
2. Maintenance Contracts: Provide service and maintenance of security access system for one (1) year from Date of Substantial Completion.
3. Operation Data: Operating instructions.
4. Maintenance Data: Maintenance and repair procedures.
5. Record Documentation: Record actual locations of access authorization equipment.

Part 2 Products

2.1 Description

1. Regulatory Requirements:
 - 1.1. Products Requiring Electrical Connection: Listed and classified by CSA as suitable for the purpose specified and indicated.

2.2 Encoded card readers

1. Card Readers: Wall mounted, 20mm or 40 mm as required.
2. Product: Signo, manufactured by HID.

2.3 Electric strike

1. Electric Strike: Cylinder or Mortise.
2. Product: 700 Series, manufactured by Folger Adam.
3. 32d finish

2.4 Motion detectors - request to exit

1. Motion Detectors: Above door mounted.
2. Product: T.REX, manufactured by Kantech.

2.5 Door contacts

1. Product: Wood or metal door recessed sensors, manufactured by Sentrol.

Part 3 Execution

3.1 Installation

1. Expand security system to manufacturer's written instructions.
2. Use 16 AWG minimum size conductors for detection and signal circuit conductors. Install wiring in cable.
3. Make conduit and wiring connections to door hardware devices provided and installed under Section 08 71 00.

End of Section

Section 28 23 00

Video surveillance systems

Part 1 General

1.1 Section includes

1. Cameras.
2. Cable and accessories.

1.2 Reference standards

1. ULC-S317-1996, Installation and Classification of Closed Circuit Video Equipment (CCVC) Systems for Institutional and Commercial Security Systems.
2. CSA-C22.2 No.214 Communications Cables
3. TIA/EIA568-B.1-(2001), Commercial Building Telecommunications Cabling Standard, Part 1: General Requirements
4. TIA/EIA568-B.2-(2001), Commercial Building Telecommunications Cabling Standard, Part 2: Balanced Twisted-Pair Cabling Components

1.3 Action submittals

1. Section 01 33 00: Submission procedures.
2. Product Data: Provide showing electrical characteristics and connection requirements for each component.
 - 2.1. Functional description of equipment.
 - 2.2. Technical data sheets of all devices.
 - 2.3. Device location plans and cable lists.
 - 2.4. Video camera surveillance chart.
 - 2.5. Video interconnection detail drawings.
 - 2.6. Certifications.
3. Shop Drawings: Indicate electrical characteristics and connection requirements, including system wiring diagram.
 - 3.1. Project layout, camera locations, cable schematics, risers, mounting details, labelling scheme.
 - 3.2. Zone layout drawings.

1.4 Informational submittals

1. Section 01 33 00: Submission procedures.
2. Installation Data: Manufacturer's special installation requirements.
 - 2.1. Indicate application conditions and limitations of use stipulated by Product testing agency.
 - 2.2. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of Product.

1.5 Closeout submittals

1. Section 01 78 00: Submission procedures.
2. Maintenance Contracts: Provide service and maintenance of television system for one year from Date of Substantial Completion.
3. Operation Data: Instructions for starting and operating system.
4. Maintenance Data: Routine troubleshooting procedures.
5. Record Documentation: Record actual locations of cameras and routing of television cable.

Part 2 Products

2.1 Description

1. Regulatory Requirements:
 - 1.1. Products Requiring Electrical Connection: Listed and classified by ULC as suitable for the purpose specified and indicated.

2.2 Video Encoder

1. Manufacturers:
 - 1.1. Avigilon; Product: ENC-4P-H264.
 - 1.2. Substitutions: Refer to Section 01 25 00.
2. 4 port video and audio encoder.
3. Rack mounting bracket.
4. Certifications: UL cUL CE ROHS WEEE RCM KC EAC

2.3 Cables

1. Indoor Camera Cable: Four-pair, 100 ohm balanced unshielded twisted pair (UTP), flame test classification FT6 to CSA-C22.2 No. 214, Category 6 to TIA/EIA-568-B.2.

Part 3 Execution

3.1 Installation

1. Install equipment to manufacturer's written instructions.
2. Install cabling and test performance.
3. Terminate and connect cabling to devices.
4. Install ULC labelling where required.
5. Label devices and cables.
6. Update all software and firmware devices to the latest and most up to date from manufacturer.
7. Review configurable features with Owner including camera views, privacy zones, VMS configuration.
8. Provide Owner with user specific passwords and accounts.

3.2 Field quality control

1. Manufacturer's Services:
 - 1.1. Supervise final wiring connections and system adjustments.
2. Operational Verification: ensure devices meet the functional requirements to achieve system performance and fully operational system, including:
 - 2.1. Operation of each device individually
 - 2.2. Operation of configurable camera features
 - 2.3. Switching of camera to monitor
 - 2.4. Privacy zones configured
 - 2.5. Events and recording times

3.3 Closeout activities

1. Demonstration:
 - 1.1. Section 01 79 00: Systems demonstration.
 - 1.2. Demonstrate system operation and provide two (2) sessions with two (2) hours of instruction with manufacturer's training personnel.
 - 1.3. Conduct walking tour of Project and briefly describe function, operation, and maintenance of each component.

End of Section



Institute of Technology & Advanced Learning

MASTER GUIDELINES FOR COMMUNICATIONS INFRASTRUCTURE

VERSION 5.01

MARCH 24, 2020

Prepared in association with:

Fibreight Design Solutions Inc.
for
Information Technology Group

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REVISIONS:

1.0 April 02, 2008

1.1 Initial Draft Creation IT Master Guideline

2.0 February 15, 2010

2.1 Revisions to IT

2.1.1 Additions of Classroom Types

2.1.2 Additions of Detail Sketches

2.1.3 Addition of Paging Systems Section

3.0 February 11, 2011

3.1 Revisions to IT

4.0 March 31, 2012

4.1 Reformat of Entire Document

4.2 Revisions to IT

4.2.1 Removal of Division 27 Samples

4.2.2 Updates to Classroom Types

4.2.3 New Detail Sketches

4.2.4 Updates to Paging Systems

4.2.5 Fibre Upgrades

4.3 Addition of Audio Visual IT Requirements Section

4.4 Addition of Security IT Requirements Section

May 15, 2012

4.5 Revision of Audio Visual IT Requirements Section

4.6 Revision to Paging Requirements Section

October 15, 2012

4.7 Revisions to IT

- 4.7.1 Revisions to Plug Types
- 4.7.2 Additions to Plug Types
- 4.7.3 Revisions to Breakout/Study Rooms
- 4.7.4 Revisions to Meeting Rooms
- 4.7.5 Revisions to Classrooms

November 28, 2012

4.8 Revisions to IT

- 4.8.1 Redefining Plug Types
- 4.8.2 Revisions to Meeting Rooms

5.0 August 25, 2013

5.0 Revision to IT

- 5.0.1 Update of all Codes, Standards, & Acronyms
- 5.0.2 Revisions to Administrative Staff & Titles
- 5.0.3 Addition of Copper Patch Cords
- 5.0.4 Addition of Fibre Patch Cords
- 5.0.5 Revision to 20A Plug Configuration
- 5.06 Update for Inclusion of all Revised Detail Sketches

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1.0 FOREWORD:

The sole purpose of this document is to guide Telecommunication Consultants in their design requirements when producing Tender Drawings and Specifications for contractors bidding various projects and expansions that Sheridan Institute of Technology and Advanced Learning may be undertaking.

Its main focus will be the IT infrastructure, components, installation recommendations, testing procedures and parameters. With telecommunications cabling being utilized in so many other disciplines, we are expanding version 5.0 of the Master Guidelines for Communications Infrastructure to include cabling for Paging, Audio Visual (A/V), and Security components.

All detail drawings or images that pertain to only one section of the master outline will be listed and included at the end of that section.

Manufacturer cut sheet samples will be provided at the end of the document in appendix 14.3

2.0 ACKNOWLEDGEMENTS:

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Other Sources

BICSI (Building Industry Consulting Service International)

3.0 DEFINITIONS:

ANSI	American National Standards Institute
ASTM	American Society for Testing Materials
BICSI	Building Industry Consulting Services International
CEC	Canadian Electrical Code
CLECs	Competitive Local Exchange Carriers
CRTC	Canadian Radio & Television Telecommunications Commission
CUL	Canadian Underwriters Laboratories, Inc.
ICEA	Insulated Cable Engineer's Association
ICT	Information Communication Technology (IT)
IDF-1	Intermediate Distribution Frame Type 1 – Communications Closet
IDF-2	Intermediate Distribution Frame Type 2 – Co-Locate Closet
IEEE	Institute of Electrical and Electronics Engineers
MCC	Main Cross Connect
MCR	Main Computer Room
MDF	Main Distribution Frame
NEC	National Electric Code
NEMA	National Electrical Manufacturer's Association
NFPA	National Fire Protection Agency
POP	Point of Presence
SIREN	Sheridan Incident Reporting & Emergency Notification
SITAL	Sheridan Institute of Technology and Advanced Learning
TIA	Telecommunications Industry Association

4.0 APPLICABLE STANDARDS:

Unless specifically indicated otherwise in this document, all telecommunications infrastructure shall be design in accordance with the following standards including all appropriate addendums and revisions:

ANSI/TIA-455	Test Procedures for Fibre Optics, Cables and Transistors
ANSI/TIA-568-C.0-2008	Generic Commercial Building Telecommunications Cabling Standard
ANSI/TIA-568-C.1-2009	Commercial Building Telecommunications Cabling Standard
ANSI/TIA-568-C.2-2009	Balanced Twisted Pair Telecommunications Cabling and Components Standard
ANSI/TIA-568-C.3-2008	Optical Fibre Cabling Components Standard
ANSI/TIA-568-C.4-2011	Broadband Coaxial Cabling and Components Standard
ANSI/TIA-569-C-2012	Telecommunications Pathways and Spaces Cabling Standard
ANSI/TIA-598-D	Optical Fibre Colour Coding (Draft)
ANSI/TIA-604-3	FOCIS 3 Fibre Optic Connector Intermateability Standard
ANSI/TIA-604-5-D	Fiber Optic Connector Intermateability Standard, Type MPO
ANSI/TIA-604-10-B	FOCIS 10B Fiber Optic Connector Intermateability Standard Type LC
ANSI/TIA-606-B	Administrative Standard for Commercial Telecommunications Infrastructure
ANSI/TIA-607-B-2011	Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises
ANSI/TIA-758-B-2012	Customer Owned Outside Plant Telecommunications Infrastructure Standard
ANSI/TIA-862-A-2011	Building Automation Systems Cabling Standard
ANSI/TIA-942-2005	Telecommunications Infrastructure Standard for Data Centres
ANSI/TIA-1005-2009	Telecommunications Infrastructure Standard for Industrial Premises

ANSI/TIA-1152-2009	Requirements for Field Test Instruments and Measurements for Balanced Twisted-Pair Cabling
ANSI/BICSI-002-2011	Data Centre Design and Implementation Best Practices
ANSI/ICEA S-83-596	Fibre Optic Premises Distribution Cable
ANSI/ICEA S-83-640	Fibre Optic Outside Plant Communications Cable
ANSI/IEEE-110-1992	Powering and Grounding Sensitive Electronic Equipment.
ANSI/NECA/BICSI 568-2006	Standard for Installing Commercial Building Telecommunications Cabling
ANSI/NECA/BICSI-568	Standard for Installing Commercial Building Telecommunications Cabling
ANSI/NFPA 70	National Electrical Code.
ANSI/NFPA 70-1987	Standard for Paging Punch Block and Cable Sizing Requirements
ANSI Z136.2	American Standards for the Safe Operation of Fiber Optic Communications Systems Utilizing Laser Diode and LED Sources
BICSI	Network Design Reference Manual, 7 th Edition
BICSI	Network Systems and Commissioning (NSC) Reference, 1 st Edition
BICSI AVDRM	AV Design Reference Manual, 1 st Edition
BICSI DCDI	Data Center Design and Implementation Best Practices
BICSI ESS	Electronic Safety and Security Design Reference Manual, 2 nd Edition
BICSI ITSI	Information Transport Systems Installation Methods Manual, 6 th Edition
BICSI OPDRM	Outside Plant Design Reference Manual, 5 th Edition
BICSI WDRM	Wireless Design Reference Manual, 3 rd Edition
BICSI TCIM	Telecommunications Cabling Installation Manual

BICSI TDMM	Telecommunications Distribution Methods Manual, 12 th Edition
CISCA	Recommended Test Procedures for Access Floors
CSA C22.1	Canadian Electric Code Part 1 Ontario Hydro Electric Safety Code
CSA C22.2 No. 182.4-M90	Plugs, Receptacles, and Connectors for Communications Systems
CSA C22.2 No. 214-94	Communications Cables
CSA C22.2 No. 232-M	Fibre Optic Cables
ICEA S 104 696	Insulated Cable Engineers Association
IEEE Std. 446	Recommended Practice for Emergency and Standby Power Systems for Industrial and Commercial Applications
IEEE Std. 1100	Recommended Practice for Powering and Grounding Electronic Equipment
NECA/BICSI 607-2011	Standard for Telecommunications Bonding and Grounding Planning and Installation Methods for Commercial Buildings
NFPA-75	Protection of Electronic Computer Data Processing Equipment.
NFPA-297	Guide on Principles and Practices for Communication Systems.
NRC-CNRC	National Building Code of Canada
(RUS) 7 CFR 1755.900	Rural Utilities Service
TIA TSB-155-A-2006	Guidelines for the Assessment and Mitigation of Installed Category 6 Cabling to Support 10BASE-T
TIA TSB-162-2006	Telecommunications Cabling Guidelines for Wireless Access Points
TIA TSB-184-2009	Guidelines for Supporting Power Delivery Over Balanced Twisted-Pair Cabling
TIA TSB-185-2009	Environmental Classification (MICE) Tutorial
TIA TSB-190-2011	Guidelines on Shared Pathways and Shared Sheaths

5.0 TELECOMMUNICATIONS DESIGN GUIDELINES

5.1 DESIGN DELIVERABLES

5.1.1 Programming;

With specific input from Information Communication Technologies, generate outlet schedule based on functional use summary of the needs/program statement.

- Provide preliminary area requirements for entrance facility and telecommunication rooms.
- Identify extent of site work necessary to bring services to building.
- Provide \$/sq.ft. budgetary number.
- Where wireless networks are to be the primary connection to the network, either a Sheridan IT person or an independent consultant with demonstrated expertise in wireless systems shall be commissioned to provide access point layout, equipment selection and input on other construction methods that may affect wireless transmissions.

5.1.2 Schematic Design:

Concept Sketches showing preliminary telecommunications rooms and sizes and zone plan showing areas served by rooms.

- Preliminary backbone riser diagrams showing interrelationships
- Concept sketch showing major pathways for backbone and horizontal cabling

5.1.3 Design Development:

Preliminary drawings identifying device layouts for typical spaces

- Preliminary drawing showing main cable tray layouts
- Preliminary drawing showing communication backbone riser.
- Preliminary drawing showing communication grounding riser.

5.1.4 Construction Documents:

Identify all device locations on scaled plan drawings

- Identify outlet configurations by unique symbol and/or schedule
- Identify all intended pathways and raceways for horizontal and backbone cable.
- Provide enlarged telecommunications room plans indicating placement of racks, cable runway, wall-mounted systems, and ground bus locations.
- Provide rack elevations indicating all patch panel placement, cable management, structural supports, ground connections and space allocated for owner provided network electronics and any owner supplied UPS/power conditioners.

- Provide backboard elevations indicating space allocated for wall fields, equipment, etc.
- Indicate location and provide details for all grounding apparatus.
- Provide CSI format specifications for cable, connectors, cable management hardware, etc.

5.1.5 Construction:

Review shop drawings for cable, connectors, and hardware for:

- Administration compliance with project specifications and Sheridan Institute of Technology & Advanced Learning requirements
- Make periodic construction visits to observe the installation for conformance to project specifications and proper installation practices.
- Perform final punch list including follow-up to verify punch list items have been completed.

5.1.6 Prequalified Manufacturer/Vendor:

Sheridan Institute of Technology & Advanced Learning has mandated that only Belden/CDT shall be an acceptable manufacturer. Any other bid submissions or alternates for cost savings shall not be viewed and any such submissions shall disqualify the bidder. Any bidding Contractor must be a CSV in good standing with Belden/CDT. A copy of certification is required with every bid submission.

5.1.7 Prequalified Contractors:

Sheridan Institute of Technology & Advanced Learning has mandated that only the following Contractors shall be invited to the bid. Any alternates or sub-contract work is not acceptable. The list is closed at:

- Cable Assembly Systems Limited.
4 Sharp Road, P.O. Box 607
Brantford, ON N3T 5P9
Tel: 519-759-4401
Fax: 519-759-4931
- CaTech Systems Limited
201 Whitehall Drive, Unit 4
Markham, ON L3R 9Y3
Tel: 905-944-0000
Fax: 905-944-4844

- Marcomm Integrated Business Solutions
7777 Weston Road.
Vaughan, ON L4L 0G9
Tel: 905-695-1700
Fax: 905-695-1701
- The State Group Inc.
3206 Orlando Drive.
Mississauga, ON L4V 1R5
Tel: 905-293-07419
Fax: 905-293-7548

5.2 FINAL DOCUMENTATION DELIVERABLES:

5.2.1 Testing and Documentation:

Testing Criteria:

- Comply minimally with EIA/TIA testing requirements
- Provide certification from manufacturer.
- Testing shall demonstrate compliance with manufacturer's stated performance.

Documentation:

- Provide warranty certificate upon completion.
- Provide hard copy of summary test results.
- Provide bound hardcopy of test results (ONLY for fewer than 25 drops).
- Provide electronic copy of both summary and test results (for all jobs)

As-builts:

- The Cabling Contractor is required to provide as-built drawing(s) of the cable installation. It shall include all horizontal cabling required to service the space as defined on the drawings.
- The as-built drawing(s) shall include all additional cables (i.e. change notices) installed during the project.
- The as-built drawings shall reflect all termination locations, labeling, elevation detail of final rack layout for horizontal cabling (digital photos are acceptable), elevation details of backboards (digital photos are acceptable), and all cabletray and support structure routing.
- Upon completion of the installation the Cabling Contractor shall provide eight (8) copies of the as-built drawing(s) to the Client. As-built drawings must be forwarded to Client's office **within 5 business days** of the completion of the

project. An additional copy of the as-built drawing is to be posted on the wall in the main distribution rooms

- All changes to drawings shall be engineer drafted standards.

5.2.2 Package Requirements:

Communications Contractor must provide 5 burned CD's with the following information:

- UTP Test Results in Microsoft Excel format or in a format that is easily interpreted by any text reader (i.e. '.txt' extension). DO NOT submit paper test results for projects greater than 25 drops. Testing requirements are outlined further in this document.
- Fibre Test results in Microsoft Excel format or in a format that is easily interpreted by any text reader (i.e. '.txt' extension). DO NOT submit paper test results for projects greater than 25 drops. Testing requirements are outlined further in this document.
- Digital pictures in '.jpg' or '.gif' format. Pictures shall include all relevant information such as top/bottom picture of all racks and cabinets (both front and rear), backboard elevations of all main backboards, all secondary backboards and all riser backboards that are utilized, as well as consolidation points (if applicable).
- Enough room shall be left on the CD for Client to burn as-built drawings onto them.

5.2.3 Warranty and Certification Requirements

- The manufacturer is required to provide minimum 20-year parts and labour Warranty for the entire Structured Cabling Platform, including both UTP copper and fibre. Response time for Warranty items is to be 24 hours. The Cabling Contractor may be required to repair deficient cabling system components outside regular working hours. Bidders are to include a statement of Warranty terms and conditions with their response.
- The Warranty for the Performance Cabling must be such that the cable meets or exceeds the requirements of EIA/TIA-568-A and EIA/TIA-568-A-5 'Transmission Performance Specifications for 100 Ohm 4-pair Category Cabling' including all Standards stated in this Contract.

- If a Warranty issue arises for the cabling the Warrantor must make arrangements to undertake the repair or replacement of Warranty issues within 24 hours of notification. This may require the repair/replace of cabling components outside regular working hours. Bidders are to include a statement of Warranty terms and conditions with their response.

- The Cabling Contractor shall forward the Structured Cabling Platform certification request form(s) to the proper authority and ensure that a Plaque or Certificate is issued to the Project Manager along with the Structured Cabling Platform user manual. The successful bidder will provide a certification number within two weeks of award of this project. Please note that the Plaque/Certificate must have the Project Managers Client name on the Plaque/Certificate.

- The Cabling Contractor will provide letter(s) of Certification within two weeks of substantial completion of the project to the Communications Consultant. This document will include the following: verification of the performance of the installed system, identification of the installation by location and project number and a copy of the Warranty.

- Upon award of contract, the Cabling Contractor shall forward copies of the Structured Cabling Platform certification request for Certification form complete with certification number(s) for the project to Communications Consultants office within 7 days of the award of contract. Provide a copy of the form with Specification submission.

- Upon request and at no additional cost to the Project Manager the Cabling Contractor must provide a manufacturer's technical representative to conduct an on-site visit to ensure complete technical compliance.

- The Cabling Contractor must ensure that a Warranty plaque and letter of certification is issued to the Project Managers Client along with a user manual for the Warranty. The letter must be issued within 2 weeks of substantial completion of the project. This document will include the following: verification of the performance of the installed system, identification of the installation by location and project number and a copy of the Warranty to the Communications Consultant.

- The Cabling Contractor must supply a sample (at the time of bidding) of the Warranty including all related terms and conditions. This sample will be the standard to which the Warranty will be held. No changes will be accepted unless it is deemed to benefit the Project Managers Client. Any proposed changes to the Warranty must be submitted in writing to the Project

Manager/their representative for review. The changes will then be accepted or declined by the Project Authority at their discretion. This is to remain valid for the entire Warranty period.

6.0 SYSTEM AND PERFORMANCE:

6.1 Data System:

Designed to support 1Gbps Ethernet to the desktop over UTP copper cable.

- Intra-building backbone shall support 10Gbps Ethernet
- Inter-building backbone shall support DWDM (Dense Wave Division Multiplexing)

6.2 Voice System:

Specific design to be coordinated with Sheridan Institute of Technology & Advanced Learning Information Communication Technologies. Typically Sheridan College uses VoIP and all cable pulls terminate in the same patch panels.

6.3 Wireless Networks:

Specific design to be coordinated with Sheridan Institute of Technology & Advanced Learning Information Communication Technologies.

6.4 Paging Networks:

Specific design to be coordinated with Sheridan Institute of Technology & Advanced Learning Information Communication Technologies.

6.5 Audio Visual Networks:

Specific design to be coordinated with Sheridan Institute of Technology & Advanced Learning Audio Visual Department.

6.6 Security Networks:

Specific design to be coordinated with Sheridan Institute of Technology & Advanced Learning Security Department.

7.0 SITE AND SERVICE CONSIDERATIONS

7.1 CABLE PATHWAYS

7.1.1 Entrance Cable Pathways:

It is strongly recommended that diverse entrances including multiple conduits from multiple carriers are established at Sheridan Institute of Technology and Advanced Learning Campus Locations. For existing buildings with existing carrier entrance facilities it is strongly recommended that a diverse carrier method be established to eliminate single point of failure.

For buildings with existing carrier entrance facilities where Sheridan Institute of Technology and Advanced Learning is not the sole building tenant, it is strongly recommended that diverse conduit pathways be established between the existing entrance facility and Sheridan Institute of Technology and Advanced Learning main communications room.

Typically, provide minimum of two (2) banks of three (3) 4" (100mm) conduits from nearest telecommunications manhole, tunnel, etc. into service entrance facility. The quantity /size of conduits can vary depending on project requirements. These can be defined on a project-to-project basis. It is also encouraged that the service provider be pressed to extend the demarcation directly to the Sheridan Institute of Technology and Advanced Learning's main communications room.

- Provide three 1 1/4" inner ducts in one of the service entrance conduits.
- Coordinate with Information Communication Technologies for further definition of design requirements.
- Minimum of 1 240V dedicated circuit.
- Minimum of 1 120V dedicated circuit.

REFERENCE FIGURE 01 – INCOMING CONDUIT BANK

7.1.2 Inter-Building Cable Pathways:

It is strongly recommended that two diverse cable pathways between Sheridan Institute of Technology and Advanced Learning occupied buildings be established. These pathways should be physically separated from each other as much as it is practical to prevent a single disaster from affecting both pathways.

Where the intra-building cable pathways enter each building a Sheridan Institute of Technology and Advanced Learning controlled building entrance room is required, as electrical protection devices need to be installed as close to the point of entry as possible. A telecommunications grounding busbar should be located within this room.

Sizes and quantities of intra-building conduit depend on the individual requirements of each project.

REFERENCE FIGURE 02 – CAMPUS ENVIRONMENT

7.1.3 Intra-Building Cable Pathways:

These pathways typically consist of conduit, sleeves and cable tray or ladder rack.

- Between Sheridan Institute of Technology and Advanced Learning Main Communications Room (MCR) and the Intermediate Distribution Frame (IDF) a.k.a. Communications Closet or Co-Locate Closet. There must be two (2) diverse cable pathways established. Typically these would be conduit paths. Quantity of conduits varies according to project requirements.
- Between two communications closets on the same floor there should be a cable pathway installed.
- Within a communications closet or main communications room that does not have raised floor, an overhead raceway is required. This raceway is typically ladder rack or cable tray.
- Sleeves or slots should be installed from the wall mounted telecommunications outlet boxes to above the access ceiling. Typically a 1-gang outlet box with a single faceplate is required for the wall mounted telecommunication outlet; with a minimum of one (1") conduit stub-up. When utilizing Deco adapters, locations with more than 3 outlets at a single location must go to a 2-two gang outlet box with a dual faceplate and the minimum conduit size shall increase to 1-1/4". If utilizing Belden/CDT cover plates, utilize 4-port cover over single gang box.
- In the offices, flexible conduit is required from the modular furniture feed point (either wall or floor) to the modular furniture. This pathway can be either flexible conduit, spiral wrap, split loom tubing, or loom tubing. It must be cut to length and cover the entire length of the exposed cable. It must be secured at both ends as not to expose cable when furniture is bumped or moved. The communications contractor typically installs this.
- In offices for case goods (non modular furniture), a typical 1-gang outlet can be utilized.
- Where case goods are utilized, and communications outlet is located behind furniture, communications contractor must label with a small, removable, coloured sticky dot on the ceiling directly above the location of the outlet.
- All empty conduits must have a pull string (or rope) installed with a minimum breaking tension of 200 lbs.
- All conduits must be reamed at both ends to avoid any sharp edges that may cut or damage cable being installed. Any conduit not de-burred must be reported immediately to the acting GC. Failure to do so will place onus on the communications contractor for any damaged cable.
- All conduits must be grounded as per local codes.

- Conduits may not be routed adjacent to hot water or steam lines or through areas where flammable materials are installed.
- Bends in the conduit are undesirable and must be kept to a minimum. The minimum inside bend radius permitted is six (6) times the inside diameter of the conduit for conduits smaller than two (2") inches. And ten (10) times the inside diameter of conduits larger than two (2") inches.
- Pull boxes must be installed when there are more than two (2) 90° bends in the conduit run, there is a reverse in the conduit run, or the run exceeds one hundred (100') feet.
- Conduits must be aligned on opposite ends of the pull box. Adjacent side (90°) stub ins on pull boxes are not permitted.
- Pull boxes must be in a strait section of conduit run and are not permitted to be used in lieu of a turn, bend, or corner.
- Pull boxes for communications should not be used for any other type of cabling (i.e. security, paging, sound masking).
- Pull boxes outside of Sheridan Institute of Technology and Advanced Learning spaces are undesirable and should be avoided.
- The preference for Sheridan Institute of Technology and Advanced Learning is to have all wiring closets stacked vertically for ease of cable pulls between floors. This is a recommendation and not a requirement.

7.1.4 Intra Building Pathway Requirements:

Backbone:

- Provide minimum of four (4) 4" sleeves through floors in stacked rooms. Cap any unused conduits. All populated conduits shall be fire stopped according to local codes.
- Where rooms are not stacked, provide minimum (4) 4" conduits continuous between rooms, or as required. Cap any unused conduits. All populated conduits shall be fire stopped according to local codes.
- Connect Communications Closets on same floor with a minimum of two (2) 4" conduits.
- Conduit between rooms shall have no more than (2) 90 degree bends without pull box. Pull boxes shall be sized per the amount of conduits.
- Sleeves shall consist of GRS conduit with bushings and stub above the floor a minimum of 4".
- Horizontal backbone routing shall only be through secure cabletray or 4" conduit. No substitutions shall be allowed.

REFERENCE FIGURE 03 – INTERFLOOR CORE REQUIREMENTS

7.1.4a Breakout Room Pathways Requirements:

Four (4) Person Breakout Room:

- Provide two (2) 1¼” conduits, one (1) from each 2-gang back box at wall locations on the two short walls of the room to the centre of the table location.
- At the wall, the conduit shall be bushed, reamed and left with a grommetted bushing as not to damage any future cabling being installed.
- At the table, the conduit shall be stubbed up a minimum of 12” from the slab. This conduit shall be bushed and reamed only not to leave sharp edges but otherwise left unfinished as it will be cut on site to accommodate specific requirements.
- Routing of conduit can be in slab or in conduit if located in ceiling space below.
- All penetrations must be fire-stopped according to code.

Six (6) Person Meeting Room:

- Provide two (2) 2” conduits, one (1) from each 2-gang back box at wall locations on the two short walls of the room to the centre of the table location.
- At the wall, the conduits shall be bushed, reamed and left with a grommetted bushing as not to damage any future cabling being installed.
- At the table, the conduits shall be stubbed up a minimum of 12” from the slab. These conduits shall be bushed and reamed only not to leave sharp edges but otherwise left unfinished as it will be cut on site to accommodate specific requirements.
- Routing of conduits can be in slab or in conduit if located in ceiling space below.
- All penetrations must be fire-stopped according to code.

Eight (8) Person Meeting Room:

- Provide two (2) 2” conduits, one (1) from each 2-gang back box at wall locations on the two short walls of the room to the centre of the table location.
- At the wall, the conduits shall be bushed, reamed and left with a grommetted bushing as not to damage any future cabling being installed.
- At the table, the conduits shall be stubbed up a minimum of 12” from the slab. These conduits shall be bushed and reamed only not to leave sharp edges but otherwise left unfinished as it will be cut on site to accommodate specific requirements.
- Routing of conduits can be in slab or in conduit if located in ceiling space below.
- All penetrations must be fire-stopped according to code.

Ten to Twelve (10-12) Person Meeting Room:

- Provide two (2) 2" conduits, one (1) from each 2-gang back box at wall locations on the two short walls of the room to the centre of the table location.
- At the wall, the conduits shall be bushed, reamed and left with a grommetted bushing as not to damage any future cabling being installed.
- At the table, the conduits shall be stubbed up a minimum of 12" from the slab. These conduits shall be bushed and reamed only not to leave sharp edges but otherwise left unfinished as it will be cut on site to accommodate specific requirements.
- Routing of conduits can be in slab or in conduit if located in ceiling space below.
- All penetrations must be fire-stopped according to code.

Fourteen Plus (14+) Person Meeting Room:

- Provide two (2) 2" conduits, one (1) from each 2-gang back box at wall locations on the two long walls and the wall where the television shall reside to the centre of the table location.
- At the wall, the conduits shall be bushed, reamed and left with a grommetted bushing as not to damage any future cabling being installed.
- At the table, the conduits shall be stubbed up a minimum of 12" from the slab. These conduits shall be bushed and reamed only not to leave sharp edges but otherwise left unfinished as it will be cut on site to accommodate specific requirements.
- Routing of conduits can be in slab or in conduit if located in ceiling space below.
- All penetrations must be fire-stopped according to code.

7.1.5 Minimum Fill Capacities:

- The following tables are to be referenced for all cable maximum fill ratios for communications cables routed through EMT conduit. If not referenced in tender specification, ownership of overfill recommendations and costs associated to remedy shall fall on the consultant and/or contractor.
- Please note that the conduit fill ratios do not apply to RMC, Inner duct, or Corlon style pathways. Consultant must reference internal diameter of these pathways and use the conduit fill formula listed below.
- Conduits under one (1") are not allowed without written expression from Sheridan Institute of Technology and Advanced Learning IT Department.
- Keep in mind when designing and utilizing fill charts below that recommended fill ratios will vary depending on the number of cables. This easy fill table should always be referenced once number of cables are determined for a conduit run or drop location:

Number of Conductors	1	2	>2
Percentage Fill	53%	31%	40%

If you cannot find the corresponding table, please utilize the conduit fill formula:

$A_{\text{conduit}} \times (1 - 1 \times 0.4) / A_{\text{cable}}$, where $A = \pi \times d^2 / 4$

For 4-pair copper cabling please utilize the following tables:

4-pair Category 5E (typical cable O.D. 0.22")

Trade Size	3/4"	1"	1-1/4"	1-1/2"	2"	2-1/2"	3"	4"
Inside ϕ	.824"	1.049"	1.380"	1.610"	2.067"	2.469"	3.068"	4.026"
Maximum	-	7	12	16	22	36	50	-

4-pair Category 6 (typical cable O.D. 0.24")

Trade Size	3/4"	1"	1-1/4"	1-1/2"	2"	2-1/2"	3"	4"
Inside ϕ	.824"	1.049"	1.380"	1.610"	2.067"	2.469"	3.068"	4.026"
Maximum	-	6	10	15	20	30	40	-

4-pair Category 6A (typical cable O.D. 0.29")

Trade Size	3/4"	1"	1-1/4"	1-1/2"	2"	2-1/2"	3"	4"
Inside ϕ	.824"	1.049"	1.380"	1.610"	2.067"	2.469"	3.068"	4.026"
Maximum	-	3	6	7	14	17	20	-

For multi pair Category 5 copper backbone cables please utilize the following tables:

25-pair Category 5 - (typical cable O.D. 0.39")

Trade Size	3/4"	1"	1-1/4"	1-1/2"	2"	2-1/2"	3"	4"
Inside ϕ	.824"	1.049"	1.380"	1.610"	2.067"	2.469"	3.068"	4.026"
Maximum	-	1	2	3	6	8	12	24

50-pair Category 5 - (typical cable O.D. 0.58")

Trade Size	3/4"	1"	1-1/4"	1-1/2"	2"	2-1/2"	3"	4"
Inside ϕ	.824"	1.049"	1.380"	1.610"	2.067"	2.469"	3.068"	4.026"
Maximum	-	-	1	1	3	3	6	12

100-pair Category 5 - (typical cable O.D. 0.78")

Trade Size	3/4"	1"	1-1/4"	1-1/2"	2"	2-1/2"	3"	4"
Inside ϕ	.824"	1.049"	1.380"	1.610"	2.067"	2.469"	3.068"	4.026"
Maximum	-	-	-	1	2	3	6	7

For Fibre Optic Cables please utilize the following tables:

12 Strand Fibre Optic Cable (typical cable O.D. 0.25")

Trade Size	3/4"	1"	1-1/4"	1-1/2"	2"	2-1/2"	3"	4"
Inside ϕ	.824"	1.049"	1.380"	1.610"	2.067"	2.469"	3.068"	4.026"
Maximum	-	5	9	14	18	27	36	-

24 Strand Fibre Optic Cable (typical cable O.D. 0.48")

Trade Size	3/4"	1"	1-1/4"	1-1/2"	2"	2-1/2"	3"	4"
Inside ϕ	.824"	1.049"	1.380"	1.610"	2.067"	2.469"	3.068"	4.026"
Maximum	-	2	5	7	9	16	20	-

7.1.6 Horizontal, Accessible Ceiling Spaces:

- Provide cable trays for bundles of cable exceeding 24 cables.
- Provide J-Hooks for cable bundles of 24 and below.
- Route main cable runs through accessible corridor spaces and drop off into each room from the main runs.
- Do not route main cable trays or cable bundles through classrooms or offices.
- Maintain 18" minimum between cable tray fluorescent lighting.

7.1.7 Manholes & Handholes:

Provide additional manholes and/or hand holes to minimize cable pulls to 400', and two 90 degree bends.

- Where required, provide 4'w x 8'l x 4'd manholes
- Where required, provide 24"w x 42"d x 36"l "Quazite" hand holes. (locate hand holes in green space only)

7.1.8 Communications Cable Tray:

- It is mandatory that any new build or retrofit for cabletray be coordinated with all electrical and mechanical drawings and signed off for clear and unrestricted access for ease of use once installed. Minimum clearances around

cabletray must be maintained as well. (i.e. two (2') at the sides and one (1') above where possible).

- All cable trays shall be WBT PW (Pewter Powder Coated Finish) or BL (Black Powder Coated Finish) Series; or Sheridan Institute of Technology and Advanced Learning approved equivalent. WBT tray is made from documented recycled steel; it offers over 400% increase in cable support and 68% reduction in cabling pressure/strain over traditional round wire trays. It is a continuous, rigid, T-welded steel wire mesh cable management system with the following requirements:

REFERENCE FIGURE 04 – WBT MONOMESH TRAY

- Mesh system permits continuous ventilation of cables and maximum dissipation of heat.
- Wire mesh welded at all intersections.
- Wire Diameter: 0.197-inch (5mm) minimum on all mesh sections.
- All mesh sections must have at least one (1) bottom longitudinal wire along entire length.

UL Classification and CUL Listed:

- 2" deep straight sections in 6, 8, 12, 16, 18, 20 and 24 inch widths
- 4" deep straight sections in 6, 8, 12, 16, 18, 20 and 24 inch widths
- 6" deep straight sections in 8, 12, 16, 18, 20, 22, and 24 inch widths
- 8" deep straight sections in 8, 12, 16, 18, and 20" inch widths

Notes: Sheridan Institute of Technology and Advanced Learning preferences 2 and 4 inch depths and 8, 12, and 18 inch widths.

Specify pewter Powder Coated Finish or Black Powder Coated Finish. Stainless Steel (304L and 316S) is also available but Stainless steel wire is used primarily in corrosive environments and food processing facilities.

Stainless steel does not require additional surface treatment. Consult WBT representative for assistance in selecting finish for specific applications (if required).

Nominal Dimensions:

- Mesh: 2 x 4 inches (50 x 100 mm).
- Straight Section Length: 118 inches (3,000 mm).
- Non-Standard widths and depths are available upon request.

Notes: Refer to drawings for size requirements at various locations. Other sizes are only for reference and must be pre-approved for installation due to interference issues. They must also be installed in multiples to add up to the minimum width required on drawings.

Refer to drawings for sizes required

Fittings:

- Field fabricated, (in accordance with manufacturer's instructions), from straight sections.

Hardware:

- Hardware, including splice connectors and support components available from manufacturer.

Accessories:

- Covers: Solid covers, pre-galvanized steel, width to match tray.

Grounding:

- Grounding Clip is available for continuous ground of cable management system. [aluminum]
- Grounding of the Cabletray shall be the responsibility of the Communications Contractor.

Installation:

- Communications Contractor shall supply and install all required cable tray for horizontal distribution as outlined on drawings.
- All Cable trays and fittings shall conform to ANSI NFPA 70, Article 318- Cable Trays.
- Supply and install all sections of tray including required coupling/joining hardware, support and attachment hardware, and dropouts (waterfalls) where required.
- The radii on all fittings shall match tray width.
- The inside of the cable tray must be free of burrs, sharp edges, or projections, which can damage the cable insulation.
- Supply and install all required rods for support of cabletray structure. Cabletray shall be supported on trapeze clips and a support must be placed within 2 feet (600mm) on each side of any connection to a fitting.
- All metallic cable trays must be grounded. Clearly mark any tray that is used as an equipment grounding conductor, as specified in ANSI/NFPA 70, Section 318-3 (c).
- Communications Contractor must follow routing laid out on the Communications drawings for all cable tray in the computer room and on the floors.
- All cabletrays must be installed above bulkheads where possible.

7.1.9 Communications Cable Support - All Other Locations

- For bundles of up to 16 cables utilise Erico Part Number CAT12, UPC Number 33178 J-hook assemblies. All cabling shall be separated into separate bundles

on each side of the rod. There shall be a maximum of 2 hooks per rod. These are to be supplied and installed by Communications Contractor.

- For bundles between 16 and 24 cables utilise Erico Part Number CAT21, UPC Number 30015 J-hook assemblies. All cabling shall be separated into separate bundles on each side of the rod. There shall be a maximum of 2 hooks per rod. These are to be supplied and installed by Communications Contractor.
- All J-hooks shall be supported by Erico Cablecat UPC Number 30245, CATHBA Angled Hanger Bracket. These are to be supplied and installed by Communications Contractor.
- All horizontal cabling designated as floor monuments shall be routed through underslab conduits (supplied and installed by Div.16) and through the floor into floor boxes and furniture feed points (supplied and installed by Div.16).

REFERENCE FIGURE 05 – ERICO J-HOOK DETAIL

7.1.10 Grounding:

- Well-designed grounding systems reduce the risk of damage to telecommunications equipment from stray voltages. The communications grounding system shall be used for the communications ONLY. Bonding and grounding conductors shall be C.U.L listed for the purposes intended. All bonding conductors shall be insulated copper with green insulation.
- The minimum inside bend radius of a grounding conductor shall be eight (8) times the diameter of that conductor. Bonding conductors should not be placed in ferrous metal conduit.
- Telecommunications grounding for each room type shall be defined in that section.

REFERENCE FIGURE 06 – COPPER GROUNDING BUSBAR

7.1.11 Telecommunications Main Grounding Busbar:

- The telecommunications main grounding busbar (TMGB) is the dedicated extension of the building grounding system for telecommunications. It serves as the master ground bar or central point for the telecommunications grounding system. The TMGB shall be mounted in the main Sheridan Institute of Technology and Advanced Learning communications room of a building. The TMGB shall be connected to the building's service equipment power ground for the building with an insulated stranded cable at least 3/0 AWG in size. This conductor should be continuous in length (no splices) and as straight as possible. Each building shall have a telecommunications main grounding busbar.
- All telecommunications grounding busbars (one in each communications closet or co-location space) will connect to the telecommunications main grounding busbar via the telecommunications bonding busbar (TBB).
- This busbar must be sized to handle a minimum of thirty (30) connections and be 6mm thick and 100mm high. It shall be pre-drilled with standard NEMA spacing.

- The TMGB must be installed on two (2") inch insulating spacers.
- All connections to the TMGB must be made using 2 hole lugs and silver epoxy. Connecting hardware must be at least 6mm copper or copper alloy and tin plated bolts and nuts.
- Do not route bonding backbone within 18" of electrical feeders.

7.1.12 Telecommunications Bonding Backbone:

- The telecommunications bonding backbone (TBB) connects the telecommunications main grounding busbar with each of the telecommunication grounding busbars. There will be one telecommunication grounding busbar in each telecommunication closet.
- The telecommunication bonding backbone shall be insulated stranded copper, 3/0 AWG in size.
- Splices should be kept to a minimum and where necessary should be located in accessible telecommunications spaces.
- Provide a 3/0 AWG insulated copper bonding backbone from the main ground bus in the service entrance facility (MDF) to the intermediate rooms (IDF) with 6 AWG jumper to TGB's.

7.1.13 Telecommunications Grounding Busbar:

- One (1) telecommunications grounding busbar will be located in each telecommunications closet. See the communications closet section for more information.
- Bond all equipment, racks, cabinets, etc to ground busbar in each telecommunications room with 6 AWG insulated ground conductor.
- Minimum performance shall be 2ohms.

7.2 TELECOMMUNICATIONS ROOM FUNCTIONS:

7.2.1 Main Distribution Frame (MDF)

AKA: Main Cross Connect

Main Cross Connect will provide telecommunications services to a building or campus environment. It is a distribution frame on one part of which terminate the permanent outside lines entering the central office building and on another part of which terminate the subscriber line multiple cabling, trunk multiple cabling, etc.

- Provide minimum of one (10' x 12') MDF telecommunications room per building.
- This room is the connection point to all other building in a campus environment.
- This room is where all entrance protectors are located.
- The room is typically lined with plywood.
- This room is located on the exterior wall of the building closest to the Main Computer room facility in the campus environment.
- A grounding system must be provided as outlined in the grounding section.

7.2.2 Main Computer Room (MCR)

The Main Computer Room is the Central Location for all computer services in a campus environment and all other buildings in a campus environment shall connect to this room through their own MCC location.

Room sizes for MDF's, MCR's and IDF's listed in this document are for reference only. All consultants and contractors must adhere to architectural drawings for each project.

The Main Computer Room at larger facilities must be a minimum of 12' x 20' in size.

REFERENCE FIGURE 07 – 12' x 20' COMPUTER ROOM LAYOUT

The Main Computer Room at smaller facilities must be a minimum of 7' x 12' in size.

REFERENCE FIGURE 08 – 7' x 12' COMPUTER ROOM LAYOUT

The Main Computer Room at remote sites must be a minimum of 7' x 8' in size.

REFERENCE FIGURE 09 – 7' x 8' COMPUTER ROOM LAYOUT

7.2.2.1 Main Computer Room General:

- The Main Communication Room must be a maximum of 500' (horizontal and vertical run combined) from the furthest Communications Closet that the Room serves.
- In campus environments these Main Rooms serving the building may be further but distances must be defined to ensure fiber lengths are accurate.
- The Main Communications Room may not be located on the exterior of the building.
- The Main Communications Room may not have windows.
- Equipment racks within the room must have at least four (4') feet clearance in front and from a wall mounted cable termination field and three (3') feet on the rear and clearance from any other wall or obstruction.
- Entrance doors to the closet should swing inward still maximizing the usable space within the room.
- Entrance doors shall have direct access to hallways (i.e. never through a classroom, office or other building services utility rooms).
- Entrance doors shall not have any windows.
- Door and a half width shall be a minimum of 54" wide and 84" high. This shall comprise of two doors, one a full width 36" door and the other a ½ width 18" width door.
- There shall be no door sill in the entrance doorway.

- Doors should be fitted with automatic closers and have either card access or keypad access only.
- The closet shall not be adjacent to any washrooms, janitor's closets, or kitchen spaces. Generally, no plumbing piping, fixtures, or HVAC equipment that could produce leaks or where water may permeate into the room should be located within the confines of the communications closets.
- The closet shall not be directly below or adjacently below any of the rooms defined above.
- No water pipes except for sprinklers shall pass through the ceiling space of the communications closet.
- The Main Communications Room size will vary from campus to campus and sizes shall be defined by Sheridan Institute of Technology and Advanced Learning IT department. The minimum size for this room shall be twelve (12') feet by twenty (20') feet.
- Main Computer Room should be centrally located within the physical area that they serve.
- The Main Computer Room may be stacked with Communication closets wherever possible.
- Adjust room sizes accordingly for additional systems (video, security, access control, etc.)
- Main Computer Room shall feed all fibre and copper backbone to Communications Closets or Co-Locate Closets.

7.2.2.2 Main Computer Room Ceilings:

- Main Computer Room does not require, nor is it recommended that they have finished ceilings. Closets without finished ceilings must have fireproofing encapsulated to reduce dust in the room.
- The minimum clear ceiling height in the Main Computer Room is 9'-6" clear from the finished floor. The only suspended fixture permitted below the 9'-6" clear is the communications cable tray, should it be required. Heights and clearances for this are defined in this document.
- Sprinkler heads within the Main Computer Room should be provided with protective cages to prevent accidental operation.

REFERENCE FIGURE 10 – TYPICAL SPRINKLER CAGES

7.2.2.3 Main Computer Room Floors:

- Main Computer Room requires the installation of anti-static Vinyl Composite Tile (VCT).
- Floors should be level, free of high/low spots that would interfere with floor mounting bolts for equipment such as racks or cabinets.

7.2.2.4 Main Computer Room Walls

- Walls should be 'slab-to-slab' partitions to satisfy one (1) hour fire rating or as local code requires in achieving that one (1) hour fire rating.

- Each wall of the closet (facing accessible ceiling areas) shall have either sleeves or a framed slot installed above the general ceiling height to allow cable to enter the closet overhead, while making the installation of the fire stop materials possible once cabling is installed.
- One wall of the Main Computer Room will have a telecommunications plywood backboard. This shall be in sheets of 4'-0" x 8'-0" x 3/4" fire rated plywood stamped accordingly. The use and space on this backboard shall be reserved to backbone cabling, sound masking, or paging. All plywood shall be G1S, free of any imperfections and mounted good side out. If raising of backboard is required, it shall be done on wood 2" x 6" x 8'-0" studs mounted on 16" centers to create a vertical cable chase behind the plywood. Horizontal bracing or blocking is not allowed.
- On another, either adjacent or opposite wall there shall be a requirement for a security backboard. This shall be one (1) sheet of 4'-0" x 8'-0" x 3/4" fire rated plywood stamped accordingly. The use and space on this backboard shall be reserved for security cabling and/or building environmental controls as required. All plywood shall be G1S, free of any imperfections and mounted good side out. If raising of backboard is required, it shall be done on wood 2" x 6" x 8'-0" studs mounted on 16" centers to create a vertical cable chase behind the plywood. Horizontal bracing or blocking is not allowed.
- Drywall walls within the room are to be painted a light color to enhance room lighting.

7.2.2.5 Main Computer Room Heating, Cooling and Ventilation:

- The Main Computer Room will require 24/7 climate control.
- The air conditioning unit will maintain a positive pressure in the room with a minimum of one air change per hour.
- The air conditioning units shall be located outside the communications closet where possible and the air conditioned air shall be ducted into the closet.
- Room temperature shall be maintained at 18°C to 24°C.
- Air conditioning unit should be backed up by the emergency power generator where available but should not be on the UPS system.
- If air conditioning is inside room, all condensate pipes must be routed to a drain located outside the room.

7.2.2.6 Main Computer Room Power:

- Each Main Computer Room shall have a UPS supplied by Sheridan Institute of Technology and Advanced Learning. All rack circuits and plugs shall be on building EPS (Emergency Power System) or Generator. The UPS panel will support equipment only and not lighting circuits or air conditioning equipment, as those should be on a panel backed up by the generator.
- Air Conditioning within any IT space should be backed up on building EPS or Generator.

- All electrical panels within the Main Computer Room should support power within the Main Computer Room only. There should be no panels mounted in the Main Computer Room that support any equipment/lighting outside of the closet.
- All active equipment in the Main Computer Room must be connected to building EPS (generator power) if it is available.
- There should only be one (1) utility electrical receptacle on each wall that does not have plywood on it or a door on it. These receptacles are not on the UPS panel and do not require generator back up.
- The Main Computer Room shall contain freestanding racks or cabinets that will require UPS power for LAN switches. If raised floor is installed in the facility, they can be under the raised floor. Type and quantity shall be defined for each project.
- UPS receptacles in the Main Computer Room should be identified as such to distinguish them from other receptacles.
- All receptacles reserved for power on the racks shall be mounted at the bottom, back of the rack at the right hand side (not on vertical cable management).

Power shall be located at the bottom of the racks on the right hand side as not to impede the mounting of equipment. It shall not impede the cable management.

REFERENCE FIGURE 11 – C.R. RACK CROSS SECTION

7.2.2.7 Main Computer Room Lighting:

- Lighting intensity within the Main Computer Room should be a minimum of 50 foot candles measured at three (3') feet above the finished floor. Additional lighting should be provided over the wall field termination plywood. Low ratio frequency emission fluorescent lighting should be used.
- Lighting should be powered from a separate power source than the critical network equipment. Lighting should be on back up generator power but not on UPS.
- Lighting should be located a minimum 12" from the front and rear of the rack as not to obstruct cabletrays and access to cabletrays. Lighting should be mounted a minimal 12" above the highest point on the cabletray.

7.2.2.8 Main Computer Room Grounding and Bonding:

- All Main Computer Room shall have a telecommunications grounding busbar (TGB). The TGB shall be 6mm thick and 5ohm high and sufficient width to accommodate fifteen (16) lugs. The TGB shall connect to the telecommunications bonding backbone (TBB) with a minimum 3/0 AWG copper cable. See grounding section of this document for more information on the telecommunication bonding backbone.
-
- All racks and cabinets including metal cable termination frames within the Main Computer Room shall have their frames individually (NOT serially)

connected to the telecommunication grounding busbar via a 6 AWG insulated copper grounding conductor.

- All conduit, ladder rack or cabletray in the Main Computer Room shall be bonded to the telecommunication grounding busbar via a 6 AWG insulated copper grounding conductor. The conduit and ladder rack or cabletray may be serially connected to the TGB. Grounding strips should be used to connect separate sections of ladder rack or cabletray to ensure continuity.
- Metallic cable sheathe should be connected to the telecommunication grounding busbar using 14 AWG insulated copper conductors.
- Typically, the telecommunication grounding busbar will be mounted at the lower right corner of the plywood cable termination wall field. The bar should be mounted on insulated stand-offs as defined in the grounding section.

7.2.2.9 Main Computer Room Rack Requirements

- Middle Atlantic RL10-45 racks are made of 11-gauge steel and are 10-32 tapped to standard EIA spacing. They also come standard with U markings and rack screws. All racks can easily be ganged together with or without cable managers.
- Included, are provisions for bolting units to the floor and standard mounting widths are all available. Optionally, Power bars and cable managers are easily fitted to suit the end use.
- All racks shall be **black** only. Upon request, custom colors and sizes are available.
- Additional components shall be required including VDC10-45 10" vertical managers when ganging racks and VDC6-45 on each side. Vertical or zero U power bars will also be required but must be verified with each project.
- Standard Features Include:
 - Heavy gauge steel, Welded or knockdown
 - Universal EIA hole spacing
 - Various heights available
 - Only 19" mounting is required, with rack height of 45U
 - Ganging capabilities with or without vertical cable managers
 - Available tapped both sides
 - Optional heavy duty kits increase footprint to 36"

REFERENCE FIGURE 12 – RACK ELEVATION DETAIL A

REFERENCE FIGURE 13 – RACK ELEVATION DETAIL B

7.2.2.10 Main Computer Room Cabinet Requirements

- Middle Atlantic MRK-4436 cabinets are made with 11-gauge steel and have a static weight capacity of 10,000 lbs. They come with 10-32 tapped to standard EIA spacing. Additional rear Z rails are required
- The tops are configurable for any scenario.
- All cabinets shall be black only. Upon request, custom colors and sizes are available.
- Additional requirements for cabinets shall be defined for each individual project.

7.2.3 Intermediate Distribution Frame Type I (IDF I) AKA: Communications Closets

Communications Co-Locate Closets will provide the IT services to the general area in which the closet is located. Each floor of each Sheridan Institute of Technology and Advanced Learning occupied building must have at least one (1) communications closet or communications co-locate closet. Cabling serving offices, classrooms, other services on a particular floor must be terminated in a communications closet or communications co-locate on the same floor.

REFERENCE FIGURE 14 – 5' x 8' I.T. CLOSET

REFERENCE FIGURE 15 – 7' x 6' I.T. CLOSET

REFERENCE FIGURE 16 – I.T. CLOSET CROSS SECTION 'A'

REFERENCE FIGURE 17 – I.T. CLOSET CROSS SECTION 'B'

REFERENCE FIGURE 18 – 4.5' x 6' SHALLOW I.T. CLOSET

7.2.3.1 Communications Closet General:

- Each closet must be a maximum of 235' (horizontal run) from the furthest telecommunications outlet that the closet serves. The remaining 60' is reserved for vertical cable run and patch cords. Please note that these lengths are for cable distance, NOT drawing scale distance.
- Equipment racks within the room must have at least four (4') feet clearance from a wall mounted cable termination field and three (3') feet of clearance from any other wall or obstruction.
- Entrance doors to the closet should swing outward where possible maximizing the usable space within the room.
- Entrance doors shall have direct access to hallways (i.e. never through a classroom, office or other building services utility rooms.
- Entrance doors shall not have any windows.
- Door width shall be a minimum of 36" wide and 84" high.
- There shall be no door sill in the entrance doorway.
- Doors should be fitted with automatic closers and have either card access or keypad access only.

- The closet shall not be adjacent to any washrooms, janitor's closets, or kitchen spaces. Generally, no plumbing piping, fixtures, or HVAC equipment that could produce leaks or where water may permeate into the room should be located within the confines of the communications closets.
- The closet shall not be directly below or adjacently below any of the rooms defined above.
- No water pipes except for sprinklers shall pass through the ceiling space of the communications closet.
- The minimum closet size is 8'-0" x 10'-0" (80 sq. ft.). These are minimum width x length requirements (i.e. a room with 4'-0" x 20'-0" is not acceptable)
- Communications closets should be centrally located within the physical area that they serve.
- Stack rooms wherever possible.
- Provide one room for every 100 to 20,000 sq.ft. and less than 295 ft. in length of cable.
- Adjust room sizes accordingly for additional systems (video, security, access control, etc.)

7.2.3.2 Communications Closet Ceilings:

- Communications closets do not require, nor is it recommended that they have finished ceilings. Closets without finished ceilings must have fireproofing encapsulated to reduce dust in the room.
- The minimum clear ceiling height in the communications closet is 9'-6" clear from the finished floor. The only suspended fixture permitted below the 9'-6" clear is the communications cable tray, should it be required. Heights and clearances for this are defined in this document.
- Sprinkler heads within the room should be provided with protective cages to prevent accidental operation.

7.2.3.3 Communications Closet Floors:

- Communications closets require the installation of anti-static Vinyl Composite Tile (VCT).
- Floors should be level, free of high/low spots that would interfere with floor mounting bolts for equipment such as racks or cabinets.

7.2.3.4 Communications Closet Walls

- Walls should be 'slab-to-slab' partitions to satisfy one (1) hour fire rating or as local code requires in achieving that one (1) hour fire rating.
- Each wall of the closet (facing accessible ceiling areas) shall have either sleeves or a framed slot installed above the general ceiling height to allow cable to enter the closet overhead, while making the installation of the fire stop materials possible once cabling is installed.
- One wall of the Communications Closet will have a telecommunications plywood backboard. This shall be in sheets of 4'-0" x 8'-0" x 3/4" fire rated plywood stamped accordingly. The use and space on this backboard shall be reserved to backbone cabling, sound masking, or paging. All plywood shall be

G1S, free of any imperfections and mounted good side out. If raising of backboard is required, it shall be done on wood 2" x 6" x 8'-0" studs mounted on 16" centers to create a vertical cable chase behind the plywood. Horizontal bracing or blocking is not allowed.

- On another, either adjacent or opposite wall there shall be a requirement for a security backboard. This shall be one (1) sheet of 4'-0" x 8'-0" x ¾" fire rated plywood stamped accordingly. The use and space on this backboard shall be reserved for security cabling and/or building environmental controls as required. All plywood shall be G1S, free of any imperfections and mounted good side out. If raising of backboard is required, it shall be done on wood 2" x 6" x 8'-0" studs mounted on 16" centers to create a vertical cable chase behind the plywood. Horizontal bracing or blocking is not allowed.
- Drywall walls within the room are to be painted a light color to enhance room lighting.

7.2.3.5 Communications Closet Heating, Cooling and Ventilation:

- All communications closets will require 24/7 climate control.
- The air conditioning unit will maintain a positive pressure in the room with a minimum of one air change per hour.
- The air conditioning units shall be located outside the communications closet where possible and the air conditioned air shall be ducted into the closet.
- Room temperature shall be maintained at 18°C to 24°C.
- Air conditioning unit should be backed up by the emergency power generator where available but should not be on the UPS system.
- If air conditioning is inside room, all condensate pipes must be routed outside the room.
- The relative humidity in the room must be kept at 40%

7.2.3.6 Communications Closet Power:

- Each communications closet shall have a UPS supplied by Sheridan Institute of Technology and Advance Learning. All rack circuits and plugs shall be on building EPS (Emergency Power System) or Generator. The UPS panel will support equipment only and not lighting circuits or air conditioning equipment, as those should be on a panel backed up by the generator.
- All electrical panels within the telecommunications closet should support power within the communications closet only. There should be no panels mounted in the closet that support any equipment/lighting outside of the closet.
- There should only be one (1) utility electrical receptacle on each wall that does not have plywood on it or a door on it. These receptacles are not on the UPS panel and do not require generator back up.
- The communications closet shall contain free standing racks or cabinets that will require UPS power for LAN switches. If raised floor is installed in the facility, they can be under the raised floor. Type and quantity shall be defined for each project.

- UPS receptacles in the room should be identified as such to distinguish them from other receptacles.
- All receptacles reserved for power on the racks shall be mounted at the bottom, back of the rack at the right hand side (not on vertical cable management).

7.2.3.7 Communications Closet Lighting:

- Lighting intensity within the room should be a minimum of 50 foot candles measured at three (3') feet above the finished floor. Additional lighting should be provided over the wall field termination plywood. Low ratio frequency emission fluorescent lighting should be used.
- Lighting should be powered from a separate power source than the critical network equipment. Lighting should be on back up generator power but not on UPS.
- Lighting should be located a minimum 12" from the front and rear of the rack as not to obstruct cabletrays and access to cabletrays. Lighting should be mounted a minimal 12" above the highest point on the cabletray.
- Lighting should not interfere, cross or be installed perpendicular to the cable tray within the room.

7.2.3.8 Communications Closet Grounding and Bonding:

- All telecommunications closets shall have a telecommunications grounding busbar (TGB). The TGB shall be 6mm thick and 50mm high and sufficient width to accommodate fifteen (16) lugs. The TGB shall connect to the telecommunications bonding backbone (TBB) with a minimum 3/0 AWG copper cable. See grounding section of this document for more information on the telecommunication bonding backbone.
- All racks and cabinets including metal cable termination frames within the closet shall have their frames individually (NOT serially) connected to the telecommunication grounding busbar via a 6 AWG insulated copper grounding conductor.
- All conduit, ladder rack or cabletray in the communications closet shall be bonded to the telecommunication grounding busbar via a 6 AWG insulated copper grounding conductor. The conduit and ladder rack or cabletray may be serially connected to the TGB. Grounding strips should be used to connect separate sections of ladder rack or cabletray to ensure continuity.
- Metallic cable sheathe should be connected to the telecommunication grounding busbar using 14 AWG insulated copper conductors.
- Typically, the telecommunication grounding busbar will be mounted at the lower right corner of the plywood cable termination wall field. The bar should be mounted on insulated stand-offs as defined in the grounding section.

7.2.3.9 Communications Closet Rack Requirements

- Middle Atlantic RL10-45 racks are made of 11-gauge steel and are 10-32 tapped to standard EIA spacing. They also come standard with U markings and rack screws. All racks can easily be ganged together with or without cable managers.

- Included, are provisions for bolting units to the floor and standard mounting widths are all available. Optionally, Power bars and cable managers are
- easily fitted to suit the end use.
- All racks shall be black only. Upon request, custom colors and sizes are available.
- Additional components shall be required including VDC10-45 10” vertical managers when ganging racks and VDC6-45 on each side. Vertical or zero U power bars will also be required but must be verified with each project.
- Standard Features Include:
 - Heavy gauge steel
 - Welded or knockdown
 - Universal EIA hole spacing
 - Various heights available
 - Only 19” mounting is required, with rack height of 44U
 - Ganging capabilities with or without vertical cable managers
 - Available tapped both sides
 - Optional heavy duty kits increase footprint to 36”

7.2.4 Intermediate Distribution Frame Type II (IDF II) AKA: Communications Co-Locate Closets

Communications co-locate closets will provide the IT services to the general area in which the closet is located. Each floor of each Sheridan Institute of Technology and Advanced Learning occupied building must have at least one (1) communications closet or communications co-locate closet. Cabling serving offices, classrooms, other services on a particular floor must be terminated in a communications closet or communications co-locate on the same floor.

7.2.4.1 Communications Co-Locate Closet General:

- Each co-locate closet must be a maximum of 235’ (horizontal run) from the furthest telecommunications outlet that the co-locate closet serves. The remaining 60’ is reserved for vertical cable run and patch cords. Please note that these lengths are for cable distance, NOT drawing scale distance.
- All co-locate closets will utilize four post, two section, front and rear lockable and vented cabinets.
- Equipment cabinets within the room must have at least four (4’) feet clearance from a wall mounted cable termination field and three (3’) feet of clearance from any other wall or obstruction.
- Entrance doors to the co-locate closet should swing inward where possible maximizing the usable space within the room.
- Entrance doors shall have direct access to hallways (i.e. never through a classroom, office or other building services utility rooms.
- Entrance doors shall not have any windows.
- Door width shall be a minimum of 36” wide and 84” high.
- There shall be no door sill in the entrance doorway.

- Doors should be fitted with automatic closers and have either card access or keypad access only.
- The co-locate closet shall not be adjacent to any washrooms, janitor's closets, or kitchen spaces. Generally, no plumbing piping, fixtures, or HVAC equipment that could produce leaks or where water may permeate into the room should be located within the confines of the co-locate closets.
- The co-locate closet shall not be directly below or adjacently below any of the rooms defined above.
- No water pipes except for sprinklers shall pass through the ceiling space of the co-locate closet.
- The minimum IT portion of the co-locate closet size is 8'-0" x 10'-0" (80 sq. ft.). These are minimum width x length requirements (i.e. a room with 4'-0" x 20'-0" is not acceptable)
- Co-locate closets should be centrally located within the physical area that they serve.
- Stack rooms wherever possible.
- Provide one co-locate closet for every 100 to 20,000 sq.ft. and less than 295 ft. in length of cable.
- Adjust room sizes accordingly for additional systems (video, security, access control, etc.)

7.2.4.2 Communications Co-Locate Closet Ceilings:

- Co-locate closets do not require, nor is it recommended that they have finished ceilings. Co-locate closets without finished ceilings must have fireproofing encapsulated to reduce dust in the room.
- If in row cooling is not being used at a co-locate closet, only then will a dropped T-bar ceiling be acceptable as a return air plenum.
- The minimum clear ceiling height in the communications closet is 9'-6" clear from the finished floor. The only suspended fixture permitted below the 9'-6" clear is the communications cable tray, should it be required. Heights and clearances for this are defined in this document.
- Sprinkler heads within the room should be provided with protective cages to prevent accidental operation.

7.2.4.3 Communications Co-Locate Closet Floors:

- Co-locate closets require the installation of anti-static Vinyl Composite Tile (VCT).
- Floors should be level, free of high/low spots that would interfere with floor mounting bolts for equipment such as racks or cabinets.

7.2.4.4 Communications Co-Locate Closet Walls

- Walls should be 'slab-to-slab' partitions to satisfy one (1) hour fire rating or as local code requires in achieving that one (1) hour fire rating.
- Each wall of the co-locate closet (facing accessible ceiling areas) shall have either sleeves or a framed slot installed above the general ceiling height to

allow cable to enter the closet overhead, while making the installation of the fire stop materials possible once cabling is installed.

- One wall of the co-locate closet will have a telecommunications plywood backboard. This shall be in sheets of 4'-0" x 8'-0" x 3/4" fire rated plywood stamped accordingly. The use and space on this backboard shall be reserved to backbone cabling, sound masking, or paging. All plywood shall be G1S, free of any imperfections and mounted good side out. If raising of backboard is required, it shall be done on wood 2" x 6" x 8'-0" studs mounted on 16" centers to create a vertical cable chase behind the plywood. Horizontal bracing or blocking is not allowed.
- On another, either adjacent or opposite wall there shall be a requirement for a security backboard. This shall be one (1) sheet of 4'-0" x 8'-0" x 3/4" fire rated plywood stamped accordingly. The use and space on this backboard shall be reserved for security cabling and/or building environmental controls as required. All plywood shall be G1S, free of any imperfections and mounted good side out. If raising of backboard is required, it shall be done on wood 2" x 6" x 8'-0" studs mounted on 16" centers to create a vertical cable chase behind the plywood. Horizontal bracing or blocking is not allowed.
- Drywall walls within the room are to be painted a light color to enhance room lighting.

7.2.4.5 Communications Co-Locate Closet Heating, Cooling and Ventilation:

- All co-locate closets will require 24/7 climate control.
- The air conditioning unit will maintain a positive pressure in the room with a minimum of one air change per hour.
- The air conditioning units shall be located outside the communications closet where possible and the air conditioned air shall be ducted into the closet.
- Room temperature shall be maintained at 18°C to 24°C.
- Air conditioning unit should be backed up by the emergency power generator where available but should not be on the UPS system.
- If air conditioning is inside room, all condensate pipes must be routed outside the room.
- The relative humidity in the room must be kept at 40%

7.2.4.6 Communications Co-Locate Closet Power:

- Each co-locate closet shall have a UPS supplied by Sheridan Institute of Technology and Advance Learning. All rack circuits and plugs shall be on building EPS (Emergency Power System) or Generator. The UPS panel will support equipment only and not lighting circuits or air conditioning equipment, as those should be on a panel backed up by the generator.

- All electrical panels within the co-locate closet should support power within the co-locate closet only. There should be no panels mounted in the closet that support any equipment/lighting outside of the closet.
- There should only be one (1) utility electrical receptacle on each wall that does not have plywood on it or a door on it. These receptacles are not on the UPS panel and do not require generator back up.
- The co-locate closet shall contain free standing cabinets that will require UPS power for LAN switches. If raised floor is installed in the facility, they can be under the raised floor. Type and quantity shall be defined for each project.
- UPS receptacles in the room should be identified as such to distinguish them from other receptacles.
- All receptacles reserved for power on the cabinets shall be mounted inside the IT section of the cabinet.

7.2.4.7 Communications Co-Locate Closet Lighting:

- Lighting intensity within the co-locate closet should be a minimum of 50 foot candles measured at three (3') feet above the finished floor. Additional lighting should be provided over the wall field termination plywood. Low ratio frequency emission fluorescent lighting should be used.
- Lighting should be powered from a separate power source than the critical network equipment. Lighting should be on back-up generator power but not on UPS.
- Lighting should be located a minimum 12" from the front and rear of the rack as not to obstruct cabletrays and access to cabletrays. Lighting should be mounted a minimal 12" above the highest point on the cabletray.
- Lighting should not interfere, cross or be installed perpendicular to the cable tray within the room.

7.2.4.8 Communications Co-Locate Closet Grounding and Bonding:

- All co-locate closets shall have a telecommunications grounding busbar (TGB). The TGB shall be 6mm thick and 50mm high and sufficient width to accommodate fifteen (16) lugs. The TGB shall connect to the telecommunications bonding backbone (TBB) with a minimum 3/0 AWG copper cable. See grounding section of this document for more information on the telecommunication bonding backbone.
- All cabinets including metal cable termination frames within the closet shall have their frames individually (NOT serially) connected to the telecommunication grounding busbar via a 6 AWG insulated copper grounding conductor.
- All conduit, ladder rack or cabletray in the communications closet shall be bonded to the telecommunication grounding busbar via a 6 AWG insulated copper grounding conductor. The conduit and ladder rack or cabletray may be serially connected to the TGB. Grounding strips should be used to connect separate sections of ladder rack or cabletray to ensure continuity.
- Metallic cable sheathe should be connected to the telecommunication grounding busbar using 14 AWG insulated copper conductors.

- Typically, the telecommunication grounding busbar will be mounted at the lower right corner of the plywood cable termination wall field. The bar should be mounted on insulated stand-offs as defined in the grounding section.

7.2.4.9 Communications Co-Locate Closet Cabinet Requirements

- Middle Atlantic MRK-4436 cabinets are made with 11-gauge steel and have a static weight capacity of 10,000 lbs. They come with 10-32 tapped to standard EIA spacing. Additional rear Z rails are required
- The tops are configurable for any scenario.
- All cabinets shall be black only. Upon request, custom colors and sizes are available.
- Co-Locate cabinets must have lockable secured doors both front and rear.

8.0 ROOM FUNCTION:

All classrooms will receive a whiteboard. The sizes and number of whiteboards will vary depending on room size and function. Exact size will be defined by the consultant and/or contractor and supplied only by the successful communications contractor. Mounting heights and sizes are defined in the reference sketch.

REFERENCE FIGURE 19 – WHITEBOARD DETAILS

8.1 STANDARD CLASSROOM

Function: Standard classrooms are designed with seating for 48, 36 or 24 students. These students sit at desks that can be moved or reconfigured. The podium where all the teaching equipment will be held will also be re-locatable. There will be no dedicated AV cabling in these rooms, instead all Audio/Video/Control signals will be sent over the network using any of the data jacks in the floor monuments and received by the projectors or sound system using devices that are also connected to our network.

REFERENCE FIGURE 20 – STANDARD CLASSROOM

8.2 SPLIT CLASSROOM

Function: Split classrooms are paired side by side with a moveable wall separating the two of them. Individually, Split rooms are designed the same way as standard rooms. However when the moveable wall is opened the two rooms become one, thus making the podiums act differently. One podium will act as the “master” and be able to take control of the Audio Visual equipment in both rooms. The other podium becomes the “slave” and can no longer control any of the equipment in either room. There will be no whiteboards or projectors mounted onto the moveable wall.

REFERENCE FIGURE 21 – SPLIT CLASSROOM

8.3 MEETING ROOMS

Function: Meeting rooms accommodate up to 14+ people at rectangular or wedge-shaped tables located in the center of the room. These rooms are similar to the group study rooms where the technology is used for presentation purposes but also may be used for video conferencing. These rooms are equipped with a minimum of one LCD screen mounted on the wall near the end of the table. The control device shall be mounted in or on the table to give the users the capability to control and display the LCD. All AV cabling for this room will run from the LCD to the table, so that there is easy access to display any laptop/tablet on the screen.

REFERENCE FIGURE 22 – 4-6 PERSON BREAKOUT ROOM

REFERENCE FIGURE 23 – 8 PERSON BREAKOUT ROOM

REFERENCE FIGURE 24 – 10-12 PERSON BREAKOUT ROOM

REFERENCE FIGURE 25 – 14+ PERSON BREAKOUT ROOM

8.4 LABS

Function: Labs accommodate multiple groups of students at lab style desks in rows. The number of students will depend on the size of the Lab. Depending on function of the lab, these desks may accommodate between two (2) and four (4) students each and not necessarily facing the front of the class. Labs are specialized classrooms. They are set up like a standard classroom but will have to accommodate specialized equipment on a case by case basis. They should include all the base functionality of a classroom with special needs layered on top.

REFERENCE FIGURE 26 – LAB

8.5 BREAKOUT/GROUP STUDY ROOMS

Function: These rooms are designed to allow a small group of students to meet and work collaboratively at a peninsula-style table that is connected to one of the walls. These rooms are equipped with an LCD screen on the opposite wall of the desk for presenting, as well as a wall jack and control device on the same wall to give the students the capability to control and display a laptop/tablet.

REFERENCE FIGURE 27 – BREAKOUT/GROUP STUDY ROOM

8.6 LECTURE HALLS

Function: Auditoriums and lecture halls are intended for large class sizes or special events. These rooms will have tiered seating and state of the art technology. Long throw projectors will be needed to allow for a large bright image to be displayed. All AV equipment will be stored in an AV room located in the back of the auditorium or in the podium at the front of the room.

REFERENCE FIGURE 28 – LECTURE HALL

REFERENCE FIGURE 29 – LECTURE HALL DETAILS

8.7 ADMINISTRATION OFFICES

Function: The need for AV in office spaces is the same as open or public spaces. Strategically placed LCDs are installed for digital signage purposes. The sizes of screens and placement height will vary throughout.

8.8 PUBLIC SPACES

Function: The need for AV in public spaces is very minimal at the college. Usually this only entails strategically placed LCDs around the campus for digital signage use. The sizes of screens and placement height will vary throughout.

8.9 PLUG CONFIGURATIONS

Plug configuration will vary throughout the Sheridan spaces. They are listed below with requirements for each one.

REFERENCE FIGURE 30 – OUTLET TYPES

Type A – Convenience Location

- 2-gang back box and cover plate (by Division 16)
- 1/2" conduit for electrical wiring
- 1" conduit to ceiling space for communications wiring
- Internal barrier between electrical and communications
- One (1) 15A duplex receptacle
- Two (2) Category 6 Modular outlets on Decora strap
- One (1) blank insert
- Mounted at 12" A.F.F.

REFERENCE FIGURE 31 – TYPE 'A'

Type B – Printer Location

- 2-gang back box and cover plate (by Division 16)
- 1/2" conduit for electrical wiring
- 1" conduit to ceiling space for communications wiring
- Internal barrier between electrical and communications
- One (1) 20A duplex receptacle
- One (1) Category 6 Modular outlet on Decora strap
- Two (2) blank inserts
- Mounted at 12" A.F.F.

REFERENCE FIGURE 31 – TYPE 'B'

Type C – Projector Location

- 2-gang back box and cover plate (by Division 16)
- 1" conduit for communications wiring
- Internal barrier between electrical and communications
- One (1) 15A duplex receptacle
- One (1) Category 6 Modular outlet on Decora strap
- Two (2) blank inserts
- Mounted at 111" A.F.F.

REFERENCE FIGURE 32 – TYPE ‘C’

Type D – Podium Location

- 3-gang back box and cover plate (by Division 16)
- 1” conduit for communications wiring
- Internal barrier between electrical and communications
- Two (2) 15A duplex receptacles
- Two (2) Category 6 Modular outlets on Decora strap
 - one of the 2 drops requires to be a purple jack.
- One (1) blank inserts
- Mounted in floor monument 6’ off each wall and/or centre of room as defined on classroom sketches

REFERENCE FIGURE 32 – TYPE ‘D’

Type E – Wireless Access Point Location

- 1-gang back box and cover plate (by Division 16)
- One (1) Category 6 Modular outlet on Decora strap
- Two (2) blank inserts
- Mounted above finished ceiling

REFERENCE FIGURE 33 – TYPE ‘E’

Type F – Above Ceiling Outlet

- 3-gang back box and cover plate (by Division 16)
- Internal barrier between electrical and communications
- Two (2) 15A duplex receptacles
- Three (3) Category 6 Modular outlets on Decora strap
- Mounted above finished ceiling outside of classroom as defined on classroom sketches

REFERENCE FIGURE 33 – TYPE ‘F’

Type G – Wall Mount Phone Location

- 1-gang back box and cover plate (by Division 16)
- 1” conduit to ceiling space for communications wiring
- One (1) Category 6 Modular outlets on Decora strap
- Two (2) blank inserts
- Mounted at 48” A.F.F.

REFERENCE FIGURE 34 – TYPE ‘G’

Type H – Lecture Capture Camera Location

- 2-gang back box and cover plate (by Division 16)
- 1/2" conduit for electrical wiring
- 1" conduit to ceiling space for communications wiring
- Internal barrier between electrical and communications
- One (1) 15A duplex receptacle
- One (1) Category 6 Modular outlet on Decora strap
- Two (2) blank inserts
- Mounted at 12" under finished ceiling

REFERENCE FIGURE 34 – TYPE 'H'

Type J – LCD Location

- 2-gang recessed back box and cover plate (by Division 16)
- 1/2" conduit for electrical wiring
- 1" conduit to ceiling space for communications wiring
- Internal barrier between electrical and communications
- One (1) 15A duplex receptacle
- One (1) Category 6 Modular outlet on Decora strap
- Two (2) blank inserts
- Mounted at 72" A.F.F.

REFERENCE FIGURE 35 – TYPE 'J'

Type K – Spider Mfg. PHA2 Table Location

- PHA2 Spider box mounted in table
- 1" conduit for communications wiring
- Internal barrier between electrical and communications
- One (1) 15A duplex receptacle
- Two (2) Category 6 Modular outlets on Decora strap
- Four (4) blank inserts

REFERENCE FIGURE 35 – TYPE 'K'

Type L – Under Table Surface Mount Location

- 3-gang surface mount box and cover plate (by Division 16)
- 1" conduit for communications wiring
- Internal barrier between electrical and communications
- Two (2) 15A duplex receptacles
- Two (2) Category 6 Modular outlets on Decora strap
- One (1) blank insert
- Mounted to underside of table

REFERENCE FIGURE 36 – TYPE 'L'

Type M – Podium Lecture Stand Location

- 3-gang back box and cover plate (by Division 16)
- 1/2" conduit to floor monument for electrical wiring
- 2" conduit to A/V Control Room for communications wiring
- Internal barrier between electrical and communications
- Two (2) 15A duplex receptacles
- Three (3) Category 6 Modular outlets on Decora strap
- Mounted inside podium

REFERENCE FIGURE 36 – TYPE 'M'

Type N – Lecture Hall Projector Location

- 3-gang back box and cover plate (by Division 16)
- 1/2" conduit for electrical wiring
- 2" conduit A/V Control Room for communications wiring
- Internal barrier between electrical and communications
- Two (2) 15A duplex receptacles
- Two (2) Category 6 Modular outlets on Decora strap
- One (1) blank insert
- Mounted above finished ceiling

REFERENCE FIGURE 37 – TYPE 'N'

Type P – A/V Closet Location

- 4-gang back box and cover plate (by Division 16)
- 1/2" conduit for electrical wiring
- Two (2) 1" conduits to ceiling space for communications wiring
- Internal barrier between electrical and communications
- Two (2) 15A duplex receptacle
- Four (4) Category 6 Modular outlets on Decora strap
- Two (2) blank inserts

REFERENCE FIGURE 37 – TYPE 'P'

Type Q – Spider Mfg. PHA2 Table Location

- PHA2 Spider box mounted in table
- 1" conduit for communications wiring
- Internal barrier between electrical and communications
- Two (2) 15A duplex receptacles
- Four (4) Category 6 Modular outlets on Decora strap
- Two (2) blank inserts

REFERENCE FIGURE 38 – TYPE 'Q'

Type R – Spider Mfg. PHA2 Table Location

- PHA2 Spider box mounted in table
- 2 @ 1” conduits for communications wiring
- Internal barrier between electrical and communications
- One (1) 15A duplex receptacles
- Two (2) Category 6 Modular outlets on Decora strap
- Two (2) blank inserts

REFERENCE FIGURE 38 – TYPE ‘R’

Type S – Wall Mount Clock Location

- 1-gang back box and cover plate (by Division 16)
- 1” conduit for communications wiring
- One (1) Category 6 Modular outlets on Decora strap
- Two (2) blank inserts
- Mounted at 12” Above Door Frame at classroom entrance

REFERENCE FIGURE 39 – TYPE ‘S’

Type T – Sheridan TV Outlet

- 3-gang back box and cover plate (by Division 16)
- 1” conduit for communications wiring
- Internal barrier between electrical and communications
- Two (2) 15A duplex receptacles
- Two(2) Category 6 Modular outlets on Decora strap
- One (1) Blank insert
- Mounted 108” A.F.F.
- Locations will be defined during design phase

REFERENCE FIGURE 39 – TYPE ‘T’

9.0 INFRASTRUCTURE FOR I.T.

9.1 CABLING – FIBRE

All fibre optic related sketches will be in the format of cut sheets attached to the appendices this document.

9.1.1 Inter Building

- Minimum 24 strand 8.3/125 μ single mode fibre terminated on LC connectors (glass fiber as manufactured by corning, jacketed under Corning) between hub buildings
- Provide 30' slack loop in manhole.
- Provide 15' slack loop in telecommunications room.

9.1.1.1 Single Mode Fibres

- .1 Low-Water-Peak Single-Mode Fiber (SMF-28e®)
 - Primary Application: Industry standard fiber used to support campus and building backbone cabling systems comprising local area networks (LANs).
 - The cabled optical fiber shall support industry-standard multi-gigabit Fibre Channel physical interface specifications.
- .2 Outdoor Loose Tube (ALTOS®) All-Dielectric Gel-Free Cable, 2-288 Fibers
 - Outside plant cable for outdoor duct or aerial overlap installation.
 - Cable shall be Corning Cable Systems part number _ _ _ _ U4-T41 _ _ D20
- .3 Outdoor Loose Tube (ALTOS®) Armored Gel-Free Cable, 2-288 Fibers
 - Rugged outside plant cable for direct burial, outdoor duct or aerial overlap installation.
 - Cable shall be Corning Cable Systems part number _ _ _ _ U C-T41 _ _ D20.
- .4 Indoor/Outdoor Loose Tube (FREEDM®) Gel-Free Cable, 2-288 Fibers
 - Campus and building backbone in lieu of transitioning from unlisted cable to NEC listed cable
 - Cable shall be Corning Cable Systems part number _ _ _ _ UF-T41 _ _ D20.

9.1.1.2 Rack Mountable Hardware

- .1 Closet Connector Housing (CCH)
 - Provide interconnect or cross-connect capabilities between outside plant, riser or distribution cables, and the opto-electronics.
 - Housing shall be Corning Cable Systems Part number CCH-01U or CCH-02U or CCH-03U or CCH-04U, according to the required fiber capacity.
- .2 LANscape® Solutions Connector Panels
 - The panels are used with field-installable connectors or in applications where the pre-connectorized cables are routed directly from the equipment to the piece of interconnect hardware.
 - Housing shall be Corning Cable Systems Part number CCH-01U or CCH-02U or CCH-03U or CCH-04U, according to the required fiber capacity.
 - Panel part number shall be Corning Cable Systems CCH-CPXX-YY (where the XX is the fiber count and the YY is the adapter code). Example YY code is A9 --- LC Duplex for SM fiber.

9.1.1.3 Fiber Optic Connectors

- .1 No-Epoxy and No-Polish (Unicam)
 - LC UniCam® Standard Single-Mode Connector (duplex format required)
 - Rapid termination of interbuilding indoor/outdoor and outdoor optical fiber cables that contain single-mode optical fiber.
 - Single-Mode LC Connector shall be Corning Cable Systems part number 95-200-99.

9.1.1.4 Fiber Optic Cable Fan-Out Kits

- .1 Buffer Tube Fan-Out Kits
 - Indoor Buffer Tube Fan-Out Kits
 - Furcation of optical fiber stranded loose tube cables to terminate individual fibers with field-installable connectors.
 - Corning Cable Systems Buffer Tube Fan-Out Kit part numbers are the following:
 - i. FAN-BT25-06 Buffer-Tube Fan-Out Kit with (6) 25in color-coded tubes
 - ii. FAN-BT47-06 Buffer-Tube Fan-Out Kit with (6) 47in color-coded tubes
 - iii. FAN-BT25-12 Buffer-Tube Fan-Out Kit with (12) 25in color-coded tubes
 - iv. FAN-BT47-12 Buffer-Tube Fan-Out Kit with (12) 47in color-coded tubes

9.1.1.5 Single Mode Fiber Optic Patch Cords

.1 Single-mode 2-fibre Patch Cord

- Patch Cord connectors shall be measured for insertion loss with the following values for each connector: typical of 0.1 dB and a maximum of 0.3 dB and guaranteed reflectance of less than or equal to -55 dB for UPC. Manufacturer shall be ISO 9001 and TL 9000 registered. Connectors shall be single mode LC UPC. Connector ferrule material shall be ceramic. Optical fiber cable type shall be zipcord construction suitable for use in indoor spaces and shall contain a riser-rated or plenum-rated jacket. Patch Cord shall be constructed with reverse-pair positioning as per TIA TSB-125. Patch Cord shall contain single-mode fibers compliant with TIA/EIA 568-B.3 and applicable TIA/EIA-604 document. Patch Cord jacket color shall be yellow. Patch Cord shall be available in different lengths. Manufacturer shall manufacture both cable and connectors used to manufacture patch cord.
- Patch Cord shall be made by Corning Cable Systems with the following part number: 040402R5120xxxM, where 'xxx' is the length in metres.
- Required cords:
 - i. 110% coverage based on fibre count to room, where;
 - 80% are 5m in length
 - 30% are 10m in length

9.1.2 Intra Building

- Minimum 12 strand 50/125µ multi-mode and 12 strand multimode (glass fiber as manufactured by corning, jacketed under Belden/CDT) between hub and endpoint buildings.
- Provide 15' slack loop in each telecommunications room.
- Single, composite cable is preferred.

9.1.2.1 Multimode Fiber

.1 Pretium™ 300 - 850 nm Laser-Optimized 50 µm Multimode Fiber for 300 m @ 10GbE

- Industry-standard multimode fiber supports 10 Gb/s serial transmission for a guaranteed distance of 300 m using 850 nm VCSEL sources. Fiber supports current network requirements from 10 Mb/s to 622 Mb/s using LED-based protocols and enables cost-effective migration to laser-based protocols such as 10 Gigabit Ethernet, Gigabit Ethernet and 10 Gigabit Fibre Channel (10GFC). Bandwidth-intensive applications and congested backbone links requiring scalability are cost-effectively supported through premises intrabuilding and interbuilding optical fiber cable plant including local area networks (LANs), storage area networks (SANs) and data centers.

- The cabled optical fiber shall support industry-standard multi-gigabit Fibre Channel physical interface specifications.
- .2 Pretium™ 550 - 850 nm Laser-Optimized 50 µm Multimode Fiber for 550 m @ 10GbE
- Industry-standard multimode fiber supports 10 Gb/s serial transmission for a guaranteed distance of 550 m using 850 nm VCSEL sources. Fiber supports current network requirements from 10 Mb/s to 622 Mb/s using LED-based protocols and enables cost-effective migration to laser-based protocols such as 10 Gigabit Ethernet, Gigabit Ethernet and 10 Gigabit Fibre Channel (10GFC). Bandwidth-intensive applications and congested backbone links requiring scalability are cost-effectively supported through premises intrabuilding and interbuilding optical fiber cable plant including local area networks (LANs), storage area networks (SANs) and data centers.
 - The cabled optical fiber shall support industry-standard multi-gigabit Fibre Channel physical interface specifications.

9.1.2.2 EDGE Plug & Play

- .1 EDGE Universal Preconnectorized MTP Indoor Trunk Cable Assembly
- 12 fiber MTP® Connectors pre-terminated on both ends for termination into pre-assembled connector modules and/or MTP adapter panels
 - A representative part number shall be G7575xxyPNDDUzzzF, where “xx” is replaced with 12, 24, 36, 48, 96 or E4 (144) strand counts), “y” is replaced with “T” for OM3 50/125 or “Q” for OM4 50/125 and the length is designated in “yyy” feet.
- .2 EDGE Universal Preconnectorized MTP Indoor Trunk Cable Assembly
- 12 fiber MTP® Connectors pre-terminated on both ends for termination into pre-assembled connector modules and/or MTP adapter panels
 - A representative part number shall be G7575xxyPNDDUzzzF, where “xx” is replaced with 12, 24, 36, 48, 96 or E4 (144) strand counts), “y” is replaced with “T” for OM3 50/125 or “Q” for OM4 50/125 and the length is designated in “yyy” feet.

9.1.2.3 Modules

- .1 Low Loss Plug & Play Universal Systems Closet Connector Housing (CCH) Modules
- Low loss modular patching for Data Center environments where pair wise polarity is maintained by the design of the module and trunk cable assemblies used. Modules allow quick connector changes in the front plane without re-termination of the backbone cable. The low loss Universal modules are mated to both ends of a Universal Trunk Cable

Assembly completing a Corning Cable Systems Universal Wiring System where pair-wise polarity is ensured.

- Modules shall be Corning Cable Systems part number EDGE-UM12-05-93x, where “x” is replaced with “T” for OM3 or “Q” for OM4

9.1.2.3 Multi-mode Fibre Optic Patch Cords

.1 Low- Loss 850-nm Laser-Optimized 50/125 μm 2-Fiber Patch Cord

- Patch Cord connectors shall be measured for insertion loss with the following values for each connector: typical of 0.2 dB and maximum of 0.3 dB. Connector reflectance shall be less than or equal to -20 dB. Boot color shall be aqua. Manufacturer shall be ISO 9001 and TL 9000 registered. Connectors shall be multimode LC. Available optical fiber cable types shall be suitable for use in indoor spaces and be listed as OFNR. Patch Cord shall contain OM3 50/125 μm 850 nm laser-optimized, EMB multimode fiber and shall comply with TIA/EIA-568-B.3 and applicable TIA/EIA-604 document. Patch Cord jacket and connector color shall be aqua. The manufacturer shall have an in-depth knowledge, and more than 10 year history, of manufacturing optical fiber Patch Cords. Manufacturer shall manufacture both cable and connectors used to manufacture Patch Cord. Patch Cord shall be available in different lengths.
- Patch Cord shall be made by Corning Cable Systems with the following part number: 050502T5120xxxM, where ‘xxx’ is the length in metres
- Required cords:
 - i. 110% coverage based on fibre count to room, where;
 - 80% are 5m in length
 - 30% are 10m in length

9.2 CABLING – COPPER

All copper related sketches will be in the format of cut sheets attached to the appendices this document.

9.2.1 Horizontal Cabling

9.2.1.1 Category 6 (FT6) UTP cable. (refer to standard specifications)

- Terminate on patch panel on rack.
- Cable shall be white and jacks shall be blue.
- Provide cable and connectors only from Sheridan Institute of Technology & Advanced Learning preferred manufacturers (Belden/CDT). Alternates will not be acceptable.

9.2.1.2 Category 6 (FT6) UTP Patch Cord.

.1 GigaFlex PS6+ Modular Cord

- The GigaFlex PS6+ Modular Cords are 4-pair 23 AWG UTP modular cords designed for the use with the Belden IBDN Systems 2400 and 4800LX, providing bandwidths of 250 MHz and 500 MHz, respectfully. The GigaFlex PS6+ Modular Cords have been designed to provide mated-connection performance that exceeds the Category 6 requirements.
- The GigaFlex PS6+ Modular Cord's patented design, with a very small footprint, makes them fully compatible with any of the highest density hubs with RJ45 jack connections.
- Patch Cord shall be made by Belden/CDT with the following part number: AX3500xx, where 'xx' defines the length and colour.
- Required cords:
 - i. 130% coverage based on copper count to room, where;
 - 110% are 1'-0" in length, blue in colour
 - 20% are 7'-0" in length, black in colour

9.2.1.3 Multi-pair Category 5 (FT6) UTP cable (a.k.a. pigtails)

- Minimum 25-pair cable
- Terminate on plywood backboard on BIX frame at one end.
- Terminate on 1U 24-port patch panel on the rack at other end.
- Cable shall be gray and patch panel jacks shall be black.
- Design adequate slack loops in closets to relocate if racks move in future.
- Provide cable and connectors only from Sheridan Institute of Technology & Advanced Learning preferred manufacturers (Belden/CDT). Alternates will not be acceptable.
 - (1) Provide 1 patch cord per cable run.
 - (2) Ten (10'-0") foot cord for active end.
 - (3) Provide 1- pair cross-connect wire.
 - (4) Designate FT4/FT6 to meet code requirements.

9.3 REQUIREMENTS BASED ON ROOM FUNCTION

Rooms:

Please refer to individual room type detail sketches for drop counts and types.

General:

Unless noted otherwise, a typical outlet shall consist of (1) cable run unless otherwise specified.

- Every enclosed space shall be provided with a minimum of (1) cable run.

REFERENCE FIGURE 40 – VERTICAL CONDUIT REQUIREMENT

10.0 INFRASTRUCTURE FOR PAGING

All paging related sketches will be in the format of cut sheets attached to the appendices this document.

Related Sheridan Institute of Technology and Advanced Learning Guidelines

- Sheridan Institute of Technology and Advanced Learning Technical Guidelines.
- Tender Specification by Consultant related to current project.

Coordination Requirements

- Sheridan Institute of Technology and Advanced Learning Information Communication Technologies

Description

- This section covers requirements for Paging Control Systems. The Paging Control System is installed by successful contractor. General Requirements for this system for Consultants and Contractors will be provided by consultant.
- These guidelines provide reference to particular types, grades and models of products. In general, the references include both generic descriptions and specific product details. These references shall not be construed as a directive to sole-source products from any particular vendor except where this is specifically stated.
- Paging shall include the following:
 - .1 Telephone Access Modules
 - .2 Indoor Speakers
 - .3 Outdoor Speakers

10.1 EQUIPMENT

All equipment will be defined by Consultant, supplied and carried by Communications Contractor.

Main module to consist of a Viking FXI-1 universal paging interface. Features are listed below.

10.2 CABLING

All cabling for paging system is defined under speaker requirements. Any cabling required for network are defined in IT section of this document.

10.3 REQUIREMENTS BASED ON TELECOMMUNICATION ROOM FUNCTION

10.3.1 Main Computer Room

- Telephone Access Modules are designed to provide telephone access to most commonly available paging systems. Provides telephone and paging system connections, input and modular page port connector, as well as mode setting switches and adjustment control.
- All main paging modules shall be located in the main computer room where possible.
- The paging system must be connected to the PABX station port.
- The typical installation shall be a Viking FXI-1 with the following features:
 - a. Integrate your paging system with virtually any POTS, Centrex, Digital or IP phone system
 - b. Suppress background music during paging
 - c. Provides contact closure to activate paging system if not provided by the phone system
 - d. Add pre-announce tone to your paging system
 - e. Features
 - f. Select: FXO (loop start), FXS (ring trip) or paging port (VOX relay) interface mode
 - g. No power supply required in FXS interface mode
 - h. Up to 6 units can be powered from one adapter in the FXO or VOX mode
 - i. 26V DC talk battery for interfacing with FXO or unused phone system line input/trunk port
 - j. Floating 600 ohm paging output with volume control
 - k. Normally open or closed relay for external paging amp activation or interfacing the paging amp with an external background music source
 - l. 800 Hz pre-announce page tone (on/off)
 - m. Compatible with 24 to 48 volt FXS operation
 - n. Calling party control (CPC) detection for immediate disconnect
 - o. Busy signal detect disconnect
 - p. 2.5 to 5 second VOX silence disconnect timer
 - q. Programmable VOX trigger sensitivity
 - r. 16 or 36 second default disconnect timer
 - s. Screw terminal block connections
 - t. Wall mount housing: (2) #6x3/4 panhead screws included

10.3.2 Communications Hub Room

- Additional Viking FXI-1 can be installed in Hub Rooms but all main paging modules shall be located in the main computer room where possible.
- The paging system must be connected to the PABX station port.
- The typical installation shall be a Viking FXI-1

10.3.3 Co-Locate Hub Room

- Additional Viking FXI-1 can be installed in Co-locate Hub Rooms but all main paging modules shall be located in the main computer room where possible.
- The paging system must be connected to the PABX station port.
- The typical installation shall be a Viking FXI-1

10.4 REQUIREMENTS BASED ON LOCATION FUNCTION

10.4.1 Indoor Paging

2 conductor 16 AWG or 18AWG cable. (refer to standard specifications)

- Terminate on BIX frame located on the backboard.
- Provide cable and connectors only from Sheridan Institute of Technology & Advanced Learning preferred manufacturers (Belden/CDT). Alternates will not be acceptable.
- All intra building zones shall be wired back to a central location on a single floor closet regardless of number of floors in the building.
- ONLY split termination if maximum distance requirements are exceeded.

10.4.2 Outdoor Paging

Category 6 (FT6) UTP cable. (refer to standard specifications)

- Terminate on BIX frame located on the backboard.
- Provide cable and connectors only from Sheridan Institute of Technology & Advanced Learning preferred manufacturers (Belden/CDT). Alternates will not be acceptable.
- All outdoor paging cables shall be enclosed in minimum 1" EMT conduit entire length of run.
- All intra building zones shall be wired back to a central location on a single floor closet regardless of number of floors in the building.
- ONLY split termination if maximum distance requirements are exceeded.

10.4.3 Indoor Speakers

Typical requirements for indoor paging speakers shall consist of:

- Arnsco part number A460K (speaker)
- Arnsco part number SE40SB (enclosure)
- Arnsco part number G70W (grill)
- Arnsco part number A70-4 (transformer)

REFERENCE FIGURE 41 – INDOOR SPEAKERS

10.4.4 Outdoor Speakers

Typical requirements for outdoor paging speakers shall consist of:

- Bogen part number SPT15A

REFERENCE FIGURE 42 – INDOOR SPEAKERS

11.0 INFRASTRUCTURE FOR SECURITY

All Security related sketches will be provided by the security vendor on a project to project requirement.

Related Sheridan Institute of Technology and Advanced Learning Guidelines

- Sheridan Institute of Technology and Advanced Learning Technical Guidelines.
- Tender Specification by Consultant related to current project.

Coordination Requirements

- Sheridan Institute of Technology and Advanced Learning Electronic Systems and Secure Access (ESSA).

Description

- This section covers requirements for Access Control Systems. The Access Control System is installed by ESSA. General Requirements for this system for Consultants and Contractors will be provided by consultant.
- These guidelines provide reference to particular types, grades and models of products. In general, the references include both generic descriptions and specific product details. These references shall not be construed as a directive to sole-source products from any particular vendor except where this is specifically stated.
- IP based system that monitors both live and recorded events for security access shall include the following:
 - .1 IP cameras.
 - .2 Power transformers.
 - .3 Card Readers

11.1 EQUIPMENT

All equipment will be defined, supplied and carried by Sheridan Security, Parking & Emergency Preparedness.

11.2 CABLING

For all Security installations the following wiring specifications apply

- All cables runs must be free of breaks and splices
- Use only stranded conductor
- Multi-pair cables must have individually shielded pairs
- IP Cameras: PoE fed over FT6 PLENUM RATED CATEGORY 6 cable
- Interior PTZ housings: 1 pair #16 stranded copper shielded cable
- Exterior PTZ housings: 1 pair #12 stranded copper shielded cable
- RM-4 to controller: 3 pair individually shielded #18 stranded copper cable
- Relay (for lock) to Lock Power Supply: 1 pair #18 stranded copper cable

- Lock to RM-4: 2 pair individually shielded #18 stranded cable
- D.C. to RM-4: 2 pair #22 Stranded copper cable
- REX to RM-4: 2 pair #22 Stranded copper cable
- READER to RM-4: 6 conductor #22 shielded copper cable

11.3 REQUIREMENTS BASED ON TELECOMMUNICATION ROOM FUNCTION

11.3.1 Main Computer Room

11.3.2 Communications Hub Room

11.3.3 Co-Locate Hub Room

11.4 REQUIREMENTS BASED ON DOOR FUNCTION

11.4.1 Single Door

.1 Card Reader

- Install junction box with a ¾" conduit leading to RM-4
- Reader is to be placed on the wall adjacent to the knob. Not hinge side.
- Bottom of reader positioned between 38" and 40" above floor level
- Edge of reader positioned at least 2" from the door frame

.2 Electric Lock

- Install ¾" conduit to RM4 enclosure (Share with Reader conduit if on same wall)
- Commercial Grade
- ¾" keeper depth
- 12/24VDC operating range
- Fail Secure
- Built in LBM required (Latch Bolt Monitor)

.3 Door Contact

- Share conduit with REX module
- 1k DEOL (1k ohm Double end of line Normally Closed configuration)
- Tied in series with LBM
- Mounted on top of door frame not the side
- Center of D.C. must be drilled from 1.5" to 3.5" from edge of door (Latch side)
- Contact and Magnet must be lightly glue into place using silicone

.4 Request to Exit

- Install ¾" conduit from top of door frame (Latch Side) to RM-4 Enclosure
- Mount REX to top edge of door frame on secure side
- Should be mounted above door knob/handle
- Aim REX to view 3' away from the base of the door

.5 RM-4 Door Control Module

- Must be located within 10' of door (suggested but can reach 20'-25')
- A separate relay (arm-1 or comparable) must be mounted with RM-4
- Mount in ceiling above door (if drop tiles are available)
- Mount above door on drywall (For locations with no nearby drop-tiles)
- Secure in small steel enclosure (White 6"x8" KEYED Enclosure)
- Conduits from Door Lock/Reader and REX/D.C lead into enclosure and a single conduit leads out back to main controller in closet.

11.4.2 Double Doors

Requirements match those of the Standard however some additions/modifications exist.

.1 Card reader conditions reflect those of the double door

.2 Electric Lock

- Independent conduit for Lock is to be placed on the non-swing door
- Transfer hinge must be installed to route power and status to lock
- Conditions b.1. – b.vi. apply

**NOTE: for a.i. CONDUIT CANNOT BE SHARED WITH READER AS THEY NO LONGER SHARE the SAME WALL IN THIS SCENARIO*

.3 Door Contact

- Install door contact on both doors (Following conditions c.i. – c.vi)

.4 Request to exit conditions reflect those of the Standard Door Requirements

.5 RM-4 conditions reflect those of the Standard Door Requirements

12.0 INFRASTRUCTURE FOR AUDIO VISUAL

12.1 EQUIPMENT

The room will be equipped with a standard, easy-to-use instructor interface. The audio/video (A/V) system will be controlled by a control system with the control panel mounted on the instructor station. System parameters can be monitored, administered, and controlled over the campus network. The A/V equipment will be located in an equipment rack inside of the instructor station.

It is important for Sheridan Institute of Technology and Advanced Learning to implement a standard operating protocol so faculty can depend on a standard, familiar interface in each classroom.

The audio system (exact type to be determined by room requirements) will be designed to fit the room's environment with an appropriate speaker system (with instructor speech reinforcement as required). The program sources are the same as for the video system. Large classrooms and auditoriums will have audience microphone capability provided throughout the student seating area.

The room will incorporate speech reinforcement with a wired or wireless microphone included on an as-needed basis according to room requirements. A line-level audio output jack (RCA) will be available on the front of the equipment rack for interfacing hearing assist or other equipment.

12.2 CABLING

The room will be equipped with Gigabit Ethernet connectivity. The junction box for AV connectivity shall be a Panduit PZICEA and shall come with four data jacks and a 15A duplex receptacle mounted inside the housing as a minimum.

Wireless Access Points in the classroom shall provide 802.11b wireless networking capability.

12.3 DEVICES

12.3.1 Hardware Devices

All hardware devices shall be defined, supplied, and installed by others on a project to project basis.

12.3.2 I/O Connections

All I/O connections shall be defined, supplied, and installed by others on a project to project basis.

12.4 REQUIREMENTS BASED ON ROOM FUNCTION

12.4.1 General

12.4.1.1 Instructor Station

The room will be equipped with a special lectern/instructor stations and shall be specified by others on a case-by-case basis. These lectern/instructor stations shall be relocatable to any position in the room.

12.4.1.2 A/V Power Requirements

A 20A un-switched dedicated circuit shall be provided for the A/V system, with duplex outlets located in the cabling junction box and at a dedicated wall projector locations. A green wire ground shall be required on all new wall projector locations.

12.4.1.3 A/V Conduit Requirements

Access to wiring connections shall be at the cabling junction box.

12.4.1.4 Cabling Junction Box

The room will be equipped with a Panduit Ceiling Mounted Media Rack.

- Designed to accept up to 2 RU of active electronics as deep as 17.5" and up to 6 RU of standard 19" passive connectivity (PZICEA only)
- Designed to accept up to 8 RU standard 19" passive connectivity (PZICE only)
- Thermal management design optimizes air flow for improved heat dissipation; ideal for high heat load PoE enabled switch applications
- Mount in 2' x 2', 2' x 4', and 2' x 6' drop ceilings
- 50 pound door weight capacity
- Include doorplate, equipment mounting bracket, integrated horizontal cable slack manager
- AC power ready – receptacle not included (PZICEA only)
- Includes low decibel 60 CFM fan (PZICEA only)

12.4.1.5 Data Requirements

The room will be equipped with Gigabit Ethernet connectivity. The cabling junction box shall house four data jacks as a minimum.

12.4.1.6 Wireless Requirement

Wireless access points in each classroom shall provide wireless networking capability. A requirement for a minimum of four (4) wireless nodes in each classroom (1 per quadrant) shall be required.

12.4.1.7 Telephone

A wall-mounted campus phone, with restricted ringing and calling capabilities, shall be located near the instructor station at ADA recommended height. The main function of the phone shall be communication with the Classroom Support Hotline.

12.4.1.8 Audio System

The monaural audio system (exact type to be determined by room requirements) will be designed to fit the room's environment with an appropriate speaker system (with instructor speech reinforcement as required). The program sources are the same as for the video system. Large classrooms and auditoriums will have audience microphone capability provided throughout the student seating area.

The room will incorporate speech reinforcement with a wired or wireless lavalier microphone included on an as-needed basis according to room requirements. A line-level audio output jack (RCA) will be available on the front of the equipment rack for interfacing hearing assist or other equipment.

12.4.1.9 Control System

All functionality for the control system in standard classrooms shall be able to control Automated screens (where applicable), lighting, and blinds.

12.4.2 Large Classroom Supplemental Information

12.4.2.1 Projection Capability

Large classrooms, lecture halls, and auditoriums require additional Projection Capable Classroom technology infrastructure, which will be individually specified on a case-by-case basis. Requirements may include:

- Increased data connectivity/bandwidth
- Separate AV booth
- Additional AV equipment closets
- Dual projection systems
- Additional I/O modules and systems

- Additional internal future growth conduit
- Auto-tracking cameras
- Auto-balancing sound system
- Audience microphone locations
- Secondary instructor station(s)

12.4.2.2 Control System

The networking option will consist of an integrated controller located in the instructor station. An eight-button panel will be located on the instructor station. The control system will have an optional network connection to allow remote support from Classroom Technical Services. The following functions will be programmed into the system:

- Video projector power control
- Projector source selection
- Volume control
- Video mute
- Audio mute

A level of automation will be programmed into the system in order to simplify room operation for the user. In order to save video projector lamp life, the system will be programmed to shut down after a specified amount of time with no user activity. The room will also be programmed to prevent system operation after hours. The system operation can be controlled by day or by week at OCM-specified access times.

12.4.2.3 Monitoring Option

The networked control system option allows the OCM Classroom Support Hotline operator to monitor and troubleshoot the operating characteristics of the room technology and to assist the instructor with any problems. Remote control and operation of the room equipment is enabled to facilitate the remote resolution of problems during actual classroom teaching activity. The control systems communication protocols permit 24-hour monitoring of system parameters and enhance proactive problem solving to eliminate system down time. A software-based automated management program oversees the operating parameters of the classroom systems, sends repair and maintenance alerts, and allows monitoring and analysis of system operation.

12.4.2.4 Standard Classroom

- Whiteboards to be mounted 39" AFF to the bottom of the whiteboard.
- One duplex and 1 data jack located behind each projector wall locations.

- The noise criteria (NC) should be NC25 and Reverberation Time (RT) should be between 0.6 and 0.7 sec
- Walls between classrooms should be designed to STC-60 standard and walls between classrooms and washrooms should be designed to STC-50 standard.
- Ambient noise to the room should not exceed 25db
- Zoned lighting is needed to darken the area near the projectors to eliminate any fading of the projected image.
- Blackout blinds are needed to control the amount of ambient light coming into the room.
- All lighting and blinds should be controllable using low voltage relay device that our room controllers can connect too.
- All lighting shall be independently controlled from either a wall switch or at the lectern location (quasi 3-way functionality)

12.4.2.5 Split Classroom

- Whiteboards to be mounted 39" AFF to the bottom of the whiteboard.
- One duplex and 1 data jack located behind each projector wall locations.
- The noise criteria (NC) should be NC25 and Reverberation Time (RT) should be between 0.6 and 0.7 sec
- Walls between classrooms should be designed to STC-60 standard and walls between classrooms and washrooms should be designed to STC-50 standard.
- Ambient noise to the room should not exceed 25db
- Zoned lighting is needed to darken the area near the projectors to eliminate any fading of the projected image.
- Blackout blinds are needed to control the amount of ambient light coming into the room.
- All lighting and blinds should be controllable using low voltage relay device that our room controllers can connect too.
- All lighting shall be independently controlled from either a wall switch or at the lectern location (quasi 3-way functionality)

12.4.2.6 Meeting Rooms

- Blocking or reinforced walls are needed to support LCD TV.
- Two duplex and 2 data jacks located behind each LCD.
- All power and data behind LCD's will be recessed into the wall.
- One (1), Two (2) or Three (3) 2" RMC conduits are needed from wall locations to the meeting table. These are defined in each meeting room type.
- Depending on ceiling height all meeting room LCDs should be mounted 4' AFF to the bottom of the LCD

- System control touch panels should be mounted in the table for all meeting rooms.
- Data and Power to be delivered to Spider box at table. Reference to room size must be made for quantities.
- Data at ceiling location for Wireless Access Point. Reference to room size must be made for quantities.

12.4.2.7 Labs

Labs will be treated the same as standard classrooms and may require project specific requirements that will be provided if necessary.

12.4.2.8 Breakout/Group Study Rooms

- Blocking or reinforced walls are needed to support each LCD TV.
- Two duplex and 2 data jacks located behind each LCD.
- All power and data behind LCD's will be recessed into the wall.
- 2" RMC conduit is needed from LCD location to the other wall where input wall plate will be terminated. There should be a break in the conduit where the touch panel will be located above the table.
- Depending on ceiling height all group study LCDs should be mounted 4' AFF to the bottom of the LCD
- System control touch panels should be mounted 4' AFF

12.4.2.9 Auditoriums/Lecture Halls

- 2" RMC conduit is needed from podium location in front of room to AV room located at the back of the auditorium
- Blackout blinds are needed to be able to control the ambient light.
- Zoned lighting is needed to darken the area near the projectors to eliminate any fading of the projected image.
- The noise criteria (NC) should be NC25 and Reverberation Time (RT) should be between 0.6 and 0.7 sec

12.4.2.10 Administration Offices

- Blocking or reinforced walls are needed to support each LCD TV.
- Two duplex and 2 data jacks located behind each LCD.
- All power and data behind LCD's will be recessed into the wall.

12.4.2.11 Public Spaces

- Blocking or reinforced walls are needed to support each LCD TV.
- Two duplex and 2 data jacks located behind each LCD.
- All power and data behind LCD's will be recessed into the wall.

13.0 APPENDICES

13.1 LABELLING CONVENTIONS

13.1.1 Numbering Format:

The new numbering format is based on the CAN/CSA-T568-93 standard with minor adaptations for Sheridan's environment.

Format: [campus]-[tc designation]-[rack][panel position]-[jack position]

Detail:

[campus]

Single character value; range: A through Z.

Denotes the Campus.

Currently defined values would be:

- "D" for Davis Campus;
- "S" for Skills Training Centre;
- "T" for Trafalgar Campus;
- "M" for Mississauga Campus.

[tc designation]

Variable-length character value

Refer to [*Telecommunication Closet Designations*](#).

[rack]

Single character value; range: 1 through Z.

Each data rack in a TC will be assigned a unique value in the range.

[panel position]

Double-digit numeric value; range: 01 through 44.

Panel Position in rack identified by top of panel in rack in vertical units. Numbering begins at 01 closest to the floor. Refer to *Default TC Rack Layouts*.

[jack position]

Double-digit numeric value; range: 01 through 24 or 48.

This identifies the jack position within the panel based on manufacturer numbering. 1U panels will number 01 through 24, 2U panels 01 through 48, etc.

[daisy-chain] (for indoor paging speakers)

Double-digit alpha-numeric value; range: A-Z and 1-5.

This identifies the indoor speaker location based on the chain identifier (A) and the speaker in the chain (3). Both the BIX frame and speaker will have matching identifiers for easy recognition.

[home run] (for outdoor paging speakers)

Double-digit alpha-numeric value; range: labeled identical to closest outside door location. (i.e. P3 or D7).

This identifies the outdoor speaker location based on the closest exterior door with an existing tag. Both the BIX frame and speaker will have matching identifiers for easy recognition.

13.1.2 Label Configuration:

There are two allowable configurations for labels. In both cases, only 10 characters will be required in the jack labeling; the campus designation will be inferred and used in documentation only. However, the full 12 characters would be entered in the switch port description to ensure the jack has a unique reference across the entire network.

For the workstation end, a double line layout would be used to conserve space. The single line layout can be used on single jack faceplates where space permits.

Single Line:

[tc designation]-[rack]-[U-position]-[panel position]-[jack position]

Double Line:

[tc designation]-[rack]-[U-position]
[panel position]-[jack position]

There will be no need for jack labeling in the TC. There will be labels required for the rack and the vertical units, but since the patch panels come pre-numbered by the manufacturer, generated labels are not required.

Examples:

B103-134-26	This drop terminates in TC-B103, on the 1st rack, in the patch panel at 34U, in the 26th jack position. (label on faceplate)
SC112-1 42-44	This drop terminates in TC-SC112, on the 1st rack, in the patch panel at 42U, in the 44th jack position. (label on faceplate)
D-C205-125-06	This drop is at the Davis Campus, terminates in TC-C205, on the 1st rack, in the patch panel at 25U, in the 06th jack position. (port description field on switch)
BR-D7	Brampton Campus – Door Location, would reference an outdoor speaker at the Brampton campus near door B4.
T-A3	Trafalgar Campus - would reference a chain of speakers 'A' in this example, with the 3 rd speaker in the chain being identified.

14.0 DETAIL DRAWINGS

All Detail Drawings pages included herein are defined in the document. Page numbers are not included as the drawings themselves and number of drawings may be revised during periodic Master Document updates.

15.0 MANUFACTURER CUT SHEETS

All Manufacturer Cut Sheet pages included herein are NOT defined in the document; they are a simple reference only. Page numbers are not included as the manufacturers themselves and number of drawings may be revised during periodic Master Document updates.

Contractor shall be responsible to supply manufacturer cut sheets or catalogue technical papers for all recommended products to the Consultant and Client for approval prior to commencing the project.

The following pages are samples only for:

- Belden/CDT
- Corning
- WBT
- APC
- Middle Atlantic
- Viking
- Bogen
- Arnscoff

Sheridan BAS Design Standard

Sheridan College Integrated Energy and Climate Master Plan

GENERAL REQUIREMENTS

The basis of design for this standard is a Delta Controls BAS system.

1. The BAS system shall control, monitor, meter, record, provide trending and alarming for all the mechanical and electrical systems. It shall be fully compatible and seamlessly integrated with the campus-wide BACnet/IP network. Co-ordinate all requirements Sheridan's Information Technology Standard.
2. The BAS shall be fully and seamlessly integrated with Sheridan's IT infrastructure, and must be certified compatible with Cisco network equipment.
3. Any BAS panel off-line for service or alteration shall not affect any other panel or system operation.
4. An open protocol, non-proprietary system shall be provided.
5. The system shall be a distributed based (DDC) system based on BACnet/IP communications.
6. The system shall be independent of the building fire alarm system.
7. The computerized control system shall be one complete package from one controls manufacturer and not an integrated system of differing manufacturers.
8. Remote off-site access to BAS by building operators shall be provided.
9. Internet access to the system shall be provided for individual user set points.
10. The system shall be graphics-based with component by component breakdown, accessible by standard web browsers (e.g. Microsoft Internet Explorer).
11. All major mechanical equipment (e.g. chilled water and heating water plant including pumps and drives, plumbing and air handling system plant, etc) shall be monitored, recorded, alarmed and controlled by the BAS. The BAS shall be capable of providing trending and forecasting.
12. All major fire protection and electrical equipment shall be monitored, recorded and alarmed by the BAS.
13. Provide sufficient control points as required for the plant management system; include auxiliary points for different disciplines such as the equipment (e.g. transformer failure alarm).
14. Connect any third-party food service operator's exhaust hood controls and fire suppression system to the BAS. Coordinate exact requirements with Sheridan and their third party food service operator.
15. The system shall be able to provide general mechanical and HVAC controls. This includes but is not limited to being able to turn all equipment on and off.

16. The system shall be complete with operator override control.
17. All multi-occupant spaces shall utilize demand control ventilation. Provide all CO₂ sensors, equipment and controls necessary.
18. Provide lead/lag sequences for all mechanical central plant equipment (e.g. domestic hot water heaters, heating boilers, chillers, cooling towers and all associated pumps).
19. Connect all variable frequency drives to the BAS via BACnet/IP.
20. All field devices shall be wireless self-powered devices to ISO/IEC 14543-3-10.
21. IT closet cooling equipment shall be monitored by the BAS, but independently controlled.
22. All VAV, small-equipment HVAC and medium-equipment HVAC applications should be controlled at the B-AAC level, and must be communicate via BACnet/IP. These devices should be Power-over-Ethernet (PoE) such that they are installed directly onto Sheridan's IT network infrastructure.

PART 1 - GENERAL

1.1 DIRECT-DIGITAL CONTROL (DDC) SYSTEM DESCRIPTION

- .1 The Controls Contractor shall supply and install a complete Direct Digital Control (DDC) Building Automation System (BAS) as required to accomplish the Sequences of Control for heating, ventilating, air-conditioning and other building-level equipment and systems as described herein.

1.2 WORK INCLUDED

- .1 Furnish all labor, materials, equipment and service necessary for a complete and operational DDC BAS pursuant with this specification.
- .2 Coordinate the requirements of all mechanical and electrical equipment that will be controlled by the DDC BAS.
- .3 Coordinate interface requirements for integration into BAS of all building-level equipment and systems which include, but are not limited to:
 - .1 Computer/Server Room Air Conditioning Units
 - .2 Utility Metering
 - .3 Occupancy, Lighting controls
 - .4 Variable Speed Drives
 - .5 Sensors/chillers/Boilers/AHU's/pumps/motors/cooling towers etc.
 - .6 Elevators
 - .7 Fire alarm and Notification Systems
 - .8 Tank-less Domestic Hot Water Heaters
- .4 All labour, material, equipment and service not specifically referred to in this specification that are required to fulfill the functional intent of this specification shall be provided at no additional cost to the Owner.

1.3 DDC SYSTEM REQUIREMENTS

- .1 DDC Systems installed under this specification shall strictly adhere to the following characteristics:
 - .1 Building Automation System (BAS) Direct Digital Controls (DDC) shall consist of natively-implemented BACnet, microprocessor-based, peer-to-peer, networked, distributed devices utilizing the BACnet/IP communication protocol in an open, interoperable system. The BAS also includes operator interface devices, programming and configuration software applications, DDC input/output devices, non-DDC automatic temperature controls, enclosures and interconnecting conduit and wire.
 - .2 The BACnet operating stack must be embedded directly in every Device at the board level, and in all operator interface software packages.
 - .3 No Gateways, Communication Bridges, Protocol Translators or any other device that translates any proprietary or other communication protocol to the BACnet/IP communication protocol shall be permitted as a part of the BAS installation pursuant with this specification section. Gateways may only be used as required for communication to existing systems or systems installed pursuant with other specification sections.
 - .4 DDC controllers that are not BACnet compliant shall not be acceptable under this specification and are strictly prohibited.
 - .5 The BAS shall be modular in nature and comprised of a network of stand-alone DDC devices. The System shall be designed and implemented in such a way that it may be expanded in both capacity and functionality through the addition of DDC Devices, sensors, actuators, etc.,
 - .6 All BAS controllers shall be tested, certified, clearly stamped and listed by the BACnet Testing Laboratories (BTL).
 - .7 Program database, data acquisition, and all control sequence logic shall reside in each DDC Device. The Building Level Communication Network (BLCN) shall not be dependent upon connection to a Server or Master Controller for performance of the Sequence of Control as outlined in this specification. Each individual Device shall, to the greatest possible extent, perform its programmed sequence without reliance on the BLCN.
 - .8 BAS shall be provided with a complete Web enabled operator interface. The Web enabled application shall operate on industry standard PC hardware. Proprietary server hardware or "Black Boxes" will not be acceptable. Third party Web enabled applications are acceptable if they are configured to be indistinguishable from the OWS applications.
 - .9 The Owner at the Owner's expense shall provide connection to the Internet for the BAS. The LAN connection type and configuration (TCP/IP addressing scheme, etc.) will be information provided to the System Contractor from the Owner, or Owner's representative.
 - .10 All BAS DDC Devices at all levels shall be fully custom-programmable in the field using the standard Operators Workstation Software. No configurable, canned program application specific controllers will be permitted.
 - .11 All BAS DDC Devices shall be capable of updating firmware using software via Internet without replacing any hardware, microprocessors or chips.
 - .12 The BAS shall be capable of sending system alarms and Event Notifications to pagers, smart phones and email services.
 - .13 Actuation of control devices shall be electronic. Spring return fail-safe actuation shall be provided when loss of property and/or property damage is possible and where specified.
 - .14 DDC Automatic Temperature Control (ATC) System shall prevent all controlled equipment from simultaneously restarting after a power outage. The order in which equipment (or groups of equipment) is started; along with the time delay between starts shall be user-selectable.

- .15 All binary output points shall be protected from short cycling via output configuration and/or programming. This feature shall allow minimum on time and off-time to be configurable.

1.4 BASIC SYSTEM ARCHITECTURE

- .1 The DDC BAS as provided and installed under this specification shall be a complete system from a single manufacturer designed for use on intranets and the internet.
- .2 The primary BAS components shall include but not be limited to:
 - .1 Web Server with operating software
 - .2 Operator Workstation Software (B-OWS)
 - .3 Remote Operator Workstation Software (Remote B-OWS)
 - .4 Portable Operator Workstation Software (Portable B-OWS)
 - .5 Building Controllers (B-BC)
 - .6 Advanced Application Controllers – Power over Ethernet (B-AAC-PoE) for VAV and HVAC applications
 - .7 Application Specific Controllers (B-ASC)
 - .8 EnOcean – Energy harvesting ISO/IEC 14543-3-10 compliant energy harvesting technologies for wireless applications with ultra-low power consumption sensors to include: temperature, humidity, CO2 occupancy and lighting.
- .3 Enterprise Level Communication Network (ELCN) shall consist of high-speed BACnet/IP Local Area Network (LAN) and/or Wide Area Network (WAN) to host Operators Workstations (B-OWS), Building Controllers (B-BC), Building Level Communication Networks (BLCN) and Web-Enabled remote connectivity
- .4 Building Level Communication Network (BLCN) shall consist of a BACnet/IP internetwork to host field level DDC Controllers
- .5 B-BC's shall automatically route BACnet communications to all configured available BACnet networks.
- .6 B-OWS and B-BC's shall be fully IT-compatible devices that communicate directly on a TCP/IP Local Area Network (LAN).
 - .1 LAN shall be 10/100/1000Mbps TCP/IP with the following minimum requirements:
 - .2 Cable: 1000 base-T, UTP-8 wire, category 6e or current Sheridan College standard
 - .3 Minimum throughput: 100Mbps with the ability to increase to 1000Mbps
 - .4 Enterprise Level Communication Network (ELCN) shall provide communication between B-BC's, B-OWS, remote B-OWS and Web Server using a B/IP LAN backbone.
 - .5 B-BC's, B-AAC-PoE's and EnOcean wireless applications and sensors shall connect directly to the LAN and communicate using BACnet/IP without a TCP/IP Gateway or network server
 - .6 Owner shall be responsible for providing TCP/IP networking scheme, addressing, etc. It shall be the responsibility of the BAS Contractor to coordinate implementation of the BAS on the Owner's LAN without disruption.
- .7 BAS Manufacturer must natively support the BACnet/IP data links as defined in the ANSI/ASHRAE Standard 135-2012.
- .8 Field sensors and control devices shall connect to peer-to-peer, fully programmable B-BC, B-AAC-PoE, B-ASC & EnOcean wireless applications and sensors as required to achieve the point monitoring and Sequence of Control as specified herein. All devices are to be monitored by a B-OWS. Final control devices are to be electronic.

- .9 Each Mechanical System and/or major piece of Mechanical Equipment shall have one (1) dedicated DDC controller with sufficient I/O capacity such that it shall be connected to ALL field devices and sensors associated with that system and/or piece of equipment. Distributed control of one (1) single piece of major mechanical equipment shall not be performed by multiple controllers.
- .10 All BAS controllers, sensors and devices shall be UL listed.
 - .1 All BAS controllers and interface devices must be UL 916 Listed
 - .2 Where required by the local Authority Having Jurisdiction (AHJ), all BAS controllers and interface devices must be UUKL-UL 864 Listed

1.5 QUALITY ASSURANCE

- .1 The BAS Contractor shall be responsible for inspection and Quality Assurance (QA) for all materials and workmanship provided under this Specification Section.
- .2 BAS components shall be manufactured by firms regularly engaged in the manufacture of equipment of the types, sizes and service required.
- .3 The BAS Contractor shall be a factory certified contractor specializing and experienced in BAS installations and with experience in networked microprocessor based commercial HVAC, building and enterprise level control systems.
 - .1 BAS Contractor shall maintain a comprehensive service office location within 100 miles of project location prior to bid date and at a minimum until the completion of the warranty period.
- .4 The BAS Contractor shall use technicians and application engineers certified by the manufacturer in the installation, configuration, programming and service of the BAS products.
- .5 The BACnet/IP internetwork shall be based upon the Manufacturer's standard integrated hardware and software product design intent and in accordance with Manufacturer's installation and application documentation.
- .6 To the highest extent practical, all BAS equipment of the same type serving the same function shall be identical and from the same manufacturer. All new B-ASC, B-AAC, B-BC, B-OWS software and web-server software shall be the products of a single manufacturer.
- .7 The completed and operational BAS shall be in compliance with and meet the requirements of all governing bodies, Authorities Having Jurisdiction (AHJ), applicable local or national standards and codes, except where more stringent or detailed requirements are indicated by the Contract Documents, including the requirements set forth in this Specification and the following:
 - .1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
 - .2 ASHRAE 135-2012: BACnet – Building Automation and Control Networking Protocol
 - .3 National Institute of Standards and Technology (NIST)
 - .4 NIST IR 6392 Annex B: Profiles of Standard BACnet Devices
 - .5 Underwriters Laboratories (UL)
 - .6 UL 916: Energy Management Systems (EMS)
 - .7 UUKL-UL 864: Control Units and Accessories for Fire Alarm Systems
 - .8 Institute of Electrical and Electronic Engineers (IEEE)
 - .9 IEEE 142: Recommended Practice for Grounding of Industrial and Commercial Power Systems
 - .10 Electronics Industries Association (EIA)

- .11 EIA-232: Interface Between Data Terminal Equipment and Data Circuit-Terminating Equipment Employing Serial Binary Data Interchange
- .12 EIA-485: Standard for Electrical Characteristics of Generator and Receivers for Use in Balanced Digital Mutli-Point System
- .13 Federal Communications Commission (FCC)
- .14 Part J: Class "A" Applications

1.6 SYSTEM PERFORMANCE

- .1 The system shall conform at a minimum to the following performance standards:
- .2 Graphics shall display with a minimum of 50 dynamic real-time data points and within 10 seconds of the request
- .3 The maximum time between the command of a binary object by the operator and the reaction by the device shall be 10 seconds. Analog objects shall start to adjust within 10 seconds of being commanded to change.
- .4 All changes of state or change of analog values shall be transmitted such that no reporting of a value is more than 15 seconds old.
- .5 The maximum time from when an object goes into alarm to when it is annunciated at the B-OWS shall not exceed 20 seconds. Those points denoted as critical shall be annunciated within 5 seconds.
- .6 B-BC, B-AAC-PoE, B-ASC, & EnOcean wireless applications and sensors shall be able to execute control loops at a selectable frequency at least 1 time every second. The controller shall scan and update the process value and output generated by this calculation at this same frequency at a minimum.
- .7 All B-OWS on the network shall receive alarms within 5 seconds of each other.
- .8 No devices utilizing mercury shall be acceptable for any application
- .9 Unless noted otherwise in these Specifications, the end-to-end accuracy from sensor to operator interface shall be as noted in Table 1.

Table 1 – System Accuracy	
Measured Variable	Reported Accuracy
Space Temperature	+/-0.5 deg C (+/-1 deg F)
Ducted air	+/-1.0 deg C (+/-2 deg F)
Outside air	+/-1.0 deg C (+/-2 deg F)
Water temperature	+/-0.5 deg C (+/-1 deg F)
Delta T	+/-0.15 deg C (+/-0.25 deg F)
Relative Humidity	+/-2% RH 10-90% RH
Water flow	+/-2% of actual value
Air flow (terminal)	+/-10% of actual value (Note 1)
Air flow (measuring stations)	+/-2% for calibrated range.
Air pressure (ducts)	+/-25 Pa (+/-0.1 "WG)

Table 1 – System Accuracy	
Air pressure (space)	+/-3 Pa (+/-0.01 "WG)
Water pressure	+/-1PSI (Note 2)
Electrical Power	+/-2% of Range (Note 3)
Carbon Monoxide (CO)	+/-5% of Reading
Carbon Dioxide (CO2)	+/- 50 PPM
Note 1: (10% to 100% of scale) (cannot read accurately below 10%)	
Note 2: for both absolute and differential pressure	
Note 3: * not including utility supplied meters	

- .10 Overall combined system repeatability of sensors, controllers and readout devices for a particular application shall be plus or minus 2% of full scale of the operating range. Repeatability of overall combined system of sensor, controller and readout device in a control loop application will be plus or minus 5% of full scale of the operating range.
- .11 Long-term electronic drift shall not exceed 0.4% per year.
- .12 The system provided shall be expandable to at least 500,000 hard points without additional database licensing fees, or replacing any devices, software or wiring provided herein.
- .13 All components provided as part of this system shall operate under ambient environmental conditions of 0°C (32°F) to 40°C (104°F) dry bulb and 10% to 90% relative humidity, noncondensing as a minimum. Sensors and control elements shall operate under the ambient environmental temperature, pressure, humidity, and vibration conditions encountered for the installed location. B-OWS equipment (hardware only), such as monitors and printers, shall, unless designated otherwise, operate properly under ambient environmental conditions of 7°C (45°F) to 32°C (90°F) and a relative humidity of 10% to 90%.
- .14 Networked components of the system shall be able to operate at 90% to 110% of nominal voltage rating and shall perform an orderly shutdown below 80%.

1.7 SUBMITTALS

- .1 All submittals and documentation including complete BAS System Engineering Design Submittal & Drawings, Project Record Documents, Application Engineering Documents and Owner's & Maintenance Manuals shall be submitted electronically in the form of an Adobe Portable Document Format (.pdf). All Control Schematics, Wiring Diagrams, Riser Diagrams, etc. shall be formatted for A3 11" x 17". All other documentation may be formatted for 8.5" x 11".
- .2 Submit in writing and so delineated at the beginning of each submittal, known substitutions and deviations from requirements of Contract Documents. Deviation from Contract Documents must be approved by Sheridan prior to submittal.
- .3 Complete BAS Engineering Design Submittal & Drawings shall be prepared pursuant with the following guidelines:
- .4 Submittal documentation and drawings shall consistently use the same abbreviations, symbols, nomenclature and identifiers. Each control system element shall be assigned a unique identifier pursuant with the Contract Documents
- .5 Submittal documentation and drawings shall have at the beginning an Index and Design Drawing Legend.
 - .1 Index shall list all design drawings and elements including the drawing number, sheet number, drawing title, etc.

- .2 Legend shall show and describe all symbols, abbreviations and acronyms used on the Design Drawings
- .6 Submit the following:
- .7 A complete bill of materials of all equipment, controllers, devices and sensors to be provided and/or used indicating unique equipment identifier/tag, unique device/controller identifier/tag, manufacturer and model number.

- .8 Riser diagram of Building Level Communication Network (BLCN) and Enterprise Level Communication Network (ELCN) shall outline execution and details of all network cabling, BAS & Network Hardware including the following:
 - .1 All BAS/DDC Hardware with controller number, unique identifier/tag, location, equipment and service
 - .2 All Network Hardware with unique identifier, location and service
 - .3 Network cabling configuration and execution specification
 - .4 Location of all network interface jacks
 - .5 A separate riser diagram shall be provided for each network segment
- .9 A schedule of all control valves including the unique equipment identifier/tag, valve size, dimensions and installation/maintenance clearance, model number (including pattern and connections), close-off rating, flow, CV, pressure drop, pressure rating and location. The valve schedule shall also contain actuator selection data supported by calculations of the force required to move, close and seal the valve at design conditions.
- .10 A schedule of all control dampers. This shall include the unique equipment identifier, unique damper identifier/tag, damper size, pressure drop, blade configuration, orientation and axis of frame, blade rotation, location and selection criteria of actuators, nominal and actual sizes, and manufacturer and model number. The Damper Schedule shall include the AMCA 500-D maximum leakage rate at the operating static-pressure differential.
- .11 Provide manufacturers cut sheets for major system components. When manufacturer's cut sheets apply to a product series rather than a specific product, the data specifically applicable to the project shall be highlighted or clearly indicated by other means. Include for every BAS component including but not limited to the following:
 - .1 Operator Workstation (B-OWS)
 - .2 Building Controllers (B-BC)
 - .3 Advanced Application Controllers – Power Over Ethernet (B-AAC-PoE)
 - .4 Application Specific Controllers (B-ASC)
 - .5 EnOcean wireless applications and sensors
 - .6 Provide a BACnet Protocol Implementation Conformance Statement (PICS) or BIBB table for each BACnet device type in the submittal.
- .12 Provide shop drawings and/or manufacturer's standard specification submittal data sheets for all associated BAS equipment, sensors and control devices including unique identifier/tag, manufacturer model number and specific accessories, mounting, etc.
- .13 Sequence of Operation shall be submitted for every piece of equipment being controlled by and/or associated with the BAS. No operational deviation from specified Sequences of Operation as outlined in Contract Documents shall be permitted without prior written approval. Sequences of Operation shall include and conform to the following:
 - .1 Refer to equipment and control devices by their specific unique identifiers/tags pursuant with the Contract Documents and BAS Submittal package.
 - .2 Clearly represent actual Application Programming methodology and functional control operation. Do not merely provide a copy of Contract Document specified Sequence of Control.
 - .3 Include description of functional system operation under normal and failure conditions.
- .14 BAS Control Schematics and Wiring Diagrams shall be submitted for every piece of equipment being controlled by and/or associated with the BAS. BAS Control Schematics and Wiring Diagrams shall include and conform to the following:

- .1 Control Schematic flow diagram of each system (air, water, gas, & etc.) being controlled showing actual physical configuration and control device/sensor location of all fans, coils, dampers, valves, pumps, heat exchangers, control devices, etc. including each hardware point type, controller and mnemonic.
- .2 Controller termination details showing every controller point termination, type and mnemonic.
- .3 Wiring Diagrams of all packaged equipment, motor starters, relay wiring, equipment interlock, safety circuits, & etc. clearly indicating all interconnecting wiring and termination of all conductors and cables including labels of all cables and point mnemonics.
- .4 Control Enclosure details for every enclosure including panel identifier, location, physical lay-out, dimensions, instrumentation, labels, & etc. Also include detail wiring (I/O, network and power) and power source for each panel, transformer and controller.
- .15 Project Record Documents. Upon completion of installation and systems commissioning submit record documents for review. "As-Built" Project Record Documents should include:
 - .1 Project Record Application Engineering Drawings shall include all BAS System Engineering Design Submittal with Drawings updated to reflect actual field conditions, architecture and execution
 - .2 Operating & Maintenance (O&M) Manual including:
 - .1 Operator's Manual with Manufacturers' complete operating instructions.
 - .2 Programming Manual including:
 - .1 Documentation of all project specific Application and DDC programs
 - .2 All necessary system Administrator-Level passwords and/or required access credentials
 - .3 Information required for programming BAS
 - .4 Complete Final Point Schedule including all hardware and software data points and documentation of calibration and configuration values for all Inputs, Outputs, Variables and PID Loops at the conclusion of systems commissioning and functional testing.
 - .5 Routine preventative maintenance procedures, corrective diagnostic troubleshooting procedures and calibration processes
 - .6 Final Bill of Material with all installed parts, manufacturers, manufacturers' part numbers and ordering information
 - .7 A schedule of recommended spare parts with part numbers and supplier
 - .3 Complete system database as functional at the conclusion of systems commissioning and functional testing including all graphics and images used by and/or created for BAS on electronic format as accepted by Owner.

1.8 EXTENDED WARRANTY

- .1 BAS manufacturer shall warranty all DDC controllers to be free of defect in material and workmanship under normal operation and expected service as published by the manufacturer in the unit's performance specifications for a period of five (5) years at a minimum.
 - .1 BAS manufacturer shall warranty all DDC controller on-board integral carbon dioxide (CO2) sensing elements to be free of defect in material and workmanship under normal operation and expected service as published by the manufacturer in the unit's performance specifications for a period of two (2) years at a minimum
 - .2 BAS manufacturer shall warranty all DDC controller on-board integral relative humidity (RH) sensing elements to be free of defect in material and workmanship under normal operation and expected service as published by the manufacturer in the unit's performance specifications for a period of one (1) year at a minimum
- .2 As a part of this contract, the BAS Contractor shall warranty all other components of the BAS and installation to be free of defects in workmanship and material under normal expected service and use for a period of one (1) year from the date of final acceptance of the BAS by the Owner.
- .3 During the installation warranty period the Contractor shall provide all labour and materials required to repair or to replace all items or components that fail due to defects in workmanship or manufacture at no charge or reduction in service to the Owner.
- .4 Except in the event of property loss or damage, warranty service shall be provided during regular working hours Monday through Friday at no charge unless otherwise explicitly outlined in the Contract Documents.
- .5 Emergency service performed outside of these parameters shall be performed for charge by BAS Contractor according to the provisions set forth in the Contract Documents

PART 2 - PRODUCTS

2.1 BACNET WEB SERVER

- .1 The BAS WEB server software shall be installed on a virtual machine in Sheridan's data centre.
- .2 The WEB Server Database shall comply with the following:
- .3 Complete controller database of each B-BC, B-AAC-PoE, B-ASC and EnOcean wireless applications and sensors shall reside (at a minimum) within the respective device. The Web Server Hardware may retain and utilize a backup of the database within each device; however, the complete and original database must reside in the B-BC, B-AAC-PoE, B-ASC and EnOcean wireless applications and sensors.
- .4 The WEB Server Software shall comply with the following:
- .5 Provide licensed copy of the Control System WEB Enabled Application Software described in Section 2.2. This license shall allow unlimited isolated systems to be served, and access by an unlimited number of users.
- .6 The Owner shall sign a copy of the manufacturer's standard software and firmware licensing agreement as a condition of this contract. Such license shall grant use of all programs and application software to Owner as defined by the manufacturer's license agreement, but shall protect manufacturer's rights to disclosure of trade secrets contained within such software.
 - .1 Manufacturer's Standard Software and Firmware licensing agreement shall be executed by Owner in writing prior to software acquisition and/or installation

2.2 WEB ENABLED APPLICATION SOFTWARE

- .1 The WEB Enabled Application software and Graphical User Interface (GUI) is to be stored on the WEB server. WEB Enabled Applications that require system graphics to be stored on the client machines will not be acceptable. The application shall support unlimited access by 20 simultaneous clients using standard Web browser such as Internet Explorer.
- .2 The WEB enabled application shall perform native BACnet/IP communications directly to all BACnet devices on the BACnet internetwork. Applications that require translation of data, gateways, or mapping of any kind shall not be acceptable.
- .3 The WEB Enabled Application shall provide the same methodology as the B-OWS application when viewing the BACnet Internetwork in terms of network architecture, system graphics, calendars, logs, etc. Systems utilizing Web Enabled Applications and Control Operator Workstation Applications of different manufacturer shall implement both applications so that the methodology is the same. Control Systems that utilize different methodology between the WEB Enabled Application and the Control System Operator Workstation Application for network architecture views, system graphic presentation or request, object, schedule or alarm interaction will not be acceptable.
- .4 Real-time values displayed on a Web page shall update automatically without requiring a manual "refresh" of the Web page.
- .5 Users shall have administrator defined access privileges. Depending on the access privileges assigned, the user shall be able to utilize those features described herein at different levels of interface varying between View only and Modify.
- .6 HTML programming shall not be required to create or display system graphics or data on a Web page.
- .7 A new point displayed on a B-OWS graphic screen shall appear automatically on the identical graphic screen served by the web-server with no further programming or file transfer required.
- .8 The WEB Enabled Application shall support via the Web Browser client the following as it is described in the Control System Operator Workstation Application as a minimum:
 - .1 Password Protection
 - .2 Alarming and Event Notification
 - .3 Weekly, Annual and Special Event Exception Scheduling
 - .4 Trend Log Graphing, and the capability to export in ASCII and Microsoft Excel format
 - .5 Runtime Log Information
 - .6 Ability to Manually Override any Database point
 - .7 Ability to Adjust any Setpoint
 - .8 The WEB Enabled Application shall support via the Web Browser client the following in addition to what is described above:
 - .9 Color Graphical User Interface (GUI)
- .9 All color graphic displays shall be dynamic with current point data automatically updated from the BACnet/IP internetwork to the browser without operator intervention. Manual operator intervention shall use the same methodology as on the B-OWS application.
- .10 Depending upon configured access level; the operator shall be able to manually adjust digital, analog or calculated values in the system, adjust values of control loops, override points or release points to automatic mode.
- .11 System Graphic screens developed for the B-OWS shall be the same image file used for the Web Browser Client. Systems, which require special translation or re-export of graphics to accommodate the web domain, will not be accepted. The Web Browser client shall support any System Graphic animation supported by the B-OWS. System Graphic screens on the Web

Browser client shall support hypertext links to other location on the Internet or on Intranet sites by specifying the Uniform Resource Locator (URL) for the desired link.

- .12 The WEB Enabled Application shall provide the capability to create a user's (as determined by the log-on user identification) home page. Provide the ability to limit a specific user to a defined home page. From the home page, links to other views, or pages in the system shall be possible, if allowed by the system administrator.
- .13 The WEB Enabled Application shall include an Audit Trail feature that automatically records the time, date, and user, and action associated with all user changes made via Web Browser clients.
- .14 The WEB Enabled Application shall store complete help files describing system configuration, and use of the Browser Client interface. The help files shall be served on-line as part of the Browser Client interface. Creation, storage and serving of custom-made help files by the owner shall be possible, in lieu of the manufacturer's help files.

2.3 OPERATORS WORKSTATION PLATFORM (B-OWS)

- .1 Provide as specified herein complete all associated Operating System, Operators Workstation Application Software and Third-Party Software Applications preloaded and configured
- .2 Local Operators Workstation (B-OWS) shall be PC-based desktop workstation. Common BAS database and graphic files shall be stored on workstation designated and acting as the system server. Workstation Hardware minimum requirements are as follows:
 - .1 Intel Pentium IV 3 GHz Processor or better
 - .2 8 GB RAM
 - .3 100 GB or larger hard disc drive with 12 millisecond access time
 - .4 22" Flat Panel LCD Monitor and 128 MB high performance graphics adapter with a minimum resolution performance of at least 1680 x 1050.
 - .5 Tower case with at least two spare drive slots and 3 spare board slots.
 - .6 At least one (1) Ethernet 10/100/1000 Network Interface Card (NIC)
 - .7 At least four (4) USB 2.0 ports
 - .8 Enhanced style keyboard with 101 key layout, 10 function keys, numeric keypad and separate cursor control pads.
 - .9 Two button mouse with adjustable sensitivity and desk pad.
 - .10 All necessary cables
 - .11 A combination surge suppressor/UPS dedicated to this machine
 - .12 Provide an integral audio tone generator to activate on detection of an alarm. Audio tone shall be capable of being enabled or disabled on operator command.

2.4 CONTROL SYSTEM OPERATORS WORKSTATION APPLICATION SOFTWARE

- .1 The B-OWS Software shall be web-based, licensed for unlimited use.
- .2 The Owner shall sign a copy of the manufacturer's standard software and firmware licensing agreement as a condition of this contract. Such license shall grant use of all programs and application software to Owner as defined by the manufacturer's license agreement, but shall protect manufacturer's rights to disclosure of trade secrets contained within such software.
- .3 Manufacturer's Standard Software and Firmware licensing agreement shall be executed by Owner in writing prior to software acquisition and/or installation
- .4 The B-OWS Software shall be BTL listed as either a B-OWS or B-AWS.

- .5 Password Protection
- .6 Multiple-level password access protection shall be provided.
- .7 Passwords shall be exactly the same for all software applications provided to communicate with the internetwork.
- .8 A minimum of 10 levels of access shall be supported with a configurable matrix of operator actions allowed for each access level, broken down into at least 200 possible operator actions
- .9 A minimum of 50 passwords shall be supported at each B-OWS.
- .10 Operators will be able to perform only those commands available for their respective passwords.
- .11 User-definable, automatic log-off timers of from 1 to 60 minutes shall be provided to prevent operators from inadvertently leaving B-OWS in an unsupervised logged-in state.
- .12 Alarming and Event Notification
- .13 B-OWS shall utilize BACnet Alarm Events and PICS shall support at a minimum the following BIBBs:
 - .1 Alarm and Event – Acknowledge-A (AE-ACK-A)
 - .2 Alarm and Event – Notification-A (AE-N-A)
 - .3 Alarm and Event – Alarm Summary View-A (AE-AS-A)
 - .4 Alarm and Event – View and Modify-A (AE-VM-A)
 - .5 Alarm and Event – View Notifications-A (AE-VN-A)
- .14 B-OWS terminal shall provide audible, visual, and printed means of alarm and event notification
- .15 System shall provide log of notification messages. Complete Alarm log of all system and operator transactions shall be archived to the hard disk of the system B-OWS.
- .16 Alarm messages shall be in user-definable text (English or other specified language) and shall be entered either at the B-OWS terminal or via remote communication.
- .17 An alarm summary shall be available to show all alarms whether including but not limited to whether or not they have been acknowledged.
- .18 System shall provide ability to prioritize and differentiate communications for at least 20 different levels of alarms
- .19 Alarm messages shall be fully customizable in size, content, behavior and sound.
- .20 Weekly Annual and Special Event Scheduling
- .21 B-OWS Software shall utilize BACnet Schedules and PICS shall support at a minimum the following BIBBs:
 - .1 Scheduling – Advanced View and Modify-A (SCH-AVM-A)
- .22 Provide ability to view and modify the schedule for the calendar week and up to 255 special events in a graphical format. Each calendar day and special event shall provide at least six time/value entries per day.
- .23 Provide the ability for the operator to select scheduling for either binary, analog, or multi-state object values.
- .24 Provide the ability for the operator to designate days, date ranges, or repeating date patterns as exception schedules.
- .25 Provide the capability for the operator to define special or holiday schedules and to link the BACnet schedule to a BACnet calendar, thereby over-riding weekly schedule programming on holidays defined in the BACnet calendar.
- .26 There shall be a provision with proper password access to manually override each schedule.

- .27 Provide the capability to designate any exception schedule to be "Executed Once" then automatically cleared.
- .28 Provide the ability to name each exception schedule with a user defined term to describe each special event.
- .29 Trend Log Graphing
- .30 B-OWS Software shall allow viewing of BACnet Trend Logs and PICS shall support at a minimum the following BIBBs:
 - .1 Trending – View-A (T-V-A)
- .31 All data points (both hardware and software) system-wide shall be assignable to a historical trending program by gathering configurable historical samples of object data stored in the local controller (B-BC, B-AAC-PoE, B-ASC, and EnOcean wireless applications and sensors).
- .32 All trend log information shall be displayable in text or graphic format. All information shall be able to be printed in black & white or color and exported directly to a Microsoft Excel Spreadsheet.
- .33 Long-term archives shall be automatically stored on the B-OWS platform or automatically stored onto a dedicated server using an SQL database data acquisition service. The B-OWS and/or SQL Database Application shall perform the following at a minimum:
 - .1 Be capable of automatically retrieving any trend-log from any device on the network without user-intervention
 - .2 Manage connection to internetwork automatically based upon configurable data acquisition thresholds; retrieving data only when necessary rather than streaming data
 - .3 Generate standard, secure SQL database accessible by third-party applications
 - .4 Archived data shall be limited only by SQL license and hard disk space available
 - .5 Be capable of exporting data directly to Microsoft Excel
 - .6 Not require a separate "viewer" but shall seamlessly present all archived data together with real-time data stored in device using the standard B-OWS Trend Log Viewer.
- .34 Runtime Log Information
- .35 B-OWS Software shall be capable of displaying Runtime and On/Off Cycle data of all Binary data points (both hardware and software) system-wide. Runtime logs shall provide the following at a minimum:
 - .1 Total Accumulated Runtime
 - .2 Accumulated Starts Today
 - .3 Total Accumulated Starts
 - .4 Timestamp each Start/Stop and duration of each on/off cycle
 - .5 Monitor equipment status and generate maintenance messages based upon user designated run time
- .36 System Configuration, Set-Up and Definition.
- .37 Device and network status shall be displayed for any device on the BACnet internetwork. At a minimum the following Device Management BIBBs shall be supported:
 - .1 Device Management – Automatic Device Mapping-A (DM-ADM-A)
 - .2 Device Management – Automatic Network Mapping-A (DM-ANM-A)
 - .3 Device Management – Reinitialize Device-A (DM-RD-A)
- .38 All control strategies and energy management routines shall be stored in the controller and shall allow modification and additions by the operator using the B-OWS software. No strategies or routines shall be stored on the B-OWS platform.

- .39 B-OWS Software shall have the capability to back-up and restore the programming and database of any BACnet device on the BACnet internetwork. The B-OWS BTL listing shall support the Device Management – Backup and Restore-A (DM-BR-A) BIBB.
- .40 Provide a context sensitive, on-line help system to assist the operator in operation and editing of the system.
- .41 Graphical User Interface (GUI)
- .42 B-OWS Software shall support at a minimum BMP, GIF, TIF, JPG, EMF, PNG, SWF and DIB graphic file formats and allow for the use of custom Flash animation objects and URL hyperlinks in every GUI
- .43 B-OWS Software shall provide a color graphics package to allow the user to generate custom dynamic graphics for graphical representation of system design and system parameters. Graphic images may reside on the B-OWS or server; however, all dynamic data and attributes must reside in the controller.
 - .1 A listed set of symbols and graphic slides shall be available to allow operators to select from the graphics table to assist in graphic generation.
 - .2 All color graphic displays shall be dynamic with current point data automatically updated from the BACnet internetwork to the B-OWS workstation without operator intervention.
 - .3 The operator shall be able to manually adjust all data point values (hardware or software) in the system, adjust values of control loops, and command points to local mode or release points to automatic mode.
 - .4 The windowing environment of the B-OWS shall allow the user to simultaneously view several graphics at the same time to analyze total building operation, and/or to allow the display of a graphic associated with an alarm to be viewed without interrupting work in progress.
 - .5 Pre-packaged animations for display of fans, pumps, dampers, etc., and shall allow custom user-created .swf and .gif animations to be used to display objects on graphic displays.
 - .6 The contractor shall submit all new graphics to Sheridan for approval.
- .44 The BAS shall be provided with fully automatic diagnostic procedures for verification of internetwork communication. In the event of communications failure, the system shall automatically Alarm the condition. B-OWS Software shall be capable of remote annunciation to printer, pager and e-mail
- .45 Control Summaries, Reports and Logging:
- .46 The system shall provide self-documentation reporting to summarize control strategies for any point or any user selected group of points within the Control System.
- .47 The B-OWS reporting package shall allow the user to configure the point information display in custom format.
- .48 The B-OWS shall enable operator to perform Wild Card data point sorting and searches
- .49 The B-OWS shall perform automated network back-up of runtime databases in all devices on the BACnet network according to operator configurable schedule and storage directory structure

2.5 BUILDING CONTROLLERS (B-BC)

- .1 B-BC shall comply with all aforementioned BAS System Requirements and shall comply with the BACnet profile for Building Controllers (B-BC)
- .2 Furnish B-BC(s) as necessary to control large point count major mechanical equipment, and execution of BAS global strategies, and as noted in the execution portion of this specification.
- .3 Each Mechanical System and/or major piece of Mechanical Equipment (e.g., Chilled Water, Heating Water, Large AHU, etc.) shall have one (1) dedicated DDC controller with sufficient I/O

capacity such that it shall be connected to ALL field devices and sensors associated with that system and/or piece of equipment. Distributed control of one (1) single piece of major mechanical equipment shall not be performed by multiple controllers.

- .4 Each B-BC shall support local hardware Inputs and Outputs (I/O) by the use of on-board I/O and/or I/O expansion modules.
- .5 B-BC shall be capable of locally executing global strategies for the BAS based on information from any object in the internetwork. Control Systems that require a higher-level host processor for update, time stamps, global point data, COS transfer, on-line control instruction, or communications control between B-BC panels shall not be acceptable.
- .6 BAS shall communicate with all B-OWS, B-BC, B-AAC-PoE, B-ASC & and EnOcean wireless applications and sensors on a peer-to-peer basis, and shall provide real-time clock functions for scheduling and network-wide time synchronization
- .7 B-BC shall have sufficient memory to support its operating system, database, and programming requirements. Battery/capacitor shall retain static RAM memory and clock functions for a minimum of 72 hours.
- .8 B-BC operating system, field database, and application programs shall reside in EEPROM.
- .9 B-BC run-time field database and application programs shall reside in battery backed-up onboard memory or EEPROM.
- .10 B-BC shall comply with the following Hardware Configuration:
- .11 B-BC shall have integral power switch. If the device manufacturer provides no on-board switch then the System Contractor shall provide a separate dedicated transformer and switch within each enclosure for each controller present
- .12 B-BC shall provide diagnostic LEDs for power, communications and processor status. The B-BC shall continually check the status of its processor and memory circuits
- .13 Controller wiring terminals shall be removable terminal strips for ease of installation and service replacement
- .14 All hardware inputs shall be Universal (i.e., binary or analog) configured on hardware and/or in software.
 - .1 Inputs shall accept dry-contact, thermistor, 4-20 mA, and 0-5VDC
 - .2 Pulse accumulation shall accommodate a maximum frequency of 40Hz
 - .3 Inputs shall have a minimum 10 Bit A/D conversion resolution
 - .4 24VAC over-voltage protection
 - .5 Status LED indicators for each input
- .15 All hardware outputs shall be Universal and configured on hardware and/or in software.
 - .1 Outputs shall provide configurable modulating voltage signal to industry standard 0-5VDC and 0-10VDC analog control devices and relays
 - .2 Outputs shall be capable of sourcing 75mA at 12VDC
 - .3 Outputs shall have a minimum 8 Bit D/A conversion resolution
 - .4 24VAC over-voltage and short protection
 - .5 On-board integral physical Hand-Off-Auto (H-O-A) Switch for every output. H-O-A switch position shall be monitored and displayed by B-BC.
 - .1 In addition to H-O-A switch, Universal Outputs shall be provided with onboard integral potentiometer for manual adjustment of analog modulating voltage signal in conjunction with the Hand position
 - .2 Status LED indicator for each output

- .16 B-BC shall interact with the Control System Application Software in compliance with the following:
- .17 Database programming, configuration and modification shall be accomplished through the B-OWS online with the B-BC. The complete database and application program shall reside in the B-BC. The System Contractor shall configure the software to attain the proper sequence of control and to accomplish all other control system functions indicated in the Contract Documents.
- .18 The B-BC shall function in a real-time, multi-tasking networked operating environment; able to display database values, programs, and control loops in real-time while functional and online using the B-OWS. The user shall be able to add, delete, or modify objects on-line as required without taking the B-BC offline. The programming shall provide all the necessary mathematics, logic, utility and control functions necessary to execute the specified sequence of control.
- .19 All required application programming shall be resident in the B-BC, B-AAC-PoE, B-ASC, and EnOcean wireless applications and sensors and third party BACnet devices, and not in the B-OWS.
- .20 B-BC shall manage system-wide alarms by performing distributed, independent alarm analysis and filtering. At no time shall the B-BC panel's ability to report alarms be affected by either operator activity at a B-OWS or local I/O device, or communications with other B-BC on the network.
 - .1 B-BCs shall have capability to broadcast alarm conditions automatically across the BLCN. Alarm Event notifications shall be sent to off-site computer or serial printer. A minimum of one B-BC per site shall be capable of sending SMTP email messages to an email server for configured alarm conditions.
 - .2 Active Alarm Events log shall be stored on the B-BC and may be viewed locally or remotely.
 - .3 All alarm or point change reports shall include the point's English language description, and the time and date of occurrence.
 - .4 The user shall be able to define the specific system reaction for each point alarm and shall be able to customize reaction and filtering to minimize nuisance reporting. Each B-BC panel shall automatically inhibit the reporting of selected alarms during the standby power modes of operation, loss of power, fire alarm mode, and normal system shutdown and start-up. Users shall have the ability to manually inhibit alarm reporting for each point.
 - .5 Alarm reports, messages, and files can be directed to a user-defined list of operator devices, or PCs used for archiving alarm information.
- .21 B-BC shall perform and manage historical data collection. Minimum sampling time shall be configurable with a minimum sample rate of once per second.
 - .1 B-BC panels shall store point history files for all analog and binary inputs and outputs.
 - .2 Measured and calculated analog and binary data shall also be assignable to user definable trends.
 - .3 Up to six points of any type can be assigned to a single trend log
 - .4 Trend data shall be stored at the stand-alone B-BC panels, and uploaded to hard disk storage automatically at preconfigured intervals when archival is desired. Separate archival application software will be accepted.
- .22 Stand-alone B-BC panels shall automatically accumulate and store runtime hours for binary input and output points.
- .23 B-BC panels shall automatically sample, calculate and store consumption totals on a daily, weekly, or monthly basis for user-selected analog and binary pulse input-type points.

- .24 B-BC panels shall have the ability to count and/or execute events on a daily, weekly, or monthly basis.
- .25 Communication and Protocols
- .26 The B-BC shall continuously scan the BACnet network and maintain a current database of field data in on board battery/capacitor backed RAM or EEPROM, including alarms, passwords, binding tables, device status, etc. The B-BC shall communicate with BACnet devices on the BLCN using BACnet/IP where not limited by third party BACnet devices such as drives, utility meters, etc.
- .27 The B-BC shall provide a communications port for connection of the Portable Operators Terminal using Point-to-Point BACnet physical data link layer protocol or a connection to the network using BACnet/IP.
- .28 B-BC shall support and be capable of monitoring and controlling a network of communicating remote space sensors. These networked sensors shall occupy input/output hardware points in the B-BC.
- .29 Provide all functions that will allow remote communications to off-site locations through Sheridan's IT network.
- .30 B-BC shall support at a minimum of two (2) distinct dedicated BACnet/IP (B/IP) data link networks using TCP/IP and one (1) BACnet/Ethernet data link network simultaneously
- .31 B-BC shall support integral communication using Modbus RTU and TCP protocols as both a Slave and Master for building systems third-party integration.
- .32 B-BC shall support SMTP and provide stand-alone remote annunciation of alarms via e-mail without additional hardware, B-OWS, or web-server.
- .33 B-BC shall support, transmit, and receive of segmented messages.
- .34 Provide as required to meet performance requirements of the system with a 50% increase in connected B-AAC-PoE and B-ASC on any individual network. Provide a dedicated B-BC for all project specific equipment requiring this controller type.
- .35 Locate strategically such that B-BC locations are as equally distributed throughout the project as possible.

2.6 ADVANCED APPLICATION CONTROLLERS – POWER OVER ETHERNET (B-AAC-PoE)

- .1 B-AAC-PoE shall comply with all aforementioned BAS System Requirements and shall comply with or exceed the BACnet profile for Advanced Application Controllers PoE (B-AAC-PoE).
- .2 Furnish one dedicated B-AAC-PoE(s) for each small or medium sized mechanical system, as noted in the execution portion of this specification. Each B-AAC-PoE shall acquire, process, and store point input data on a real time basis for internal use and for sharing with other controllers. Each B-AAC-PoE shall also maintain and supervise digital and analog output signals to the control devices and have a real time operating system capable of time of day scheduling and other time based functions.
- .3 Provide one dedicated B-AAC-PoE for each Terminal Unit Mechanical Device on the project. Those include Variable Air Volume (VAV) Air Terminal Units (ATU), Serial and Parallel Fan-Powered (FP) VAV ATU's, Unit Heaters (UH), Unit Ventilators (UV), Fan Coil Units (FCU), Roof-Top Units (RTU) and Individual Fans. Terminal Units specifically called out in the sequence of operation, as "NonDDC" shall be excluded from this requirement.
- .4 If the hardware point requirements of any medium-sized system should exceed the I/O configuration of available B-AAC-PoE offerings then a B-BC must be used. Control of one piece of mechanical equipment may not be performed by more than one controller.
- .5 All points used for a single mechanical system shall be connected to the same B-AAC-PoE. Points used for control loop reset based on outside air, or space/zone temperature, or extremely

remote differential pressure sensors on slow acting control loops are exempt from this requirement.

- .6 Provide spare additional I/O such that future use of spare capacity shall require providing only the field device, field wiring, point database definition and operational sequence programming changes as required. Additional point modules may be required to implement use of these spare points.
- .7 Provide at least one (1) spare universal input and one (1) spare universal output or 15% spare I/O of the total capacity of each B-AAC-PoE whichever is greater.
- .8 If B-AAC-PoE I/O is not universal then provide at least one (1) spare analog input, one (1) spare digital input, one (1) spare analog output and one (1) spare digital output or 15% spare I/O of the total capacity for each point type of each B-AAC-PoE whichever is greater.
- .9
- .10 B-AAC-PoE shall provide microprocessor based self-contained stand-alone fully programmable operation of local process control loops. All local level application programs shall be installed on individual controllers in non-volatile memory.
- .11 Each B-AAC-PoE shall be capable of sharing point information with other B-BC, B-AAC-PoE, or B-ASC on a peer-to-peer basis via the BACnet BLCN.
- .12 Control systems that utilize 'canned' programs or programmable read only memory (PROM) level application programming are not acceptable.
- .13 Once downloaded, a B-AAC-PoE shall not require further communication with the B-OWS except for data base changes, operator commands, and requests from the B-OWS for B-AAC-PoE data. Programming of B-AAC-PoEs shall be completely modifiable in the field, over the installed BACnet network or remotely via the internet.
- .14 Each B-AAC-PoE shall be provided with the ability to prevent unauthorized access to its software program.
- .15 B-AAC-PoE shall have sufficient memory to support its operating system, database, and programming requirements. .
- .16 B-AAC-PoE operating system, field database, and application programs shall reside in EEPROM.
- .17 B-AAC-PoE run-time field database and application programs shall reside in on-board memory or EEPROM.
- .18 B-AAC-PoE shall feature real-time 24-hour clock and 365-day calendar. Battery or capacitor back-up of these functions is required where the B-AAC-PoE is installed as a standalone controller.
- .19 B-AAC-PoE shall be designed for wall-mounting to a single or double-device box in the space
- .20 B-AAC-PoE shall feature a software configurable audible enunciator which shall be configured to trigger on the occurrence of selected alarms, and shall be audible and acknowledgeable either to all users, or only to those users with sufficient password authority.
- .21 B-AAC-PoE shall comply with the following Hardware Configuration:
- .22 B-AAC-PoE shall provide diagnostic LEDs for power, communications and processor status. The B-AAC-PoE shall continually check the status of its processor and memory circuits
- .23 B-ASC for VAV ATU's application shall comply with the following:
 - .1 B-ASC shall be provided with integral damper actuator. Actuator shall feature the following at a minimum:
 - .1 35 in-lbs of torque
 - .2 Brushless DC Operator

- .3 Actual damper position feedback. Drive time or other software calculated damper position shall not be accepted
 - .4 Damper End Switch using motor current sense or equivalent for positive feedback of both end stop positions
 - .5 Software selectable rotation
- .2 B-ASC shall be provided with integral differential pressure transducer, with range of 0–1 inwc, +/-5% FS.
- .24 Airflow Calibration, Test and Air Balance, etc. shall be performed via BACnet communication with a P-OWS. Special proprietary software and/or applications loaded on a computer or PDA shall not be acceptable to perform this function.
- .25 Universal field device hardware inputs shall be provided and configured on hardware and/or in software and comply with the following:
 - .1 Inputs shall accept dry-contact, thermistor, 4-20 mA, and 0-5VDC
 - .2 Pulse accumulation shall accommodate a maximum frequency of 100Hz
 - .3 Inputs shall have a minimum 10 Bit A/D conversion resolution
 - .4 24VAC over-voltage protection
- .26 In addition to field device Hardware inputs, the B-AAC-PoE shall feature the following on-board integral hardware inputs at a minimum:
 - .1 Temperature sensor (local or remote)
 - .1 10k Thermistor
 - .2 0°C to 40°C (32°F to 104°F) range
 - .3 +/- 0.1°C (+/- 0.18°F) resolution
 - .4 User calibrated +/- 0.1°C (+/- 0.18°F)
 - .2 Setpoint Adjustment Slider
 - .1 20k potentiometer
 - .2 Range defined, limited and configured via Application Software
 - .3 Relative Humidity (RH)
 - .1 10% – 90% range
 - .2 0.1% resolution
 - .3 +/- 2% accuracy
 - .4 Replaceable sensing element
 - .5 User calibrated as necessary
 - .4 Occupancy
 - .1 Passive Infrared Radiation (PIR)
 - .2 5m/16.4' detection distance
 - .3 100° horizontal / 82° vertical detection
 - .4 64 detection zones
 - .5 Carbon Dioxide (CO2)
 - .1 0 – 2000ppm
 - .2 +/- 30ppm Accuracy
 - .3 Auto-Drift Calibration
- .27 Hardware Outputs shall be configured as to be modular in nature and support the following characteristics:
 - .1 Universal Output
 - .1 0 – 12 VDC @ 75 mA
 - .2 Digital or Analog functional operation

- .2 Single Stage Relay
 - .1 SPDT Form C Dry Contact
 - .2 Minimum 0.5 A @ 24 VAC/VDC Contact Rating
 - .3 NO/NC Selectable
- .3 Single Stage TRIAC
 - .1 Single NO Contact for Switching AC Loads
 - .2 Minimum 0.5 A @ 24 VAC/VDC Contact Rating
 - .3 Minimum Switching Current of 20 mA
- .28 Universal hardware outputs shall be provided and configured on hardware or in software and comply with the following:
 - .1 Universal Outputs shall provide configurable modulating voltage signal to industry standard 0-5VDC and 0-10VDC analog control devices and relays
 - .2 Outputs shall be capable of sourcing 75mA at 12VDC
 - .3 Outputs shall have a minimum 8 Bit D/A conversion resolution
 - .4 24VAC over-voltage and short protection
- .29 Control System Application Software:
- .30 The B-AAC-PoE application software shall be the same as and indistinguishable from the B-BC specified interaction with the Control System Application Software.
 - .1 The controller software shall reside in a real time, multi-tasking, networking operating environment. Database definition shall be accomplished through the B-OWS online with the B-AAC-PoE. The complete database and application program shall reside in the B-AAC-PoE. The System Contractor shall configure the software to attain the proper sequence of control and to accomplish all other control system functions indicated in the Contract Documents.
 - .2 The user shall be able to add, delete, or modify objects on-line as required. The programming shall provide all the necessary mathematics, logic, utility and control functions necessary for proper sequence of control.
- .31 Communications and Protocols
- .32 The B-AAC-PoE shall communicate with field devices and controllers on the BLCN using BACnet/IP where not limited by third party devices such as variable speed drives, utility meters, etc.
- .33 The B-AAC-PoE shall provide a communications port for connection of the Portable Operators Terminal using Point-to-Point BACnet physical data link layer protocol or a connection to the BACnet/IP network.
- .34 B-AAC-PoE shall support and be capable of monitoring and controlling a network of a minimum of four (4) communicating remote space sensors. These networked sensors shall not consume input/output hardware points in the B-AAC-PoE.
- .35 B-AAC-PoE shall perform and manage historical data collection. Minimum sampling time shall be configurable with a minimum sample rate of once per second.
- .36 B-AAC-PoE panels shall store point history files for all analog and binary inputs and outputs.
- .37 Measured and calculated analog and binary data shall also be assignable to user-definable trends.
- .38 Up to six points of any type can be assigned to a single trend log.
- .39 Trend data shall be stored at the stand-alone B-AAC-PoE panels, and uploaded to hard disk storage automatically at preconfigured intervals when archival is desired. Separate archival application software will be accepted.

- .40 Stand-alone B-ASC panels shall automatically accumulate and store runtime hours for binary input and output points.
- .41 B-ASC panels shall automatically sample, calculate and store consumption totals on a daily, weekly, or monthly basis for user-selected analog and binary pulse input-type points.
- .42 B-ASC panels shall have the ability to count and/or execute events on a daily, weekly, or monthly basis.
- .43 B-AAC-PoE shall support, transmit, and receive of segmented messages.

2.7 APPLICATION SPECIFIC CONTROLLERS (B-ASC)

- .1 B-ASC shall comply with all aforementioned BAS System Requirements and shall comply with the BACnet profile for Application Specific Controllers (B-ASC).
- .2 B-ASC shall provide microprocessor based self-contained stand-alone fully programmable operation of local process control loops. All local level application programs shall be installed on individual controllers in non-volatile memory.
- .3 Each B-ASC shall be capable of sharing point information with other B-BC, B-AAC-PoE, or B-ASC on a peer-to-peer basis via the BACnet BLCN.
- .4 Control systems that utilize 'canned' programs or programmable read only memory (PROM) level application programming are not acceptable.
- .5 Once downloaded, a B-ASC shall not require further communication with the B-OWS except for data base changes, operator commands, and requests from the B-OWS for B-ASC data. Programming of B-ASCs shall be completely modifiable in the field, over installed BACnet Internetwork or remotely via modem.
- .6 Each B-ASC shall be provided with the ability to prevent unauthorized access to its software program.
- .7 B-ASC shall have sufficient memory to support its operating system, database, and programming requirements.
- .8 B-ASC operating system, field database, and application programs shall reside in EEPROM.
- .9 B-ASC run-time field database and application programs shall reside in on-board non-volatile memory or EEPROM.
- .10 B-ASC shall perform and manage historical data collection. Minimum sampling time shall be configurable with a minimum sample rate of once per second.
- .11 B-ASC panels shall store point history files for all analog and binary inputs and outputs.
- .12 Measured and calculated analog and binary data shall also be assignable to user-definable trends.
- .13 Up to six points of any type can be assigned to a single trend log.
- .14 Trend data shall be stored at the stand-alone B-ASC panels, and uploaded to hard disk storage automatically at preconfigured intervals when archival is desired. Separate archival application software will be accepted.
- .15 Stand-alone B-ASC panels shall automatically accumulate and store runtime hours for binary input and output points.
- .16 B-ASC panels shall automatically sample, calculate and store consumption totals on a daily, weekly, or monthly basis for user-selected analog and binary pulse input-type points.
- .17 B-ASC panels shall have the ability to count and/or execute events on a daily, weekly, or monthly basis.
- .18 Universal field device hardware inputs shall be provided and configured on hardware and/or in software and comply with the following:

- .1 Inputs shall accept dry-contact, thermistor, 4-20 mA, and 0-5VDC
- .2 Pulse accumulation shall accommodate a minimum frequency of 40Hz
- .3 Inputs shall have a minimum 10 Bit A/D conversion resolution
- .4 24VAC over-voltage protection
- .19 Hardware outputs for field devices shall be provided as follows:
 - .1 Three (3) Universal Outputs or One (1) Universal Output, one (1) single stage TRIAC Output, and one (1) Dual Stage TRIAC Output
- .20 Hardware Outputs shall be configured on hardware and/or in software and comply with the following:
 - .1 Universal Outputs shall provide configurable modulating voltage signal to industry 0-5VDC and 0-10VDC analog control devices and relays
 - .2 Each TRIAC Output shall source 500 mA current, 24 VAC 0.5 ACA
 - .3 Universal Output shall be capable of sourcing 75mA at 12VDC
 - .4 Outputs shall have a minimum 8 Bit D/A conversion resolution
 - .5 24VAC over-voltage and short protection
- .21 B-ASC shall provide diagnostic LEDs for power, communications and processor status. The B-ASC shall continually check the status of its processor and memory circuits
- .22 Controller wiring terminals shall be 5mm space between poles with removable terminal strips for ease of installation and service replacement
- .23 B-ASC Enclosure shall be rated as follows:
 - .1 NEMA 1
 - .2 UL 94-5V
- .24 B-ASC for unitary applications shall comply with the following:
 - .1 B-ASC shall provide diagnostic LEDs for power, communications and processor status. The B-ASC shall continually check the status of its processor and memory circuits
 - .2 Controller wiring terminals shall be removable terminal strips for ease of installation and service replacement
 - .3 Universal field device hardware inputs shall be provided and configured on hardware and/or in software and comply with the following:
 - .1 Inputs shall accept dry-contact, thermistor, 4-20 mA, and 0-5VDC
 - .2 Pulse accumulation shall accommodate a minimum frequency of 40Hz
 - .3 Inputs shall have a minimum 10 Bit A/D conversion resolution
 - .4 24VAC over-voltage protection
 - .4 Hardware outputs for field devices shall be provided as follows:
 - .1 Four (4) Universal Outputs, or Four (4) TRIAC Outputs or One (1) Universal Output, one (1) single stage TRIAC Output, and two (2) Dual Stage TRIAC Output
 - .5 Hardware Outputs shall be configured on hardware and/or in software and comply with the following:
 - .6 Universal Outputs shall provide configurable modulating voltage signal to industry standard 0-5VDC and 0-10VDC analog control devices and relays
 - .7 Each TRIAC Output shall source 500 mA current, 24 VAC 0.5 ACA
 - .8 Universal Output shall be capable of sourcing 75mA at 12VDC
 - .9 Outputs shall have a minimum 8 Bit D/A conversion resolution

- .10 24VAC over-voltage and short protection
- .25 Control System Application Software:
 - .1 The B-ASC application software shall be the same as and indistinguishable from the B-BC specified interaction with the Control System Application Software.
 - .2 The controller software shall reside in a real time, multi-tasking, networking operating environment. Database definition shall be accomplished through the B-OWS online with the B-ASC. The complete database and application program shall reside in the B-ASC. The System Contractor shall configure the software to attain the proper sequence of control and to accomplish all other control system functions indicated in the Contract Documents.
 - .3 The user shall be able to add, delete, or modify objects on-line as required. The programming shall provide all the necessary mathematics, logic, utility and control functions necessary for proper sequence of control.
- .26 Communications and Protocols
 - .1 The B-ASC shall communicate with field devices and controllers on the BLCN using BACnet/IP or BACnet MS/TP where not limited by third party devices such as variable speed drives, utility meters, etc.
 - .2 The B-ASC shall provide a communications port for connection of the Portable Operators Terminal using Point-to-Point BACnet physical data link layer protocol or a connection to the internetwork.
 - .3 B-ASC shall support and be capable of monitoring and controlling a network of a minimum of four (4) communicating remote space sensors, each with capability of a local LCD Display, adjustable set-point and outputs for zone controls. These networked sensors shall not consume input/output hardware points in the B-ASC.
 - .4 B-ASC shall support, transmit, and receive of segmented messages.

2.8 NETWORKED COMMUNICATING SPACE SENSORS

- .1 Wall-Mounted Networked Communicating Space Sensors (SS) on a daisy-chained network are not allowed; each SS must occupy a hardware point.
- .2 SS shall provide a Liquid Crystal Display (LCD), where indicated on the drawings, with the following minimum features:
 - .1 36mm x 36mm (1.4" x 1.4") display area.
 - .2 Display four (4) 0.6" digits and six (6) 0.3" characters simultaneously
 - .3 Capable of displaying icons, time, analog, and digital engineering units
- .3 SS shall be programmable to display up to ten (10) data points in any combination of local and/or networked values from any device on the internetwork
- .4 Each SS shall have a customizable design overlay that can be swapped out at any time without affecting the local user interface. This overlay must be removable and replaceable, such that Sheridan can change branding or layout of the thermostat by changing only the front design.
- .5 Each SS shall provide a local keypad for local user interface to perform navigation and adjustment of points configured as adjustable.
 - .1 Button layout shall be adjustable
 - .2 Controls for the operation of building services or safety devices, including electrical switches, thermostats, and intercom switches, intended to be operated by the occupant and located in a barrier-free path of travel shall be operable using a closed fist
- .6 Each SS shall provide a point of access for a B-OWS, Service Tool, etc. to the BACnet internetwork via the SS communication network.

- .7 Where indicated on the drawings each SS shall provide at a minimum the following on-board integral I/O without the consumption of any inputs and/or outputs at the host DDC controller:
 - .1 Temperature sensor (local or remote)
 - .1 10k Thermistor
 - .2 12 Bit A/D Conversion
 - .3 0°C to 40°C (32°F to 104°F) range
 - .4 +/- 0.1°C (+/- 0.18°F) resolution
 - .5 User calibrated +/- 0.1°C (+/- 0.18°F)
 - .2 Relative Humidity (RH)
 - .1 10% – 90% range
 - .2 0.1% resolution
 - .3 +/- 3% accuracy
 - .4 Replaceable sensing element
 - .5 User calibrated
 - .3 Occupancy
 - .1 Passive Infrared Radiation (PIR)
 - .2 5m/16.4' detection distance
 - .3 100° horizontal / 82° vertical detection
 - .4 64 detection zones
 - .4 Additional Space/Zone I/O
 - .1 Two (2) thermistor or dry-contact inputs
 - .2 Two (2) TRIAC Outputs (24VAC @ 0.5A)
 - .5 CO2 Sensor
 - .1 Dual Beam, Self-Calibrating NDIR Detection
 - .2 Range 0-2000ppm
 - .3 Accuracy @ 25C +/- 2% of value
 - .4 Temperature Dependence: 2ppm/C typical
 - .5 Pressure dependence: 0.13% of reading per mm Hg
 - .6 Stability: 20 ppm/year
- .8 SS shall be equipped with RGB backlight to visually indicate conditions of the space being monitored
- .9 SS shall be fully programmable in GLC+

2.9 TEMPERATURE CONTROL PANELS (TCP), ENCLOSURES & SUB-PANELS

- .1 All system components not designed for or required to be field installed shall be mounted in a control enclosure. Those components shall be sub panel mounted except components that are mounted on the panel face. Provide on/off power switch with over-current protection for control power sources in each local enclosure.
- .2 All control enclosures shall be located as shown on the drawings and wherever possible (or where not indicated on the drawings) so that visual observation and adjustment can be accomplished while standing flatfooted on the floor in a convenient location adjacent to the equipment served. Install all equipment in readily accessible location as defined by Chapter1 Article 100 Part A of the NEC.
- .3 Label all control system components.
- .4 A copy of the "As-built" application engineering for the system served shall be laminated in clear plastic, shall be legible and suspended within enclosure.
- .5 All B-BC shall be mounted in an enclosure.

- .6 Provide pedestal base or wall mounted local control enclosure to house all control components associated with each area, system or mechanical equipment room
 - .1 The enclosures shall be minimum 16 gauge steel or aluminum, totally enclosed on all sides and painted with a baked enamel finish. All enclosures must maintain a minimum separation of 1" from the back wall.
 - .2 Enclosures located in wet indoor conditions or located outdoors shall meet NEMA 4X.
 - .3 Penetrations are permitted on bottom of enclosure only. Do not make conduit penetrations in top or side of enclosure. Each enclosure shall be equipped with a wire gutter below with a minimum of six ¾" minimum conduit penetrations into the bottom of the enclosure to accommodate system wiring.
 - .4 Where required by AHJ, enclosures located in mechanical or electrical rooms shall meet NEMA 2 requirements
 - .5 Enclosures located in all other locations including but not limited to mechanical or electrical rooms not requiring NEMA 2, occupied spaces, above ceilings and plenums shall be the same NEMA classification as all other enclosures located in the same environment, except if location requires additional protection due to potential vandalism or environmental conditions and shall at a minimum meet NEMA 1 requirements
 - .6 Enclosures provided as an integral (pre-packaged) part of another product and/or piece of equipment are acceptable
 - .7 Provide a continuous piano hinged door, keyed locking latch and removable sub-panel. A single key shall be common to all control enclosures.
- .7 Provide each DDC panel with a line filter, surge suppressor, electrical disconnect, control fuse, and control transformer. All sized and provided by the control system contractor.
- .8 Provide power supplies located inside control enclosures shall be fully enclosed with external 24 VAC terminals, on/off control, equipment overcurrent protection, power indication, high/low voltage separation, and convenience 120VAC outlets.
- .9 Provide insulated, modular, feed-through, clamp-style terminal blocks suitable for rail-mounting with end plates and partitions for the termination of all field wiring in control enclosures. Field wiring to equipment with integral terminals and/or unitary equipment (i.e., VAV ATU's, EF's, &c.) shall not be required to have terminal blocks.
- .10 Rail mounted terminal blocks shall be color coded to match the associated conductor colors adhering to the Sheridan standard wire recognition coloring scheme as scheduled in section 2.10.

2.10 INTERCONNECTING WIRE & CABLE

- .1 All wiring regardless of service and/or voltage shall comply with Contract Document Electrical System Specifications, the Ontario Electrical Safety Code (OESC), and any/all applicable local codes and/or Authorities Having Jurisdiction (AHJ) and shall include but may not be limited to the following:
 - .1 All power wiring required not indicated on the electrical plans and specifications.
 - .2 Power to all actuators and sensors.
 - .3 Provide all wiring and cabling for network communications except for owner provided LAN's/WAN's.
 - .4 All sensor and control device input and output wiring.
 - .5 All interconnecting cabling between and amongst network devices, PCs printers, modems, etc.
 - .6 Interlock wiring between devices, and between motor starters.

- .7 All other necessary wiring for fully complete and functional system as specified.
- .8 Install piping, wiring/cabling routed parallel to or at right angles with the structure, properly supported every six (6) feet at a minimum and installed in a workmanlike manner.
- .2 Maximum allowable voltage for control wiring shall be 120 VAC.
- .3 All wiring shall be installed as continuous links. Any required splices shall be made only within an approved junction box or other approved protective device with a maximum fill of 50%.
 - .1 BACnet network cabling shall not be field spliced
- .4 Verify integrity of all wiring to ensure continuity and freedom from shorts and grounds.
- .5 Contractor shall terminate all control and/or interlock wiring and shall maintain updated (as-built) wiring diagrams with terminations identified at the job site.
- .6 Power Wiring and Cabling
 - .1 Where required, power wiring for the control system shall be from circuits on emergency power panels. At a minimum; B-BC's, the B-OWS and any other DDC devices and control devices connected to and/or responsible for system critical equipment shall be powered from circuits on emergency power panels.
 - .2 Power wiring for all enclosures and equipment, including branch circuit wiring from circuit breaker panels shall be the responsibility of the System Contractor unless specifically shown on the Plans or Specifications. Dedicated branch circuits shall be provided.
 - .3 All B-OWS equipment shall be served from isolated ground receptacles via UPS by dedicated branch circuits.
 - .4 All other enclosures, sensor and control devices shall be fed from separate circuits in the electrical distribution panels and shall not be served from the typical floor receptacle or lighting circuits.
- .7 Network Wiring and Cabling
 - .1 Network installation shall strictly adhere to the manufacturer's networking installation instructions and procedures
 - .2 All communications wire shall be externally identified as "Building Energy Management System Network" at least once every five feet.
- .8 Where required all wiring regardless of service and/or voltage shall be in conduit in accordance with applicable Section 26 specifications "Raceways and Boxes for Electrical Systems" and "Cable Trays for Electrical Systems" and shall be routed parallel to or at right angles with the structure, properly supported every six (6) feet at a minimum and installed in a workmanlike manner.
- .9 Where permitted by all applicable specifications, local codes, OESC and AHJ; plenum-rated control cabling may be used where final application will be concealed but accessible. Where plenum-rated cable is allowed, it shall be routed parallel to or at right angles with the structure, properly supported every six (6) feet at a minimum and installed in a workmanlike manner.
- .10 The Sheridan wiring color shall be as below:

Low Voltage Wiring	
BACnet Communications	Green with White Strip
24 VAC Power	Red and black jacketed conductors with black jacketed sheath over the pair

Input/Output	White and black jacketed conductors and white jacketed sheath over the pair.
Communicating Sensor	Green jacketed sheath

2.11 GENERAL FIELD DEVICES

- .1 All control relays shall be CSA listed with contacts and coils rated for the application
- .2 Relays used for in-line control start/stop of line voltage motors and shall have a current rating at least 150% full load amps.
- .3 Control transformers shall be CSA and C-UL listed. Primary and secondary sides shall be fused in accordance with the NEC or shall be class 2 current limiting type. Transformers shall be sized such that the connected load is not greater than 80% of the transformer rated capacity.
- .4 Voltage/Current to Pneumatic Transducer shall be non-bleed type 0-5V or 0-10V input and output pressure to match spring range of controlled device.
- .5 Emergency shut-off switches shall be heavy duty, two-position push-pull, maintained contact, and illuminated 1-3/8 inch in diameter mushroom style push button switch. Provide hinged easy open protective clear cover to prevent accidental operation of switch.

2.12 ANALOG SENSORS

- .1 Temperature Sensors: Temperature sensors are required leaving each element designed to change or vary a given supply temperature.
- .2 Temperature sensors shall be linear precision element Thermistor type.
- .3 Single point duct temperature sensor shall consist of 316 stainless steel or platinum sensing element, junction box for wiring connections and gasket to prevent air leakage and vibration noise.
- .4 Averaging duct temperature sensor shall consist of a copper or stainless steel averaging element, junction box for wiring connections and gasket to prevent air leakage or vibration noise.
- .5 Liquid immersion temperature sensor shall include thermowell, sensor and connection head for wiring connections.
- .6 Outside air temperature sensor shall consist of a single device sensor, ventilated non-metallic sun shield, utility box for terminations, and watertight gasket to prevent water seepage.
- .7 Space temperature sensor shall consist of an element within a ventilated cover. Sensors located in mechanical areas, plenums shall be simple sensor with no setpoint adjustment.
- .8 Terminal Unit space temperature sensors shall be EnOcean wireless applications and sensors provided in accordance with the drawings at the locations indicated with the following options as indicated on drawings:
 - .1 Standard Wall-Mount Space Sensor
 - .2 Setpoint Adjustment Buttons (“+” & “-”)
 - .3 Override/Bypass
 - .4 Occupancy
 - .5 CO2
 - .6 RH
 - .7 Network Jack

- .9 All sensors not located in public spaces and associated with B-ASC or B-AAC-PoE that is located in normally inaccessible locations shall be the same.
- .10 Sensors shall be manually calibrated on site so that the wiring length does not detract from the sensor accuracy specified.
- .11 Where necessary due to structural cavities, masonry walls, proximity to exterior openings, and unconditioned spaces an insulated mounting base shall prevent temperature of mounting location from affecting sensor temperature reading.
- .12 Sensor guards shall protect sensor from damage in all public areas such as gymnasiums, classrooms, vestibules, restrooms, and corridors or as indicated at locations on the drawings.
- .13 Provide brass or stainless steel thermowells for each immersion type temperature sensor and switch.
- .14 Wet Bulb temperature and humidity station shall be suitable for duct or outside mounting and consist of sensors, ventilated non-metallic sun shield, utility box for terminations, and watertight gasket to prevent water seepage.
- .15 Pressure
 - .1 Static Air Pressure Sensor shall have linear output voltage signal. Zero and span shall be field-adjustable. Tubing shall be connected to a Pitot tube or other pressure/airflow sensing device. Under no circumstances shall tubing pass through equipment housing or ductwork.
 - .2 Pitot tube probe shall be at least 4 inches allowing for internal duct insulation.
 - .3 Steam and water gauge pressure sensor shall include connections secured to a stainless steel diaphragm sensor with a gasketed, dust and watertight housing for remote mounting.
 - .4 All steam devices and sensors shall incorporate a "pig-tail" in installation
 - .5 The differential pressure sensor for air applications shall provide a linear output voltage signal. The device shall be capable of over-pressurization to 10 PSI without a zero-shift and shall have a field adjustable zero and span. The assembly shall consist of pressure connections that secure pressure sensor to a housing for duct or remote mounting.
 - .6 Differential Pressure Sensor for water shall consist of a differential pressure tap secured to a stainless steel diaphragm and an electronic sensor enclosed in a gasketed, dust and watertight case.
- .16 Five-valve manifold assembly shall be required to allow isolation and bypass of operating pressures from differential pressure sensor.
- .17 Snubbers shall be required to prevent system pressure hammers and surges from being fully transmitted to the pressure sensor.
- .18 Position
 - .1 Damper Position indication consists of a potentiometer mounted in housing.
 - .2 Damper Position End Switches shall employ mechanical position proving. Mercury style end switches shall not be accepted.
- .19 Control valve Position indicator consists of a potentiometer mounted on the valve actuator.
- .20 Float type level switch with SPDT snap acting contacts. Electronics shall be housed in a watertight enclosure.
- .21 Proximity Limit Switch shall be oil-tight, roller type, SPDT snap-acting switch with adjustable trim arm.
- .22 Flow
 - .1 Electronic Air Flow Monitoring System (Type II): Other installations: Airflow monitoring systems shall be a solid state electronic device comprised of a thermistor based sensing

grid and microprocessor based electronics panel for flow averaging, temperature compensation and signal transmission. [Eatron,] [Paragon,] [Tek-Air] or [Air Monitor].

- .2 Water Flow In-Line Type: (For Pipe Sizes up to 1 ½ inches): In-line type flow sensor shall have a nonmagnetic spinning impeller. Sensor shall be Data Industrial Model 250B or equal.
- .3 Water Flow Insertion Type: (For Pipe Sizes 1 ½ inch to 10 inches): Provide a probe-mounted insertion type turbine sensor.

.23 Gas

.1 Refrigerant Vapor Detection System

- .1 Provide a refrigerant vapor detection system to meet ASHRAE 15-1994 and the applicable local codes. The system shall sample and monitor a minimum of two (2) remote sampling points per Chiller.
- .2 Provide the following accessories:
 - .1 One alarm relay for each level of alarm and one relay for flow failure or horn silence. Failure relay output that shall energize upon failure of monitor system operation. Failures include but are not limited to the following: low airflow through monitor, power circuit failure, and a saturated or absent sensor signal.
 - .2 Analog Output 4-20 mA or 0-5 VDC.
 - .3 Sample Pump shall be capable of drawing 0.25-1 liter/minute through 3/16 inch ID tubing for distances up to 100 ft.
 - .4 Enclosure type: NEMA 4X.
- .3 Sampling Tubing shall be Type L or hard drawn copper tubing.
- .4 The read out/control unit shall be wall mounted pursuant with contract drawings. Remote sampling points shall be located within the central plant area according to the drawings.
- .5 If the equipment and installation procedures are in accordance with these Specifications, products and services from Mine Safety Appliances Instruments Company (MSA) or approved equal will be acceptable.
- .6 The water chilling unit manufacturer shall provide refrigerant data.

.2 Indoor Air Quality Sensors shall measure both VOCs and CO2 in PPM. Sensors shall be mounted as indicated on the drawings.

- .1 Carbon Monoxide detection, where required on the contract drawings shall be a single or multi-channel, dual-level detectors, using solid-state sensors with 3-year minimum life, maximum 15-minute sensor replacement, suitable over a temperature range of 23°F to 130°F, calibrated for 50 and 100 ppm, with maximum 120-second response time to 100-ppm carbon monoxide.
- .2 Carbon Dioxide Sensor and Transmitter: Single detectors using solid-state infrared sensors; suitable over a temperature range of 23°F to 130°F (-5°C to 55° C) and calibrated for 0% to 2% of full range, with continuous or averaged reading, 4- to 20-mA output for wall mounting.
- .3 Occupancy Sensor: Passive infrared or Dual PIR/Ultrasonic, with time delay, daylight sensor lockout, sensitivity control, and 180-degree field of view with vertical sensing adjustment; for flush mounting.
- .4 Oxygen Sensor and Transmitter: Single detectors using solid-state zircon cell sensing; suitable over a temperature range of -32°F to 1100°F (0°C to 593°C) and calibrated for 0% to 5%, with continuous or averaged reading, 4- to 20-mA output; for wall mounting.

2.13 SWITCHING SENSORS/THERMOSTATS

.1 Temperature Thermostats

- .1 Provide one (1) Low Limit thermostat for each 20 sq./ft. of coil face. Low limit thermostat shall be of the vapor pressure remote element, manual reset type with adjustable set point. The device shall respond to the lowest temperature to which any 1 foot of the element is exposed. Capillary sensing tubing serpentine vertically across the discharge face of the coil, and be supported firmly by mechanical clips.
- .2 Low Limit thermostats shall be DPDT with a minimum of one (1) NO contact and one (1) NC contact
- .2 High limit thermostat shall be manual reset type. Sensing element shall be bimetal.
- .3 Capillary Type Thermostats shall have liquid or vapor-filled thermal system consisting of stainless steel or copper sensing element, connected to a fully compensating capillary tube, and operating bellows or spiral.
- .4 Surface Mounted Thermostats shall be line voltage on-off type suitable for strapped mounting to pipe.
- .5 Wall Mounted Thermostats shall be line voltage on-off type suitable for wall mounting.

2.14 AUTOMATIC CONTROL VALVES

- .1 General Requirements: Honeywell is a preferred product.
 - .1 Valves shall be provided with metallic linkage.
 - .2 Unless otherwise indicated, all valves shall have a minimum range-ability of 50:1. All valves shall be guaranteed to have not more than 1% leakage of design flow rate at the pump shutoff pressure
 - .3 Globe valves shall have replaceable seats.
 - .4 Valves shall be quiet in operation.
 - .5 Unless otherwise indicated, minimum body rating for any valve is 125 psi and maximum fluid temperature of 177°C (350°F).
 - .6 Valves shall have stainless-steel stems and stuffing boxes with extended necks to clear the piping insulation.
 - .7 Valve bodies shall meet or exceed pressure and temperature class rating based upon design operating temperature and 150% design operating pressure.
 - .8 Unless otherwise indicated two and three-way Automatic Control Valves shall be globe-style bodies and comply with the following selection criteria:
 - .1 Globe-style valve minimum body rating for any valve is 125 psi and maximum fluid temperature of 120°C (250°F).
 - .2 Bodies for valves 2" and smaller shall be brass or bronze with NPT threaded connections, and shall be rated for ANSI Class 250 working pressure. Spring-loaded packing shall be required to protect against leakage at the stem.
 - .3 Bodies for valves 2½" to 3" shall be brass, bronze or iron with flanged connections and shall be rated for ANSI Class 125 working pressure. Packing shall protect against leakage at the stem.
 - .4 Bodies for valves 3" to 6" shall be iron, cast iron or cast steel with flanged connections and shall be rated for ANSI Class 125 working pressure. Packing shall protect against leakage at the stem.
 - .5 For modulating applications, valve Cv (Kv) shall be within 100% to 125% of the design Cv (Kv)
 - .6 For two-position applications, valve Cv (Kv) shall be the largest available for the valve size
 - .7 Valve and actuator combination shall be Normally-Open (NO) or Normally-Closed (NC) as shown

.9 Where specified ball-style body Automatic Control Valves shall adhere to the following:

- .1 Ball-style valve minimum body rating for any valve is 125 psi and maximum fluid temperature of 100°C (212°F).
- .2 Bodies for valves 2" and smaller shall be forged brass body with nickel plating, NPT threaded connections
- .3 All control ball valves shall be furnished with chrome plated bronze ball and stainless steel stem and fiberglass reinforced Teflon ☐ seats and seals a blowout proof stem design.
- .4 The stem packing shall be 2 O-rings designed for modulating service and requiring no maintenance.
- .5 All control ball valves shall feature characterized flow guides when used for modulating applications

.10 Where specified butterfly-style body Automatic Control Valves shall adhere to the following:

- .1 Unless otherwise indicated, butterfly valves shall have a minimum range ability of 10:1. All valves shall be guaranteed to have not more than 1% leakage of design flow rate at the pump shut-off pressure
- .2 Butterfly-style valve minimum body rating for any valve is 125 psi and maximum fluid temperature of 120°C (250°F).
- .3 Bodies for valves 3" to 12" shall be fully-lugged cast iron body
- .4 Flanges shall meet all ANSI 125 and ANSI 150 standards.
- .5 The stem shall be one piece stainless.
- .6 The 416 stainless shaft shall be supported at three locations with PTFE bushings for positive shaft alignment.
- .7 The seat shall be EPDM; Phenolic backed, non-collapsible, and easy to replace.
- .8 The disc shall be aluminum bronze to provide bubble-tight close off in either direction.
- .9 Valve shall have a long stem design to accommodate 2 inches insulation.

.11 Valves for Chilled Water (CHW) and Glycol (GCHW) service shall adhere to the following:

- .1 All internal trim regardless of body type shall be Type 316 Stainless Steel. Valves 3" and larger shall be butterfly valves.

.12 Valves for Heating Hot Water (HHW) service shall adhere to the following:

- .1 Valves for HHW service between 210°F (99°C) and 250°F (120°C) shall have all internal trim (including seats, rings, modulating plugs and springs) of Type 316 Stainless Steel
- .2 Valves for HHW service below 210°F (99°C) shall have all internal trim (including seats, rings, modulating plugs and springs) of Brass, Bronze or Type 316 Stainless Steel
- .3 Non-metallic valve components shall be suitable for a minimum continuous operating temperature of 250°F (120°C) and/or 50°F (10°C) above the system design temperature, whichever is higher

2.15 VALVE ACTUATORS: BELIMO IS PREFERRED PRODUCT.

- .1 Actuators used in wet conditions and/or in or near outdoor air streams shall have NEMA 2 housings.
- .2 Valve Actuators shall be modulating, with feedback signal, two-position and spring return fail safe as called out in the control sequence of operation or indicated on the drawings. All modulating valves shall be positive positioning, and respond to a 0-10VDC or 2-10 VDC with the exception that terminal unit zone valves may use an actuator that responds to a floating or tri-state with feedback signal.
- .3 All control valves shall have a visual position indicator.

- .4 All non-spring return actuators shall have an external clutch/manual gear release to allow manual positioning of the valve when the actuator is not powered. Spring return actuators with more than 60in-LBtorque capacity shall have a manual crank for this purpose. In lieu of a manual positioning device, it will be acceptable for the contractor to provide a full line size bypass around the control valve. Three bypass shut off valves shall be provided to allow the control valve to be isolated while the open stop valve in the bypass allows flow around the control valve.
- .5 All modulating actuators shall have an external, built-in switch to allow the reversing of direction of rotation.
- .6 Any mechanical equipment with direct introduction of outside air shall require fail-safe spring return valve actuators. Terminal equipment (VAV ATU, &c.) without direct introduction of outside air are permitted to have actuators that maintain their last commanded position when power is lost to the actuator. Equipment isolation and differential or temperature pressure bypass valves shall not be required to be provided with a spring return actuator provided that a failure of the valve to return to its "fail-safe" position will not incur damage to property or the system it serves.

2.16 AUTOMATIC CONTROL DAMPERS

- .1 All Automatic Control Dampers provided as a part of this Specification shall bear the AMCA Seal as an indication that they comply with all requirements of the AMCA Certified Ratings Programs.
- .2 A single damper section shall have blades that do not exceed 48" in length and shall be no higher than 72". Damper blades shall not exceed 8" in width. Applications requiring larger dampers shall be achieved by combining single damper sections.
- .3 Frame construction shall be a minimum of #14 gauge galvanized steel formed into channels and welded, 14 gauge galvanized roll-formed steel or extruded aluminum at a minimum 4½" by 1' by 0.125" thick.
- .4 Blades and baffles shall be fabricated of minimum 16 gauge steel with corrosion resistant galvanized finish or extruded aluminum 6" by 0.08".
- .5 All dampers shall be provided with nylon, cyclopy or oilite bearings, stainless steel or elastomeric side seals, and zinc plated hardware as standard.
- .6 Axles shall be a minimum of ½" diameter and be locked to blade with rivets or welded.
- .7 Dampers shall be made up of 6" or 8" blades or combination of the two. Dampers shall have a minimum of four brakes running the entire length. Silicone or polyurethane blade edging shall be furnished on all dampers.
- .8 Maximum leakage rate through any 48 inches by 48 inches closed damper in any application shall not exceed 10.0 cfm per sq. ft. of damper face area at 4 inches of water pressure differential and a maximum closing torque of 4 inch-lbs/sq. ft. of damper face area. Damper leakage ratings shall be certified in accordance with AMCA Standard 500-D.
- .9 Blades mounted vertically shall be supported by thrust bearings
- .10 All Automatic Control Dampers in modulating applications shall be sized so as to achieve linear airflow characteristics
- .11 Flow Control Application Dampers (Opposed Blade Operational Style)
 - .1 Opposed Blade Automatic Flow Control Dampers shall be required as indicated on the drawings for:
 - .1 All mixing, volume throttling, airflow control, etc. applications installed in Outdoor, Relief, Exhaust, and/or Supply airstreams.
 - .2 Any application upstream of critical components
 - .3 Ducted Outlets

- .4 Automatic Flow Control Dampers specifically indicated to be provided by Mechanical Equipment manufacturer and/or as a component of packaged equipment shall not be provided by the Contractor.
- .2 To minimize leakage, blade edges shall be interlocked and blade seals shall be compressible at all contact points. Channel frames shall also be provided with jamb seals.
- .3 All Outdoor Air Damper components shall be suitable for applications operating in the temperature range of -40°F (-4°C) to 167°F (75°C)
- .4 Damper shall be rated for a minimum velocity of 2000 ft./min
- .12 Mechanical Ventilation, Miscellaneous Utility Dampers (Parallel Blade Operational Style)
 - .1 Parallel Blade Automatic Flow Control Dampers shall be permitted as indicated on the drawings for applications not requiring Opposed Blade operation pursuant with that specification section and for:
 - .1 Two-position (fully-open or fully-closed) applications
 - .2 Applications where the damper constitutes the primary source of total system pressure loss
 - .3 Applications where greater control is required at the upper end of airstream volume operating range
 - .4 Mechanical Space ventilation and exhaust, combustion intake & exhaust, etc.
 - .2 Shall comply with AMCA 500-D Class 4 and shall not leak in excess of 80cfm per sq./ft. at 4inwc static pressure when closed.
 - .3 Damper shall be rated for a minimum velocity of 1500 ft./min
- .13 Operating Linkages and Damper Accessories
 - .1 All operating linkages and/or damper accessories required for installation and application in accordance with specification design intent and manufacturer's installation procedures shall be provided
 - .2 Operating linkages provided external to dampers (crank arms, connecting rods, shaft extensions, etc.) for transmitting motion from the actuator/operator to dampers shall be designed as to functionally operate a load equal to or in excess of 300% of the maximum required operating force for the damper.
 - .3 Crank arms and connecting rods shall be adjustable. Linkages shall be brass, bronze, zinc coated steel, or stainless steel.
 - .4 Adjustments of Crank Arms shall control the position of the damper
 - .5 Use of Operating Linkages external to damper drive shaft shall neither delay nor impede operation of the damper in a manner of performance less than a direct-coupled damper actuator. Operating linkages shall not under any circumstances be permitted to flex, warp, shift etc. under normal operation of connected damper sections.

2.17 AUTOMATIC CONTROL DAMPER ACTUATORS: BELIMO IS A PREFERRED PRODUCT

- .1 Control damper actuators shall be electronic direct-coupled type. Actuators shall have a means for reversing drive direction and a manual override accessible at the front cover.
- .2 Single bolt or setscrew type fasteners are not acceptable.
- .3 The actuator shall have electronic overload or digital rotation sensing circuitry. Mechanical end switches or magnetic clutch to deactivate the actuator at the end of rotation are not acceptable.
- .4 For spring return fail-safe applications, an internal mechanical spring return mechanism shall be built into the actuator housing. Non-mechanical forms of fail-safe operation are not acceptable.

- .5 All non-spring return actuators shall have an external manual clutch/gear release to allow manual positioning of the damper when the actuator is not powered. Spring return actuators with more than 60 in-LB torque capacity shall have a manual crank for this purpose.

PART 3 - EXECUTION

3.1 GENERAL

- .1 BAS component locations are the responsibility of the System Contractor. All control system components shall be installed in locations as required to properly sense the controlled medium.
- .2 BAS Installation shall be performed by professionals in a workmanlike manner and in compliance with the Contract Documents, Section 26 Project Electrical System Specifications, the Ontario Electrical Safety Code (OESC), and any/all applicable local codes and/or Authorities Having Jurisdiction (AHJ) and the following:
- .3 Complete BAS installation including all DDC Devices, Enclosures, wiring, equipment, control devices and sensors shall be installed in accordance with the manufacturers' recommended installation procedures and as specified.
- .4 All control devices are to be provided and installed with all required gaskets, seals, flanges, connection enclosures, thermal compounds, insulation, piping, fittings and valves as required for design operation, isolation, equalization, purging and calibration.
- .5 Strap-on control devices shall not be permitted except as explicitly called out
- .6 All control devices mounted outdoors shall be protected by a weather-shield, integral outdoor enclosure, &c. from ambient elements in such a manner as to not impede design functionality and/or sensing
- .7 BAS installation shall be such that it provides sufficient clearance for system maintenance by maintaining sufficient access for equipment, device and/or component service, calibration, removal, repair or replacement.
- .8 BAS installation shall not interfere with required clearance for mechanical and/or electrical equipment maintenance.
- .9 Penetrations through and mounting holes in the building exterior associated with the BAS installation shall be sealed and made water-tight
- .10 Dielectric isolation shall be provided where dissimilar metals are used in installation for connection and support
- .11 Installation, wiring and material shall be protected from damage by and during BAS installation by BAS Contractor,
- .12 The Contractor shall be responsible for his/her work and equipment until finally inspected, tested and accepted. The Contractor shall protect his/her work against theft or damage, and shall carefully store material and equipment received on site that is not immediately installed.
- .13 After completion of installation, calibrate and commission all components provided as part of the Control System and demonstrate proper sequence of operation in compliance with the specifications. BAS components not operating correctly shall be field corrected or replaced.

3.2 DIRECT AND WEB-ENABLED BAS APPLICATION SOFTWARE

- .1 At time of acceptance all operating system, Third party and Control System Application software shall be at least the latest official release version available.
- .2 Software programs are described to their general intent. It is recognized that Networked System manufacturer's software differ; however, the Application software provided shall incorporate the features described fully implemented and optimized to provide the sequences described, minimize energy consumption and prolong equipment life.

- .3 The following standard naming convention shall be utilized for the naming of BACnet Devices on the BACnet internetwork.
- .4 When programming the system BACnet addressing rules will be strictly adhered to. All addressing strategies will have to be approved by Sheridan prior to configuring any LAN types.
- .5 All analog and binary values shall be programmed with appropriate alarms.
- .6 Except as specified otherwise, throttling ranges, proportional bands, and switching differentials shall be centered on the associated set point.
- .7 All set points unless otherwise indicated are adjustable and shall be programmable for all control loops.
- .8 Each control loop and/or interlock(s) for all mechanical system including terminal unit systems shall be programmed with a control loop specific graphical trend to trend all values associated with each specific control loop or system interlock.
- .9 Where any sequence or occupancy schedule calls for more than one motorized unit to start simultaneously, the system start commands shall be staggered by 60-second (adj.) intervals to minimize inrush current.
- .10 Scheduling shall be developed for each mechanical system. Final schedules shall be coordinated with Sheridan prior to system commissioning. Until indicated otherwise the following schedule shall be used:
 - .1 Occupied: Monday – Saturday/06:30 – 20:30
 - .2 Unoccupied: All other times and all statutory holidays.
 - .3 Optimal start/stop programs shall be applied to all regularly scheduled mechanical and electrical systems.
- .11 At a minimum, trend log/historical data shall be implemented for every hardware point on the system. Additionally all software (virtual) points used as setpoints shall be trended. Point trends shall be grouped into logically interrelated points for individual mechanical and building systems. Initial set-up shall be to log values once every 5 minutes. Refer to points list on electrical and mechanical drawings for components requirements.
- .12 B-OWS Graphical User Interface (GUI) must be approved by Sheridan and shall incorporate at a minimum the following:
- .13 At a minimum, all physical hardware, sensors, control devices and set points shall be visible on a B-OWS in graphical form.
- .14 All mechanical systems shall have a programmed real time color graphic for primary graphical user interface
- .15 Individual floor plan graphics will be programmed for each floor or area of the building. All space sensors will be visible on floor plan graphics and system graphic.
- .16 The system shall observe the following command priorities (from highest to lowest):
- .17 Smoke Control and Life Safety (BACnet Object Priority Array Level 1 & 2)
- .18 Manual Operator Command (BACnet Object Priority Array Level 8)
- .19 Energy Management (BACnet Object Priority Array Level 9)
- .20 Normal Automatic Control (BACnet Object Priority Array Level 10)

3.3 WEB-ENABLED B-OWS HARDWARE

- .1 Provide as specified for each PC-Based B-OWS
- .2 Assemble B-OWS components in a configuration that allows easy operator access to all necessary components from one position. Locate components as required Sheridan Facilities Services office.

- .3 Connect B-OWS to Sheridan LAN through a dedicated Ethernet port.
- .4 Per specifications in 2.3, provide sufficient permanent and removable storage drives for required free memory after provision for all operating system, Third party and Control System Application software, all fully configured point databases, storage/back-up of all B-BC, B-AAC-PoE and B-ASC application programming, all graphic files, all user-defined reports and a three year archive of all trend and historical data described in this specification.
- .5 Provide sufficient RAM to meet system performance requirements.

3.4 BACNET PROTOCOL VERIFICATION SOFTWARE

- .1 Demonstrate exclusive communication utilizing the BACnet Protocol on all segments of the BACnet network.

3.5 LOCAL SYSTEM NETWORK INTERFACE

- .1 At a minimum the Portable B-OWS shall be able to connect to the BACnet Internetwork within each mechanical equipment space within the project. For manufacturers systems that do not allow direct portable B-OWS connections to B-AAC-PoE and B-ASC this may require that a higher level LAN be routed to each mechanical equipment space with a jack.

3.6 INTERCONNECTING WIRING AND CABLING - GENERAL

- .1 It shall be the System Contractor's responsibility to provide all wiring required for a complete Control System.
- .2 Control system wiring and cabling installed for this project shall be performed by professionals in a workmanlike manner and in accordance with the Contract Documents, Section 26 Project Electrical System Specifications, the National Electric Code (NEC), and any/all applicable local codes and/or Authorities Having Jurisdiction (AHJ)
- .3 Network installation shall conform to standards for the LAN types and cabling types selected. Specific network rules inherent to the ANSI/AHRAE Standard 135-2012, BACnet will be followed. Those include but are not limited to:
 - .1 Only one path can exist from any BACnet device to another
 - .2 Each BACnet device connected to an internetwork LAN must have a unique device instance (0 - 4,194,303).
 - .3 Each internetwork LAN must have a unique Network Number (1 - 65,545).
 - .4 Wire type used for MSTP, RS-485 twisted pair communications must be balanced twisted pair with 100 to 120 Ohms Characteristic Impedance. The wire shall be less than 30 pF per foot, and preferred 22AWG or lower. A shield wire shall be included for ground connection.
- .4 Primary LAN Network wire and cable shall be run separately from all other wiring.
- .5 Other LAN Network wire and cabling shall be installed separate from any wiring over thirty (30) volts.
- .6 All communications shielding shall be grounded as per Networked System manufacturer's recommendations.
- .7 Installation
- .8 Except in mechanical and electrical spaces where other conduits or piping is exposed, conceal wiring and cabling as much as possible and install and comply with the requirements of the Contract Documents, Section 26 Specifications, the Ontario Electrical Safety Code (OESC), and any/all applicable local codes and/or Authorities Having Jurisdiction (AHJ)
- .9 All wiring and cabling installed in and/or routed through TCP, Enclosures and Sub-Panels shall regardless of voltage and/or service be fastened securely using cable ties, non-metallic wiring

duct and/or other standard industry wiring management means and methods in a workmanlike manner parallel and/or perpendicular with enclosure.

- .10 All TCP, Enclosures, Sub-Panels, Junction Boxes, Pull Boxes, Troughs, Trays, Raceways, Conduits, etc. shall not exceed 70% maximum conductor fill.
- .11 Each Input/Output device shall be controlled from a dedicated 2-pair conductor
- .12 Each Input/Output device requiring power shall have a dedicated power wire run to the control enclosure and shall be terminated to a dedicated terminal strip
- .13 All wire with controls enclosure shall be neat and suitably bundled and contained in Panduit wire duct or equivalent
- .14 All wiring will be suitably identified by thermal print heat shrink tubing at controller and Input/Output device.

3.7 ANALOG SENSORS

- .1 Temperature
 - .1 All wires attached to sensors shall be air sealed in their conduits or in the wall to stop air transmitted from other areas affecting sensor readings.
 - .2 Install and properly support all enclosures and sensing elements as much as possible in the center of duct cross section and in straight duct runs. In condensing environments use stainless steel flanges to support sensing elements.
 - .3 Sensors mounted on air ducts having exterior insulation shall be provided with handy-box mounting with insulating material firmly fitted around handy-box.
 - .4 Sensors for mixed air and outdoor air streams greater than 6 square feet or 24" in either direction shall be averaging type. Provide a minimum of 1 linear foot of sensor per 4 square feet of duct area or equal to duct width where installed, whichever is longer. Averaging sensing tubing shall serpentine vertically across airstream and be supported firmly by mechanical clips.
 - .5 Temperature sensors installed in piping or tanks shall be in separable thermowells. Sensors shall be inserted into thermowells with conductive paste. Assembly shall allow removal of sensor without loss of fluid.
 - .6 At a minimum one outside air temperature sensor shall be installed. It shall be mounted outside on a northern exposure as high as serviceable on the building. The sensor shall be mounted within a ventilated enclosure to shield the sensor from the effects of the sun. The sensor location shall be selected such that it may not be affected by artificial and/or mechanical airstreams (i.e., building exhaust, building relief, etc.).
- .2 Terminal Unit Sensors shall be provided one per terminal unit device with the exception of large non-partitioned areas served by multiple terminal units.
 - .1 They shall be wall mounted in the space at a height above finished floor consistent with Ontario Building Code, and located as shown on drawings.
 - .2 Provide a minimum of 16' of coiled temperature sensor control wiring for equipment with space sensor not located on the Drawings.
 - .3 In all areas where terminal unit sensor locations are not known at the time of building start-up, sensors shall be hung approximately 24 inches from the ceiling in the area of the controlled zone and connected. Control wiring shall be neatly coiled and attached to ceiling grid. Sensors located in service corridors where subject to regular damage shall be mounted 84" above finished floor.
 - .4 Zone temperature sensors shall not be located on perimeter walls. Where explicitly indicated on drawings to do so and/or in locations near exterior walls and/or subject to

drafts sensors shall have insulated mounting bases to prevent false room temperature readings.

- .5 Where wall sensors are mounted in an area subject to damage provide suitable protective guard.
- .6 Where wall sensors are mounted in public spaces with adjustable set points provide suitable security guard.
- .7 Provide matched temperature sensors for differential temperature measurement. Differential accuracy shall be within 0.1°C (0.2°F).
- .8 Wet Bulb
- .3 For outside air mount same as outside air temperature sensor.
 - .1 For duct mounting execute same as duct mounted temperature sensor.
- .4 Pressure
 - .1 Orient static pressure sensing taps faced directly down-stream in the airflow so as to eliminate velocity pressure effects. Locate pressure transducers within 50' of sensing point and use tubing sized such as to prevent signal phase lag.
 - .2 Final location of static/differential pressure sensing taps shall be pursuant with Contract Documents and as indicated on drawings. Where not explicitly indicated on drawings, pressure sensing taps shall be located as follows:
 - .1 Duct static pressure control sensor tap shall be located 2/3 distance from the Air Handling Unit of the total duct length in a straight section of ductwork with a minimum or four (4) duct diameters in both directions
 - .2 Positive static high-pressure safety cut-outs shall be located at Air Handling Unit immediately downstream of fan section
 - .3 Mixed-Air static and/or differential sensor tap shall be located in mixing box section
 - .4 Negative static pressure safety cut-outs shall be located immediately upstream of fan section
 - .5 Filter differential pressure taps shall be installed on both filter inlet and outlet
 - .6 Mount air differential pressure taps so that true differential is sensed
 - .3 Water gauge taps shall include snubbers and isolation valves
 - .4 Water differential pressure sensors shall be piped through a five-valve bypass assembly with snubbers
- .5 Position
 - .1 Mount damper position indicator onto damper blade and out of air stream as much as possible.
- .6 Flow
 - .1 Mount airflow measuring station differential pressure sensor outside of fan casing.

3.8 SWITCHING SENSORS

- .1 Temperature
 - .1 Wherever mixed or entering air temperatures are below 35°F (1.4°C), the sensing tube shall be installed across the leaving face of the first coil in the airstream. The low-temperature thermostat shall be arranged to stop the units supply fan and its associated return air fan should the temperature at any point along the sensing element fall below 35°F (1.4°C). Provide a minimum of one foot of sensing element for each square foot of coil face area. In condensing environments use stainless steel sensing element and capillary mounting clips.
- .2 Differential Pressure

- .1 Differential pressure type switches shall be installed as per differential pressure sensors and shall provide a maximum switching differential of 10% of the sensed operating range for the application at minimum and maximum designed flow rates. Set point shall be selected to operate at midpoint of span.
- .2 Paddle type water flow switch shall be used to verify flow through chillers, other applications for operational, safety or other critical control interlock, on-off flow status monitoring, and at locations as indicated on the Drawings. Provide with NEMA 4 enclosure when installed in a condensing environment.
- .3 Differential pressure type water flow switch shall be used for on-off flow status monitoring of equipment and to position secondary chilled water loop return control valves. The sensing tubes shall be installed between the equipment and the nearest service valves.
- .3 Position
 - .1 Mount damper blade end switch in such a manner that it is located out of the airstream as much as possible. End switch as installed shall be repeatable to within a range of 5 degrees. Under no circumstances shall mercury-style end switches be permitted.
- .4 Direct drive motors are permitted to utilize a current switch without an adjustable set point.

3.9 AUTOMATIC CONTROL VALVES

- .1 Flow characteristics shall be as follows:
 - .1 Flow type for 2-way valves shall be equal percentage, except for terminal unit zone valves, and differential pressure control applications.
 - .2 Flow type for 3-way valves shall be linear, except for terminal unit zone and ball valves.
 - .3 Terminal unit zone, differential pressure applications shall be linear flow characteristic.
- .2 Two-way, control valves shall be provided for all convectors, fin radiation, horizontal unit heaters, unit ventilators, and all steam applications.
- .3 Two-way control valves shall be provided for all cabinet unit heaters, duct coils, and any other locations noted on drawings.
- .4 Two-way valves shall not be placed on branch or main hydronic circuits where these valves will cause a "dead-head" pumping condition.
- .5 Valve actuator and trim shall be furnished to provide the following minimum close-off pressure ratings:
 - .1 Two-Way liquid valves shall be 150% of total system (pump) head.
 - .2 Three-Way liquid valves shall be 300% of pressure differential between ports A and B at design flow or 100% of total system (pump) head, whichever is greater.
- .6 Water Sizing Criteria at full flow:
 - .1 Two-position service shall be line size.
 - .2 Two-way or three-way modulating service shall have a maximum pressure drop not to exceed 4 PSI.
 - .3 Differential pressure modulating service shall have a maximum pressure drop not to exceed 12 PSI.

3.10 VALVE ACTUATORS

- .1 When an air handling unit or major piece of mechanical equipment is not in operation, control devices shall remain in their "off" positions. Fail-safe positions shall be the same and defined as follows:

DEVICES	OFF/FAIL-SAFE POSITION
1. HHW Coil Valves:	As-is position to Coil/Equipment
2. CHW Coil Valves:	As-is position to Coil/Equipment

3.11 DAMPER ACTUATORS

- .1 Check operation of damper/actuator combination to confirm that actuator modulates damper smoothly throughout stroke to both open and closed positions.
- .2 Spring return actuators shall be provided except as follows.
 - .1 Terminal or unitary equipment without direct introduction of outside air are permitted to have actuators that maintain their last commanded position when power is lost.
 - .2 Damper actuator shall not be required to be provided with spring return provided that it is not directly connected to Outdoor Air and a failure of the damper to return to its "normal" position will not incur damage to the system/space it serves.
- .3 Modulating actuators shall be provided for terminal unit mechanical devices may use an actuator that responds to a floating or tri-state signal.
- .4 Minimum torque and power output requirements of actuators shall not be less than 1.2 times required design load.
- .5 When an air handling unit or major piece of mechanical equipment is not in operation, control damper shall remain in their "off" positions. Fail-safe positions shall be the same and defined as follows

DEVICES	OFF/FAIL-SAFE POSITION
1. Outdoor Air Dampers:	Closed
2. Return Air Dampers:	Open
3. Exhaust/Relief Air Dampers:	Closed