

SPECIFICATIONS

<u>Division</u>	<u>Section</u>	<u>Title</u>	
00	00 01 10	Table of Contents	3
01	01 11 00	Summary of Work	7
	01 14 00	Work Restrictions.....	4
	01 31 19	Project Meetings.....	2
	01 32 16.19	Construction Progress Schedule – Bar (GANTT) Chart.....	4
	01 33 00	Submittal Procedures	4
	01 35 29.06	Health and Safety Requirements	4
	01 35 35	DND Fire Safety Requirements	6
	01 35 43	Environmental Procedures	2
	01 41 00	Regulatory Requirements	3
	01 45 00	Quality Control	3
	01 61 00	Common Product Requirements	4
	01 71 00	Examination and Preparation	2
	01 74 00	Cleaning.....	2
	01 74 19	Waste Management and Disposal	4
	01 78 00	Closeout Submittals	8
	01 79 00	Demonstration and Training	2
	01 91 13	Commissioning	3
		Appendix – AC Unit Construction Checklist.....	7
02	02 41 99	Demolition for Minor Works	3
		Appendix – Form 588 – Halocarbon Service Report	6
07	07 52 00	Modified Bituminous Membrane Roofing.....	7
09	09 91 23	Interior Painting	9
21	21 05 01	Common Work Results for Mechanical	4
22	22 05 00	Common Work Results for Plumbing	4
	22 11 16	Domestic Water Piping.....	3
	22 13 16.13	Sanitary Waste and Vent Piping: Cast Iron and Copper.....	3
23	23 05 00	Common Work Results for HVAC	6
	23 05 15	Common Installation Requirements for HVAC Pipework	6
	23 05 29	Hangers and Supports for HVAC Piping and Equipment	9
	23 05 48	Vibration and Seismic Controls for HVAC	7
	23 05 53	Identification of HVAC Piping and Equipment.....	7
	23 05 93	Testing, Adjusting and Balancing for HVAC	8
	23 07 13	Duct Insulation	8
	23 07 19	HVAC Piping Insulation.....	7
	23 09 33	Electric and Electronic Controls System for HVAC	11
	23 23 00	Refrigerant Piping	4
	23 31 13.01	Metal Ducts – Low Pressure to 500 Pa.....	5

	23 33 00	Air Duct Accessories	4
	23 33 46	Flexible Ducts	3
	23 81 40	Air Source Unitary Heat Pumps.....	9
		Appendix – Form 67 – Service Log for a Refrigeration, Air Conditioning or Fire Extinguishing System	5
	23 84 13	Humidifiers	5
26	26 05 00	Common Work Results for Electrical	10
	26 05 05	Selective Demolition for Electrical	6
	26 05 20	Wire and Box Connectors (0-1000 V).....	3
	26 05 21	Wires and Cables (0-1000 V).....	5
	26 05 28	Grounding: Secondary	3
	26 05 29	Hangers and Supports for Electrical Systems	3
	26 05 31	Splitters, Junctions, Pull Boxes and Cabinets	2
	26 05 32	Outlet Boxes, Conduit Boxes and Fittings.....	3
	26 05 34	Conduits, Conduit Fastenings and Conduit Fittings	4
	26 12 16.01	Dry-Type Transformers up to 600 V Primary.....	3
	26 24 16.01	Panelboards: Breaker Type	3
	26 27 26	Wiring Devices	4
	26 28 16.02	Moulded Case Circuit Breakers	3
	26 28 23	Disconnect Switches – Fused and Non-Fused	2
	26 29 01	Contactors	2

DRAWINGS

STRUCTURAL

S-100	Structural Roof Plan – New Work
S-101	Structural Details
S-102	Structural Details
S-103	Structural Details

MECHANICAL

M-001	Legend & Drawing List
M-101	Details
M-102	Details
M-103	Schedules
M-301	HVAC Ground Floor Demolition
M-302	HVAC Ground Floor New Work
M-303	HVAC Roof Demolition
M-304	HVAC Roof New Work
M-601	Controls, Legend & Schematics
M-602	Controls Schematics
M-603	Controls Schematics

ELECTRICAL

E-001	Electrical Legend, Drawing List and Schedules
E-101	Electrical Single Line Diagram Demolition and New
E-102	Electrical Panel Schedules Demolition
E-103	Electrical Panel Schedules Demolition
E-301	Electrical Power Ground Floor Demolition
E-302	Electrical Power Ground Floor New Work
E-303	Electrical Power Roof Demolition
E-304	Electrical Power Roof New Work

END OF SECTION

Part 1 General

1.1 INQUIRIES

- .1 All inquiries related to starting date, schedule, security passes, building entry, storage etc., shall be conducted through the Departmental Representative:
 - .1 Name: Andrew MacDonald
 - .2 Address: 1010 Somerset West, 2nd Fl., Ottawa ON, K1A 0K9
 - .3 Telephone Number: 613-794-1743
 - .4 E-Mail: Andrew.MacDonald@pwgsc-tpsgc.gc.ca
- .2 The Departmental Representative is responsible for the management of this Request for Proposal/Invitation to Tender or any resulting Contract.
- .3 Any changes must be authorized in writing by the Departmental Representative.
- .4 The Contractor is not to perform work in excess of or outside the scope of Work in the resulting contract based on verbal or written requests or instructions from any government personnel other than the aforementioned Departmental Representative

1.2 WORK COVERED BY CONTRACT DOCUMENTS

- .1 Work of this Contract comprises upgrade electrical services of CFSU Uplands Building 475, Ottawa, ON.
- .2 Drawings and specifications are complementary, items shown or mentioned in one and not in the other are deemed to be included in the contract document.

1.3 APPOINTED SUPERVISOR

- .1 The Contractor must retain and pay for the services of a competent and permanent supervisor or superintendent who must remain on site until the works are accepted, and, having full authority to represent the Contractor

1.4 TIME OF EXECUTION

- .1 Commence work in accordance with notification of acceptance and complete work within approved schedule 3 days from the date of such notification.
- .2 Supply all necessary labour, materials, tools, and equipment required to carry out a complete and professional installation and to the satisfaction of the Departmental Representative.
- .3 It shall be the Contractor's responsibility to ascertain the entire Scope of Work & conditions affecting the work before submission of a bid for this requirement.

1.5 SCHEDULE

- .1 On award of contract, submit bar (GANTT) chart identification schedule for work, indicating anticipated progress stages within time of completion, see Section 01 32 16.19. Where schedule has been reviewed by the Departmental Representative, take necessary measures to complete work within scheduled time. Do not change schedule without notifying the Departmental Representative

- .2 Carry out work "normal hours" Monday to Friday.
- .3 Carry out work "after hours" Monday to Friday and on Saturdays, Sundays and statutory holidays.
- .4 Give the Departmental Representative 48 hours notice for work to be carried out during "after hours".
- .5 Unless indicated otherwise by the Departmental Representative, carry out noise generating work during "after hours" Monday to Friday from 18:00 to 7:00 hours and on Saturdays, Sundays and statutory holidays:
 - .1 Victoria Day
 - .2 Canada Day
 - .3 Civic Holiday
 - .4 Labour Day
- .6 Unless indicated otherwise by the Departmental Representative, carry out work that will cause an interruption to electric power to the whole building or any individual room in the building "after hours" Monday to Friday from 18:00 to 7:00 hours and on Saturdays, Sundays and statutory holidays:
 - .1 Victoria Day
 - .2 Canada Day
 - .3 Civic Holiday
 - .4 Labour Day
 - .5 Thanksgiving
- .7 Unless indicated otherwise by the Departmental Representative, carry out work that will render air conditioning work unavailable during the months of April and May.
- .8 Use of a crane on site to place and deliver any equipment must be scheduled 14 days in advance with the Departmental Representative. Crane shall not exceed height as directed and required by the Ottawa Airport Authority. Contractor shall confirm crane height with authorities and submit all details to the Departmental Representative for review.

1.6 NOTIFICATIONS REQUIRED

- .1 The Departmental Representative must be provided with specific advance notice in writing of the following:
 - .1 Any work involving interruption of power to Panelboard U1: 2 weeks notice.
 - .2 Any work interrupting cooling from unit AC-5: 72 hours notice.
 - .3 Any work requiring access to room 129: 72 hours notice.
 - .4 Any other work interrupting AC: 48 hours notice.

1.7 DEFINITIONS

- .1 "Contract" means the contract documents referred to as such therein and every other document specified or referred to in any of them as forming part of the Contract, all as amended by agreement of the parties;
- .2 "Superintendent" means the employee or representative of the Contractor designated by the Contractor

- .3 "Work" means, subject only to any express stipulation in the Contract to the contrary, everything that is necessary to be done, furnished or delivered by the Contractor to perform the Contract in accordance with the contract documents.
- .4 "Departmental Representative" means the person designated in the Contract, or by written notice to the Contractor, to act as the Departmental Representative for the purposes of the Contract, and includes a person, designated and authorized in writing by the Departmental Representative to the Contractor;
- .5 Any changes must be authorized in writing by the Departmental Representative. The Contractor is not to perform work in excess of or outside the scope of this Request / resulting Contract based on verbal or written requests or instructions from any government personnel other than the aforementioned Departmental Representative.

1.8 ACCEPTABLE MATERIAL

- .1 Approval of alternate materials must be given in writing by the Departmental Representative prior to tender closing.

1.9 MEASUREMENTS

- .1 Measurements, sizes, exact count and dimension are the responsibility of the Contractor to verify. Verify all drawings, measurements and detentions or omissions before commencing the work.
- .2 Verify all conditions and dimensions prior to fabrication and construction.
- .3 Notify the Departmental Representative of any discrepancies or divergences from the drawings before proceeding.

1.10 CHANGES

- .1 Changes to the work shall only be made on receipt of written instructed approval from the Departmental Representative. Any resulting price adjustment to the work shall be agreed upon by the Departmental Representative prior to any implementation of the approved changes.
- .2 If the Departmental Representative agrees that the cost of the work will be affected due to contemplated change, the Contractor shall submit a quotation to the Contracting Authority in accordance with the instructions specified herein.
- .3 Quotations for Contemplated Change Notices (CCN) must include a detailed breakdown of the work, material, plant and equipment costs incurred by the Contractor. Quotations from subcontractors involved in the change must also be supported by similarity detailed breakdowns of the subcontractors costs.
- .4 It is the responsibility of the Contractor to ensure that all subcontractor's quotations included in the Contractor's quotation to the Departmental Representative are fair and reasonable in view of the terms expressed herein.
- .5 The work hours required for the contemplated change shall be based on the estimated number of hours to perform the work.
- .6 Time spent by a working foreman may be included in the number of hours, at a rate agreed to in writing by the Contractor and the Departmental Representative.

- .7 Time attributable to material handling, productivity factors and approved rest periods are to be included in the number of hours required by the contemplated change.
- .8 When a change deletes work which has not yet been performed, the Departmental Representative is entitled to an adjustment in the contract amount equal to the cost the Contractor would have incurred had the work not been deleted.
- .9 If the contemplated change in the work necessitates a change in the contract completion date, or has as impact on the work, the Contractor shall identify and include the resulting cost in the breakdown of its quotation to the Departmental Representative.
- .10 The work shall conform to the contract documents unless otherwise stated in the contemplated change notice, change order, or site instruction signed by the Departmental Representative.
- .11 Upon acceptance of the Contractor's Quotation by the Departmental Representative, the Departmental Representative shall prepare and issue the formal change order.
- .12 Hourly Labour Rate:
 - .1 The hourly labour rate listed in the Contractor's quotation shall be Determined in accordance with the collective agreements that are applicable at the site of the work and shall include:
 - .1 The base rate of pay;
 - .2 Vacation pay;
 - .3 Benefits which includes:
 - .1 Welfare contributions;
 - .2 Pension contributions;
 - .3 Union dues;
 - .4 Other applicable benefits.
- .13 Normal overhead & profit not included in project are to be shown separately on the construction management cost breakdown sheet supplied by the Departmental Representative.

1.11 SUBCONTRACTING

- .1 Neither the whole nor any part of the work may be subcontracted by the Contractor without the written consent of the Departmental Representative.
- .2 The Contractor shall notify the Departmental Representative in writing of the Contractor's intention to subcontract.
- .3 The Contractor shall notify the Departmental Representative in writing identifying the part of the work, and the subcontractor with whom it is intended to subcontract.
- .4 If the Departmental Representative objects to a subcontracting pursuant, the contractor shall not enter into the intended subcontracting.
- .5 Neither subcontracting nor the Departmental Representative's consent to subcontracting by the Contractor shall be construed to relieve the Contractor from any obligation under the contract or impose any liability upon the Government of Canada.
- .6 Should the Departmental Representative consent to the subcontractor, all submittal requirements in this contract shall apply. Submittals shall be made for review by the

Departmental Representative prior to the subcontractor being permitted to enter the construction site.

1.12 WORK SEQUENCE

- .1 Construct Work in stages to accommodate Departmental Representative's continued use of premises during construction.
- .2 Co-ordinate Progress Schedule and co-ordinate with Departmental Representative, Occupancy during construction.
- .3 Construct Work in stages to provide for continuous public usage. Do not close off public usage of facilities until use of one stage of Work will provide alternate usage.
- .4 Maintain fire access/control.

1.13 CONTRACTOR USE OF PREMISES

- .1 Unrestricted use of site until Substantial Performance.
- .2 Contractor is responsible for their own parking. Some parking is available on-site.
- .3 Limit use of premises for Work, for access, for storage, to allow:
 - .1 Work by other contractors.
 - .2 DND usage.
- .4 Co-ordinate use of premises under direction of Departmental Representative.
- .5 Obtain and pay for use of additional storage or work areas needed for operations under this Contract.
- .6 Remove or alter existing work to prevent injury or damage to portions of existing work which remain.
- .7 Repair or replace portions of existing work which have been altered during construction operations to match existing or adjoining work, as directed by Departmental Representative.
- .8 At completion of operations condition of existing work: equal to or better than that which existed before new work started.

1.14 OWNER OCCUPANCY

- .1 Owner will occupy premises during entire construction period for execution of normal operations.
- .2 Co-operate with Owner in scheduling operations to minimize conflict and to facilitate Owner usage.

1.15 ALTERATIONS, ADDITIONS OR REPAIRS TO EXISTING BUILDING

- .1 Execute work with least possible interference or disturbance to occupants, building operations, public and normal use of premises. Arrange with Departmental Representative to facilitate execution of work.

1.16 EXISTING SERVICES

- .1 Notify, Departmental Representative and utility companies of intended interruption of services and obtain required permission.
- .2 Where Work involves breaking into or connecting to existing services, give Departmental Representative 48 hours notice for necessary interruption of mechanical or electrical service throughout course of work. Minimize duration of interruptions. Carry out work at times as directed by governing authorities with minimum disturbance to DND and associated operations.
- .3 Provide alternative routes for personnel, pedestrian and vehicular traffic.
- .4 Establish location and extent of service lines in area of work before starting Work. Notify Departmental Representative of findings.
- .5 Submit schedule to and obtain approval from Departmental Representative for any shut-down or closure of active service or facility including power and communications services. Adhere to approved schedule and provide notice to affected parties.
- .6 Provide temporary services when directed by Departmental Representative to maintain critical building and tenant systems.
- .7 Where unknown services are encountered, immediately advise Departmental Representative and confirm findings in writing.
- .8 Protect, relocate or maintain existing active services. When inactive services are encountered, cap off in manner approved by authorities having jurisdiction.
- .9 Record locations of maintained, re-routed and abandoned service lines.

1.17 DOCUMENTS REQUIRED

- .1 Maintain at job site, one copy each document as follows:
 - .1 Contract Drawings.
 - .2 Specifications.
 - .3 Addenda.
 - .4 Reviewed Shop Drawings.
 - .5 List of Outstanding Shop Drawings.
 - .6 Change Orders.
 - .7 Other Modifications to Contract.
 - .8 Field Test Reports.
 - .9 Copy of Approved Work Schedule.
 - .10 Health and Safety Plan and Other Safety Related Documents.
 - .11 Other documents as specified.

1.18 GUARANTEES AND WARRANTIES

- .1 Under the Company Letter Head submit a 12 months guarantee.
- .2 Upon notice from the Departmental Representative, any failures or defects in material or workmanship shall be corrected by the Contractor at no further cost to her Majesty within 12 months of the date of acceptance.

- .3 Conduct an inspection of work, identify deficiencies and defects, and repair as required to conform to Contract Documents.
- .4 Notify the Departmental Representative in writing of satisfactory completion of Contractor's Inspection of work to identify obvious defects or deficiencies.
- .5 The Departmental Representative and Contractor will perform inspection of work to identify obvious defects and deficiencies. Contractor will correct work accordingly.
- .6 Submit written certificate that following have been performed:
- .7 Work has been completed and inspected for compliance with contract documents.
- .8 Defects have been corrected and deficiencies have been completed.
- .9 Equipment and system have been tested and are fully operational.
- .10 Operation of system have been demonstrated to the Departmental Representative.
- .11 Work is completed and ready for final Inspection.
- .12 Request final inspection of work by the Departmental Representative when items noted above are completed. If work is deemed incomplete by the Departmental Representative complete outstanding items and request re-mill

1.19 PAYMENT

- .1 Invoice for the work will be processed for the final payment upon its turnover and acceptance by the Departmental Representative. However, if acceptance is subject to deficiencies, a minimum of ten percent (10%) of the total job cost will be held back subject to completion of the entire work, to the satisfaction of the Departmental Representative.
- .2 Provide a Statutory Declaration duly signed and sealed if contract value exceeds \$25K.

1.20 COST BREAKDOWN

- .1 Before submitting first progress claim, submit cost breakdown of the Contract amount in detail to the Departmental Representative. After approval by the Departmental Representative cost breakdown will be used as the basis of progress payments

Part 2 Products

2.1 NOT USED

- .1 Not used.

Part 3 Execution

3.1 NOT USED

- .1 Not used.

END OF SECTION

Part 1 General

1.1 ACCESS AND EGRESS

- .1 Design, construct and maintain temporary "access to" and "egress from" work areas, including stairs, runways, ramps or ladders and scaffolding, independent of finished surfaces and in accordance with relevant municipal, provincial and other regulations.

1.2 USE OF SITE AND FACILITIES

- .1 Sanitary facilities will be assigned for Contractor's personnel. Keep facilities clean.

1.3 SIGNS

- .1 Provide common-use signs related to traffic control, information, instruction, use of equipment, public safety devices, etcetera, in both official languages or by the use of commonly-understood graphic symbols to the Departmental Representative's approval.
- .2 No advertising will be permitted on this project.

1.4 ALTERATIONS, ADDITIONS OR REPAIRS TO EXISTING BUILDING

- .1 Execute work with least possible interference or disturbance to the normal use of premises. Make arrangements with the Departmental Representative to facilitate execution of work.

1.5 EXISTING SERVICES

- .1 Notify, Departmental Representative and utility companies of intended interruption of services and obtain required permission. See also specific notification requirements in section 01 11 00 – Summary of Work.
- .2 Existing services required for the work may be used by the Contractor without charge. Ensure capacity is adequate prior to imposing additional loads. Connect and disconnect at own expense and responsibility.
- .3 Connect to existing power supply in accordance with the Ontario Electrical Code.
- .4 Where Work involves breaking into or connecting to existing services, give Departmental Representative 72 hours of notice for necessary interruption of mechanical or electrical service throughout course of work. Keep duration of interruptions minimum. Carry out interruptions after normal working hours of occupants, preferably on weekends.

1.6 TEMPORARY SERVICES

- .1 When the work requires air conditioning unit AC-5 to be unavailable, provide temporary ventilation fans on stands through the spaces affected to assist with cooling the room(s) and equipment. Rooms where fans are required:
 - .1 123, 126, 127, 128, 129.

1.7 PROTECTION

- .1 All work is being carried out in occupied areas. Protect existing work surfaces, equipment, floors, walls, partitions from damage during construction
- .2 Protect finished work against damage until take-over.
- .3 Protect adjacent work against the spread of dust and dirt beyond the work areas.
- .4 Protect operatives and other users of site from all hazards
- .5 Provide 48 hours notice to Departmental Representative for temporary relocation of loose furniture.

1.8 SITE STORAGE

- .1 Storage space shall be equipped and maintained by the Contractor.
- .2 Do not unreasonably encumber site with materials or equipment,
- .3 Move stored products or equipment which interfere with operations of Departmental Representative or other contractors.
- .4 Obtain and pay for use of additional storage or work areas needed for operations.

1.9 REMOVED MATERIAL

- .1 Unless otherwise specified, materials for removal become the Contractor's property and shall be taken from site.
- .2 Comply with Environmental Code of Practice for Elimination of Fluorocarbons Emissions from Refrigeration and Air Conditioning Systems SOR/2003-289 in all aspects of dismantling of refrigeration equipment recovery of ozone depleting substances, and installation of new refrigeration equipment. Comply also with Federal Halocarbon Regulations, 2003 (FHR 2003).
- .3 Comply with the Environmental Protection Act, Ontario Regulation O.Reg. 102 / 94 and O. Reg. 103 / 94 for waste management program on construction and demolition projects.
- .4 Submit complete records of all removals from site including:
 - .1 Time and date of removal
 - .2 Description of material and quantity.
 - .3 Proof that materials have been received at an approved Waste Processing Site or certified Waste Disposal Site as required

1.10 SPECIAL REQUIREMENTS

- .1 Paint public or occupied areas Monday to Friday from 18:00 to 07:00 hours only and on Saturdays, Sundays, and statutory holidays.
- .2 Carry out noise generating Work Monday to Friday from 18:00 to 07:00 hours and on Sundays, and statutory holidays, Saturdays.
- .3 Submit schedule in accordance with Section 01 32 16.19- Construction Progress Schedule - Bar (GANTT) Chart.
- .4 Ensure Contractor's personnel employed on site become familiar with and obey regulations including safety, fire, traffic and security regulations.

- .5 Keep within limits of work and avenues of ingress and egress.

1.11 SECURITY

- .1 Where security has been reduced by Work of Contract, provide temporary means to maintain security.
- .2 Security clearances:
 - .1 Personnel employed on this project will be subject to security check. Obtain clearance, as instructed, for each individual who will require to enter premises.
 - .2 All personnel employed on this project must be approved through a security screening process. Obtain enhanced level clearance, as instructed by the Departmental Representative for each individual requiring access to site.
 - .3 Prior to commencement submit to the Departmental Representative the names and date of birth of his employees who will be working on project site.

1.12 BUILDING SMOKING ENVIRONMENT

- .1 Comply with smoking restrictions. Smoking is not permitted.

1.13 CLEAN UP

- .1 Clean up work area as work progresses. At the end of each work period, and more often as per O. Reg. 213/91, s. 35 (1) or if ordered by the Departmental Representative, remove debris from site, neatly stack material for use, and clean up generally.
- .2 Upon completion remove scaffolding, temporary protection and surplus materials. Make good defects noted at this stage.
- .3 Clean areas under contract to a condition at least equal to that previously existing and to Departmental Representative's approval.

1.14 DUST CONTROL

- .1 Provide dust tight screens or partitions to localize dust generating activities, and for protection of workers, finished areas of work and public as per requirements in the NFC 2015.
- .2 Maintain and relocate protection until such work is complete.
- .3 Protect all furnishing within work area with 10 mil thick polyethylene film during construction. Remove film during non-construction hours and leave premises in clean, unencumbered and safe manner for normal daytime function

Part 2 Products

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 NOT USED

.1 Not Used.

END OF SECTION

Part 1 General

1.1 ADMINISTRATIVE

- .1 Schedule and administer project meetings throughout the progress of the work. Frequency of meeting will be determined during project stages to ensure all activities are addressed.
- .2 Prepare agenda for meetings.
- .3 Distribute written notice of each meeting four days in advance of meeting date to Departmental Representative.
- .4 Provide physical space and make arrangements for meetings.
- .5 Preside at meetings.
- .6 Record the meeting minutes. Include significant proceedings and decisions. Identify actions by parties.
- .7 Reproduce and distribute copies of minutes within three days after meetings and transmit to meeting participants affected parties not in attendance.
- .8 Representative of Contractor, Subcontractor and suppliers attending meetings will be qualified and authorized to act on behalf of party each represents.

1.2 PRECONSTRUCTION MEETING

- .1 Within 15 days after award of Contract, request a meeting of parties in contract to discuss and resolve administrative procedures and responsibilities.
- .2 Senior representatives of Contractor, major Subcontractors, Site Superintendent, Departmental Representative and Consultant will be in attendance.
- .3 Establish time and location of meeting and notify parties concerned minimum 5 days before meeting.
- .4 Agenda to include:
 - .1 Appointment of official representative of participants in the Work.
 - .2 Schedule of Work: in accordance with Section 01 32 16.19- Construction Progress Schedules - Bar (GANTT) Chart.
 - .3 Schedule of submission of shop drawings, samples, colour chips. Submit submittals in accordance with Section 01 33 00- Submittal Procedures.
 - .4 Proposed changes, change orders, procedures, approvals required, mark-up percentages permitted, time extensions, overtime, administrative requirements.
 - .5 Owner provided products.
 - .6 Record drawings in accordance with Section 01 33 00- Submittal Procedures.
 - .7 Maintenance manuals in accordance with Section 01 78 00- Closeout Submittals.
 - .8 Take-over procedures, acceptance, warranties in accordance with Section 01 78 00- Closeout Submittals.
 - .9 Monthly progress claims, administrative procedures, photographs, hold backs.

- .10 Appointment of inspection and testing agencies or firms.
- .11 Insurances, transcript of policies.

1.3 PROGRESS MEETINGS

- .1 During course of Work and four (4) weeks prior to project completion, schedule progress meeting.
- .2 Contractor, major Subcontractors involved in Work Departmental Representative are to be in attendance.
- .3 Notify parties minimum seven (5) days prior to meetings.
- .4 Record minutes of meetings and circulate to attending parties and affected parties not in attendance within three (3) days after meeting.
- .5 Agenda to include the following:
 - .1 Review, approval of minutes of previous meeting.
 - .2 Review of Work progress since previous meeting.
 - .3 Field observations, problems, conflicts.
 - .4 Problems which impede construction schedule.
 - .5 Review of off-site fabrication delivery schedules.
 - .6 Corrective measures and procedures to regain projected schedule.
 - .7 Revision to construction schedule.
 - .8 Progress schedule, during succeeding work period.
 - .9 Review submittal schedules: expedite as required.
 - .10 Maintenance of quality standards.
 - .11 Review proposed changes for affect on construction schedule and on completion date.
 - .12 Other business.

Part 2 Products

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 NOT USED

- .1 Not Used.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 01 33 00 - Submittal Procedures

1.2 DEFINITIONS

- .1 Activity: element of Work performed during course of Project. Activity normally has an expected duration, an expected cost, and an expected resource requirement. Activities can be subdivided into tasks.
- .2 Bar Chart (GANTT Chart): graphic display of schedule-related information. In typical bar chart, activities or other Project elements are listed down left side of chart, dates are shown across top, and activity durations are shown as date-placed horizontal bars. Generally Bar Charts should be derived from commercially available computerized project management system.
- .3 Baseline: original approved plan (for project, work package, or activity), plus or minus approved scope changes.
- .4 Construction Work Week: Monday to Friday, inclusive, will provide five day work week and define schedule calendar working days as part of Bar (GANTT) Chart submission.
- .5 Duration: number of work periods (not including holidays or other nonworking periods) required to complete activity or other project element. Usually expressed as workdays or workweeks.
- .6 Master Plan: summary-level schedule that identifies major activities and key milestones.
- .7 Milestone: significant event in project, usually completion of major deliverable.
- .8 Project Schedule: planned dates for performing activities and the planned dates for meeting milestones. Dynamic, detailed record of tasks or activities indicating precedence that must be accomplished to satisfy Project objectives. Monitoring and control process involves using Project Schedule in executing and controlling activities and is used as basis for decision making throughout project life cycle.
- .9 Project Planning, Monitoring and Control System: overall system operated by the Contractor to enable monitoring of project work in relation to established milestones.

1.3 REQUIREMENTS

- .1 Ensure Master Plan and Detail Schedules are practical and remain within specified Contract duration.
- .2 Plan to complete Work in accordance with prescribed milestones and time frame.
- .3 Limit activity durations to maximum of approximately 10 working days, to allow for progress reporting.

Project No. R.065220.652

- .4 Ensure that it is understood that Award of Contract or time of beginning, rate of progress, Substantial Completion as defined times of completion are of essence of this contract.

1.4 SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit to the Departmental Representative within ten (10) working days of Award of Contract Bar (GANTT) Chart as Master Plan for planning, monitoring and reporting of project progress.
- .3 Submit Project Schedule to the Departmental Representative within then (10) working days of receipt of acceptance of Master Plan.

1.5 PROJECT MILESTONES

- .1 Project milestones form interim targets for Project Schedule.
 - .1 Contract award
 - .2 Site preparation
 - .3 City of Ottawa Permits
 - .4 Airport Authority Permits for craning
 - .5 Shop drawing submissions for all material
 - .6 Final testing, commissioning of new equipment.
 - .7 Certificate of Substantial Performance.
 - .8 Closeout submittals delivered

1.6 MASTER PLAN

- .1 Structure schedule to allow orderly planning, organizing, and execution of Work as Bar Chart (GANTT).
- .2 The Departmental Representative will review and return schedule within five (5) working days with related comments.
- .3 The Contractor shall update the schedule based on the review comments and resubmit within five (5) working days.
- .4 The accepted schedule will become Master Plan and be used as baseline for updates.

1.7 PROJECT SCHEDULE

- .1 Develop detailed Project Schedule derived from Master Plan.
- .2 Ensure detailed Project Schedule includes as minimum the following activities as follows:
 - .1 Contract award.
 - .2 Site preparation.
 - .3 City of Ottawa Permits.

Project No. R.065220.652

- .4 Airport Authority Permits for craning.
- .5 Shop drawing submissions for all material.
- .6 Power interruptions requiring entire building shutdown.
- .7 All other power interruptions.
- .8 Crane mobilization
- .9 Removal of AC-3.
- .10 Replacement of new AC-3.
- .11 Removal of AC-4.
- .12 Replacement of new AC-4.
- .13 Removal of AC-5.
- .14 Replacement of new AC-5.
- .15 Removal of AC-3 rooftop condenser.
- .16 Replacement of new AC-3 rooftop condenser.
- .17 Removal of AC-4 rooftop condenser.
- .18 Replacement of new AC-4 rooftop condenser.
- .19 Removal of AC-5 rooftop condenser.
- .20 Replacement of new AC-5 rooftop condenser.
- .21 Installation of new AC-6 split unit.
- .22 Crane demobilization
- .23 Final TAB of new AC units.
- .24 Final Commissioning of new AC units.
- .25 Certificate of Substantial Performance.
- .3 No unplanned power outages will be tolerated. All power outages required for the entire project must be presented as milestones on the Gantt chart.
- .4 Note that for the AC unit replacement milestones, each AC-unit must be replaced and returned to service prior to removal of the subsequent AC unit, so as to minimize cooling unavailability throughout the project:
 - .1 This project constraint has implications on the time required on-site for the craning/hoisting. The contractor must keep this equipment on-site for the duration of all removals or else allow for multiple mobilizations and demobilizations to satisfy this constraint.

1.8 PROJECT SCHEDULE REPORTING

- .1 Update Project Schedule on a weekly basis reflecting activity changes and completions, as well as activities in progress.
- .2 Include as part of Project Schedule, narrative report identifying Work status to date, comparing current progress to baseline, presenting current forecasts, defining problem areas, anticipated delays and impact with possible mitigation.

Project No. R.065220.652

1.9 PROJECT MEETINGS

- .1 Discuss Project Schedule at regular site meetings, identify activities that are behind schedule and provide measures to regain slippage. Activities considered behind schedule are those with projected start or completion dates later than current approved dates shown on baseline schedule.
- .2 Weather related delays with their remedial measures will be discussed and negotiated.

Part 2 Products

2.1 NOT USED

- .1 Not used.

Part 3 Execution

3.1 NOT USED

- .1 Not used.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 21 05 01 - Common Work Results for Mechanical.
- .2 Section 26 05 00 – Common Work Results for Electrical.

1.2 ADMINISTRATIVE

- .1 Submit to Departmental Representative submittals listed for review. Submit promptly and in orderly sequence to not cause delay in Work. Failure to submit in ample time is not considered sufficient reason for extension of Contract Time and no claim for extension by reason of such default will be allowed.
- .2 Do not commence manufacture or order materials before shop drawings and samples are reviewed. Do not proceed with Work affected by submittal until review is complete
- .3 Present shop drawings, product data, samples and mock-ups in SI Metric units.
- .4 Where items or information is not produced in SI Metric units converted values are acceptable.
- .5 Review submittals prior to submission to Departmental Representative. This review represents that necessary requirements have been determined and verified, or will be, and that each submittal has been checked and co-ordinated with requirements of Work and Contract Documents. Submittals not stamped, signed, dated and identified as to specific project will be returned without being examined and considered rejected.
- .6 Notify Departmental Representative, in writing at time of submission, identifying deviations from requirements of Contract Documents stating reasons for deviations.
- .7 Verify field measurements and affected adjacent Work are co-ordinated.
- .8 Contractor's responsibility for errors and omissions in submission is not relieved by Departmental Representative's review of submittals.
- .9 Contractor's responsibility for deviations in submission from requirements of Contract Documents is not relieved by Departmental Representative's review.
- .10 Keep one reviewed copy of each submission on site.

1.3 CERTIFICATES AND TRANSCRIPTS

- .1 Immediately after award of Contract, submit Workers' Compensation Board status. applicable.
- .2 Submit Certificate of insurance immediately after award of Contract.
- .3 Prior to construction, submit Copies of all workers':
 - .1 Certificate of Qualification

1.4 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit for the Departmental Representative's review, copies of each shop drawings.

- .2 The term "shop drawings" means drawings, diagrams, illustrations, schedules, performance charts, brochures and other data which are to be provided by Contractor to illustrate details of a portion of Work.
- .3 The review is for the sole purpose of ascertaining conformance with the general design concept and does not mean approval of design details inherent in the shop drawings, responsibility for which shall remain with the Contractor. Such review shall not relieve the Contractor of responsibility for errors or omissions in the shop drawings requirements of the contract documents.
- .4 Indicate materials, methods of construction and attachment or anchorage, erection diagrams, connections, explanatory notes and other information necessary for completion of Work. Where articles or equipment attach or connect to other articles or equipment, indicate that such items have been co-ordinated, regardless of Section under which adjacent items will be supplied and installed. Indicate cross references to design drawings and specifications.
- .5 Adjustments made on shop drawings by Departmental Representative are not intended to change Contract Price. If adjustments affect value of Work, state such in writing to Departmental Representative prior to proceeding with Work.
- .6 Make changes in shop drawings as Departmental Representative may require, consistent with Contract Documents. When resubmitting, notify Departmental Representative in writing of revisions other than those requested.
- .7 Accompany submissions with transmittal letter, in duplicate, containing:
 - .1 Date.
 - .2 Project title and number.
 - .3 Contractor's name and address.
 - .4 Identification and quantity of each shop drawing, product data and sample.
 - .5 Other pertinent data.
- .8 Submissions include:
 - .1 Date and revision dates.
 - .2 Project title and number.
 - .3 Name and address of:
 - .1 Subcontractor.
 - .2 Supplier.
 - .3 Manufacturer.
 - .4 Contractor's stamp, signed by Contractor's authorized representative certifying approval of submissions, verification of field measurements and compliance with Contract Documents.
 - .5 Details of appropriate portions of Work as applicable:
 - .1 Fabrication.
 - .2 Layout, showing dimensions, including identified field dimensions, and clearances.
 - .3 Setting or erection details.
 - .4 Capacities.

- .5 Performance characteristics.
 - .6 Standards.
 - .7 Operating weight.
 - .8 Wiring diagrams.
 - .9 Single line and schematic diagrams.
 - .10 Relationship to adjacent work.
- .9 After Departmental Representative's review, distribute copies.
- .10 Submit one electronic copy of shop drawings for each requirement requested in specification Sections and as Departmental Representative may reasonably request.
- .11 Submit 1 electronic copy of product data sheets or brochures for requirements requested in specification Sections and as requested by Departmental Representative where shop drawings will not be prepared due to standardized manufacture of product.
- .12 Submit 1 electronic copy and one (1) hard copy of test reports for requirements requested in specification Sections and as requested by Departmental Representative.
- .1 Report signed by authorized official of testing laboratory that material, product or system identical to material, product or system to be provided has been tested in accord with specified requirements.
 - .2 Testing must have been within 3 years of date of contract award for project.
- .13 Submit electronic 1 copy and one (1) hard copy of certificates for requirements requested in specification Sections and as requested by Departmental Representative.
- .1 Statements printed on manufacturer's letterhead and signed by responsible officials of manufacturer of product, system or material attesting that product, system or material meets specification requirements.
 - .2 Certificates must be dated after award of project contract complete with project name.
- .14 Submit electronic 1 copy and one (1) hard copy of manufacturers instructions for requirements requested in specification Sections and as requested by Departmental Representative.
- .1 Pre-printed material describing installation of product, system or material, including special notices and Material Safety Data Sheets concerning impedances, hazards and safety precautions.
- .15 Submit 1 electronic copy and one (1) hard copy of Manufacturer's Field Reports for requirements requested in specification Sections and as requested by Departmental Representative.
- .16 Documentation of the testing and verification actions taken by manufacturer's representative to confirm compliance with manufacturer's standards or instructions.
- .17 Submit electronic 1 copy and one (1) hard copy of Operation and Maintenance Data for requirements requested in specification Sections and as requested by Departmental Representative.
- .18 Delete information not applicable to project.
- .19 Supplement standard information to provide details applicable to project.

- .20 If upon review by Departmental Representative, no errors or omissions are discovered or if only minor corrections are made, copies will be returned and fabrication and installation of Work may proceed. If shop drawings are rejected, noted copy will be returned and resubmission of corrected shop drawings, through same procedure indicated above, must be performed before fabrication and installation of Work may proceed.

1.5 SAMPLES

- .1 Submit for review samples in duplicate as requested in respective specification Sections. Label samples with origin and intended use.
- .2 Deliver samples prepaid to Departmental Representative's site office.
- .3 Notify Departmental Representative in writing, at time of submission of deviations in samples from requirements of Contract Documents.
- .4 Where colour, pattern or texture is criterion, submit full range of samples.
- .5 Adjustments made on samples by Departmental Representative are not intended to change Contract Price. If adjustments affect value of Work, state such in writing to Departmental Representative prior to proceeding with Work.
- .6 Make changes in samples which Departmental Representative may require, consistent with Contract Documents.
- .7 Reviewed and accepted samples will become standard of workmanship and material against which installed Work will be verified.

1.6 RECORDS, PRINTS & AS-BUILT DRAWINGS

- .1 As work progresses, maintain accurate records to show deviations from contract drawings.
- .2 Supply to the Departmental Representative one set of white As-built Drawing with all deviations neatly inked in red.
- .3 Contractor to pay for all reproductions.

1.7 MOCK-UPS

- .1 Erect mock-ups in accordance with Section 01 45 00- Quality Control.

Part 2 Products

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 NOT USED

- .1 Not Used.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 Canada Labour Code, Part 2, Canada Occupational Safety and Health Regulations.
- .2 Occupational Health and Safety Act and Regulations for Construction Projects. R.S.O. 1990, c.0.1, as amended and O.Reg 2B/91, as amended.
- .3 Canadian Standards Association (CSA)
 - .1 CSA CSA S350-M1980, Code of Practice for Safety in Demolition of Structures.

1.2 DEFINITION

- .1 Competent Person:
 - .1 Person with the knowledge, training and expertise in organizing the work and its performance.
 - .2 Person familiar with the acts and the regulations that apply to the work.
 - .3 Person with the knowledge of any potential or actual danger to Health and Safety in the workplace.
- .2 "Working Alone" means the performance of any function by an employee who:
 - .1 Is the only employee in the workplace at any given time.
 - .2 Is not within the range of sight, or within the hearing distance of another employee for more than five minutes at a time.
 - .3 Must follow applicable provincial regulations

1.3 SUBMITTAL REQUIREMENTS

- .1 Bids not meeting all of the following submittal requirements will be given no further consideration.
- .2 Submit the following requirements to the Departmental Representative within (24) hours after date of notice to proceed and prior to commencement of work:
 - .1 Submit proof of liability insurance paper with a Valid clearance certificate from the Workplace Safety Insurance Board (WSIB).
- .3 Submit site-specific Health and Safety Plan: Within 24 hours after date of notice to proceed and prior to commencement of Work. Health and Safety Plan must include:
 - .1 Results of site Specific Safety Hazard Assessment.
 - .2 Results of Health and Safety Risk or Hazard Analysis for site tasks and operation found in work plan.
 - .3 Company Health and Safety Policy.
 - .4 On-site Contingency and Emergency Response Plan: Address standard operating procedures to be implemented during emergency situation.

- .4 The Departmental Representative will review Contractor's site-specific Health and Safety Plan and provide comments to Contractor within 120 hours after receipt of plan. Revise plan as appropriate and resubmit plan to the Departmental Representative within 24 hours after receipt of comments from the Departmental Representative.
- .5 Submit to Departmental Representative, submittals listed for review. Submit promptly and in orderly sequence to not cause delay in Work. Failure to submit in ample time is not considered sufficient reason for extension of Contract Time and no claim for extension by reason of such default will be allowed.
 - .1 Do not proceed with Work affected by submittal until review is complete
- .6 Departmental Representative's review of Contractor's final Health and Safety Plan should not be construed as approval and does not reduce the Contractor's overall responsibility for construction Health and Safety.
- .7 Submit copies of reports or directions issued by federal, provincial and territorial Health and Safety Inspector.
- .8 Submit copies of incident and accident reports.
- .9 Submit WHMIS 2015 - Safety Data Sheets (SDS) in accordance with Section 01 33 00 – Submittal Procedures.
- .10 Personnel training requirements including as follows:
 - .1 Submit names of personnel and alternates responsible for site health and safety hazards present on site, and use of personal protective equipment

1.4 SUBMITTALS PRIOR TO CONSTRUCTION

- .1 Submit Copies of all contractors and worker:
 - .1 Proof of liability Insurance. Insurance must be Site Specific with PSPC indicated.
 - .2 MOL Registration of constructors and employers engaged in construction form (Form 1000) completed (Ontario Projects).
 - .3 Employees Working at Heights Training Certificates (Ontario Projects).
 - .4 Employees WHMIS Certificates (Ontario Projects).

1.5 DOCUMENT VALIDITY

- .1 PSPC reserves the right to verify the applicability and validity of all documents submitted. No contract will be awarded without the submission of the above documents

1.6 FILING OF NOTICE

- .1 File notice of project with Provincial Authority prior to commencement of work and leave a copy on site. (if applicable)

1.7 MEETINGS

- .1 Pre-construction meetings: Attend health and safety pre-construction meetings

1.8 REGULATORY REQUIREMENTS

- .1 Comply with specified standards and regulations to ensure safe operations at site containing hazardous or toxic material

1.9 RESPONSIBILITY

- .1 Comply with and enforce compliance by employees with safety requirements of Contract Documents, follow federal, provincial, and local statutes, regulations, and ordinances, and with site-specific Health and Safety Plan.
- .2 Do not allow any person to work alone as per provincial regulations.

1.10 COMPLIANCE REQUIREMENTS

- .1 Comply with Occupational Health and Safety Act.
- .2 Comply with the most recent Provincial Electrical Code.
- .3 Comply with Z-462 Workplace Electrical Safety.

1.11 UNFORSEEN HAZARDS

- .1 Should any unforeseen or peculiar safety-related factor, hazard, or condition become evident during performance of work, immediately stop work and advise the Departmental Representative verbally and in writing

1.12 CONSTRUCTION SAFETY CHECKLISTS

- .1 Complete the PSPC General Safety Orientation Checklist from the Departmental Representative prior to starting work on site.
- .2 PSPC General Safety Orientation Checklist will be kept on site in a three-ring site binder unless stated otherwise.
- .3 Review and implement applicable Health and Safety information as per the PSPC General Safety Orientation Checklist provided by the Departmental Representative daily and monitoring site-specific Contractor's Health and Safety Plan.

1.13 CORRECTION OF NON-COMPLIANCE

- .1 Immediately address health and safety non-compliance issues identified by the Departmental Representative.
- .2 Provide the Departmental Representative with written report of action taken to correct non-compliance of health and safety issues identified.
- .3 The Departmental Representative may stop Work if non-compliance of health and safety regulations is not corrected.

1.14 POWDER ACTUATED DEVICES

- .1 Use of powder actuated devices are not permitted in occupied buildings unless receipt with a written permission from the Departmental Representative.

1.15 POWER ACTUATED FASTENING DEVICES

- .1 Use of powder actuated fastening devices are not permitted in occupied buildings unless receipt with a written permission from the Departmental Representative

1.16 WORK STOPPAGE

- .1 Give precedence to safety and health of public and site personnel and protection of environment over cost and schedule considerations for Work.
- .2 Assign responsibility and obligation to Site Supervisor to stop or start work when, at Site Supervisors discretion, it is necessary or advisable for reasons of health or safety. The Departmental Representative may also stop Work for health and safety considerations.

1.17 PUBLIC SAFETY

- .1 Precaution shall be taken to ensure that no person is exposed to undue risk. Risk area shall be adequately barricaded and warning signs (in both official language) or lights shall be installed on each section of the barricades. Barricades shall be without opening.

Part 2 Products

2.1 NOT USED

- .1 Not used.

Part 3 Execution

3.1 NOT USED

- .1 Not used.

END OF SECTION

Part 1 General

1.1 CONSTRUCTION FIRE SAFETY

- .1 Be responsible for provision of construction fire safety in accordance with National Fire Code of Canada.

1.2 FIRE DEPARTMENT BRIEFING

- .1 Departmental Representative will co-ordinate arrangements for a Pre-Commencement Meeting following contract award. Senior Fire Fighter or designated representative will brief Contractors regarding Fire Safety before on site work can start.
- .2 Departmental Representative will provide Contractor with a copy of all Fire Orders.

1.3 REPORTING FIRES

- .1 Inform Departmental Representative and Senior Fire Fighter of fire incidents at construction site, regardless of size.
- .2 Know location of nearest fire alarm pull station and telephone, including emergency phone number.
- .3 Report immediately fire incidents to Fire Department as follows:
 - .1 Activate nearest fire alarm pull station.
 - .2 Telephone.
- .4 Person activating fire alarm pull station will remain at main entrance of site to direct Fire Department to scene of fire.
- .5 When reporting fire by telephone, give location of fire, name or number of building and be prepared to verify location.

1.4 FIRE SAFETY PLAN

- .1 Prepare a fire safety plan for construction site prior to commencement of on site work.
- .2 Submit fire safety plan to Departmental Representative for review by local fire department. Implement changes or recommendations made by local fire department into fire safety plan.
- .3 Limit scope of fire safety plan to area of construction only. Existing fire safety plans covering other existing buildings are not responsibility of this construction contract.
- .4 Post fire safety plan at entrance to construction site or near construction site's health and safety board.
- .5 Prepare fire safety plan in conformance with National Fire Code of Canada. Include:
 - .1 Emergency procedures in case of fire, including:
 - .1 Sounding fire alarm.
 - .2 Notifying fire department.
 - .3 Instructing occupants on procedures followed when fire alarm sounds.

- .4 Evacuating occupants, including special provisions for persons requiring assistance.
- .5 Confining, controlling and extinguishing fires.
- .2 Appointment and organization of designated supervisory staff to carry out fire safety duties.
- .3 Training of supervisory staff and other occupants in their responsibilities for fire safety.
- .4 Documents including diagrams, showing type, location and operation of building fire emergency systems.
- .5 Holding of fire drills (where applicable).
- .6 Control of fire hazards in the building.
- .7 Inspection and maintenance of building facilities provided for the safety of occupants.

1.5 FIRE WARNING SYSTEM

- .1 Provide a fire warning system for entire construction site, capable of notifying construction personnel of a fire emergency in construction area.
- .2 Provide system with sufficient coverage so that alarms are capable of being heard throughout building and anywhere on site.

1.6 FIRE PROTECTION SYSTEM IMPAIRMENT

- .1 Maintain existing systems in an operational state at all times during construction.
- .2 Use of fire hydrants, standpipes or hose systems for purposes other than fire fighting unless authorized by Senior Fire Fighter, is prohibited.
- .3 Existing fire protection and alarm systems will not be obstructed, shut off, disabled or left inactive at end of each working day or shift without written authorization from Senior Fire Fighter.
- .4 Submit written notification to Departmental Representative and Senior Fire Fighter 48 hours in advance of planned interruption of services. Submit written notification for operation including shutting down active fire protection system, including water supply, fire suppression, fire detection and life safety systems.
- .5 Where a fire protection system that provides fire alarm monitoring is impaired in an existing building, provide a fire watch as directed by Senior Fire Fighter.
- .6 Conduct work on fire protection system where systems are affected or impaired in accordance with National Fire Code of Canada conforming to Base Fire Orders.

1.7 FIRE EXTINGUISHERS

- .1 Supply fire extinguishers, as scaled by Senior Fire Fighter, necessary to protect work in progress and contractor's physical plant on site.
- .2 Provide supplemental fire extinguishers to these areas and otherwise as directed by Senior Fire Fighter:
 - .1 Adjacent to hot works.
 - .2 Areas where combustibles materials are stored.

- .3 Adjacent to areas where flammable liquids or gases are stored or handled.
- .4 Near or on internal combustion engines.
- .5 Adjacent to temporary oil fired or gas fired equipment.
- .6 Adjacent to bitumen heating equipment.
- .3 Provide extinguishers rated as follows: 4A:40BC. Minimum 20 pounds unless otherwise directed by Senior Fire Fighter.
- .4 Provide dry chemical type extinguishers unless otherwise required by hazard being protected.
- .5 Provide sufficient numbers of extinguishers based on a maximum travel distance between extinguishers of 23.0 meters.

1.8 INSTALLATION OR REPAIR OF ROOFS

- .1 Notify Senior Fire Fighter of location of asphalt kettles and dates that kettles will be in use. Ensure personnel use and take precautions as follows:
 - .1 Use kettles equipped with thermometers or gauges in good working order.
 - .2 Locate kettles in safe place outside of building or, if approved by Senior Fire Fighter, on non-combustible roof. Locate to avoid danger of igniting combustible material below.
 - .3 Maintain continuous supervision while kettles are in operation and provide metal covers for kettles to smother flames in case of fire. Provide fire extinguishers sized to accommodate kettle and contents.
 - .4 Prior to start of work, demonstrate container capacities to Senior Fire Fighter.
 - .5 Use only glass fibre roofing mops.
 - .6 Leaving used roofing mops unattended on roof is prohibited. Store mops away from building and combustible materials.
 - .7 Store roofing materials no closer than 3.0 metres from structures.

1.9 ACCESS FOR FIRE FIGHTING

- .1 Provide and maintain access for firefighting in accordance with National Fire Code of Canada.
- .2 Provide written notification to Senior Fire Fighter a minimum of 5 working days in advance of operation that would impede fire apparatus response including:
 - .1 Violation of minimum horizontal and overhead clearances.
 - .2 Other operations as directed by Senior Fire Fighter.
 - .3 Erecting of barricades and digging of trenches.
- .3 Maintain a minimum clear horizontal width on access routes of 5.0 meters or otherwise as defined by Senior Fire Fighter.
- .4 Maintain a minimum vertical clearance of 6.0 meters or otherwise as defined by Senior Fire Fighter.

1.10 SMOKING PRECAUTIONS

- .1 Smoking is prohibited in buildings including buildings under construction.

- .2 Obey posted signs and confine smoking only to designated smoking areas. Observe posted smoking restrictions near existing buildings.

1.11 RUBBISH AND WASTE MATERIALS

- .1 Keep rubbish and waste materials to a minimum.
- .2 Burning of rubbish is prohibited.
- .3 Remove rubbish from work site at end of each work day or shift or more frequently as directed by Senior Fire Fighter.
- .4 Storage:
 - .1 Store oily waste in approved receptacles to ensure maximum cleanliness and safety.
 - .2 Deposit greasy or oily rags and materials subject to spontaneous combustion in approved receptacles and remove at end of each work day.

1.12 FLAMMABLE AND COMBUSTIBLE LIQUIDS

- .1 Handle, store and use flammable and combustible liquids in accordance with National Fire Code of Canada and as otherwise directed by the Senior Fire Fighter.
- .2 Store flammable and combustible liquids such as gasoline, kerosene and naphtha in quantities not exceeding 45 litres. Store in approved safety cans bearing Underwriters' Laboratory of Canada or Factory Mutual seal of approval. Obtain written authorization from Senior Fire Fighter for storage of quantities of flammable and combustible liquids exceeding 45 litres.
- .3 Transfer of flammable or combustible liquids within buildings or on jetties is prohibited.
- .4 Transfer of flammable or combustible liquids in vicinity of open flames or any type of heat-producing devices is prohibited.
- .5 Use of flammable liquids having flash point below 38 degrees C such as naphtha or gasoline as solvents or cleaning agents is prohibited.
- .6 Storing flammable and combustible waste liquids on site is prohibited. Remove daily or more frequently as directed by Senior Fire Fighter.

1.13 HOT WORKS

- .1 Implement a hot works program in accordance with National Fire Code of Canada and NFPA 51B Standard for Fire Prevention. Apply hot works program to processes involving welding, cutting, roofing and other hot works as defined by Senior Fire Fighter.
- .2 Obtain a "Hot Works" permit from Senior Fire Fighter for hot works in construction area. Frequency of renewal for hot works permits is at discretion of the Senior Fire Fighter.
- .3 When work is carried out in dangerous or hazardous areas involving use of heat, provide fire watchers equipped with sufficient fire extinguishers. Determination of dangerous or hazardous areas along with level of protection necessary for Fire Watch is at discretion of the Senior Fire Fighter.
- .4 Provide fire watch service for work as directed by Senior Fire Fighter and as defined in Fire Department Briefing. Provide fire watchers trained in use of fire extinguishing equipment.

- .5 Carry out hot works processes in areas free of combustible and flammable content.
- .6 Where hot works must be carried out in areas where combustibles are present:
 - .1 Protect flammable and combustible materials within 15.0 meters of hot works in accordance with National Fire Code of Canada.
 - .2 Provide a fire watch during hot work and for a minimum of 60 minutes after work is complete unless otherwise directed by Senior Fire Fighter.
 - .3 Conduct a final inspection of area not less than 4 hours after completion of hot works unless otherwise directed by Senior Fire Fighter.
- .7 Where there is a possibility of sparks leaking onto combustible materials in areas adjacent to areas where the hot work is carried out:
 - .1 Cover or close openings in walls, floors or ceilings to prevent passage of sparks to such adjacent areas.
 - .2 Provide a fire watch during hot works and for a minimum of 60 minutes after work is complete.
 - .3 Conduct a final inspection not less than 4 hours after completion of hot works unless otherwise directed by Senior Fire Fighter.
- .8 Protection of flammable or combustible materials:
 - .1 Remove flammable and combustible materials including combustible or flammable dust or residue from area where hot works is carried out.
 - .2 When removal is not possible, protect materials with a non combustible covering.
- .9 Provide a fire extinguisher within 3.0 meters of hot works. Provide a minimum size of 20 lbs Type ABC extinguisher unless otherwise directed by Senior Fire Fighter.

1.14 HAZARDOUS SUBSTANCES

- .1 Perform work involving the use of toxic or hazardous materials, chemicals or explosives, or otherwise creating hazard to life, safety or health, in accordance National Fire Code of Canada (NFC).
- .2 Provide ventilation where flammable liquids, such as lacquers or urethanes are used. Eliminate sources of ignition. Provide written notification to the Senior Fire Fighter a minimum of 5 days prior to starting work and immediately at completion of work.

1.15 PARTIAL OCCUPANCY

- .1 Implement partial occupancy procedures as defined in General Conditions of the Contract. Partial occupancy is defined as when construction occurs adjacent to work areas occupied by Departmental or Canadian Forces personnel. This includes:
 - .1 Phased new construction.
 - .2 Early or partial occupancy of new construction.
 - .3 New construction being added onto an existing building.
 - .4 Renovation or recapitalization of an existing building.
 - .5 Phased renovation or recapitalization of an existing building.

- .2 Where partial occupancy occurs, implement requirements as indicated in drawings and specifications. This may include construction of a rated fire separation between occupied and construction areas as required by National Fire Code.
- .3 If work is carried out in an occupied building, provide regular inspections every hour, throughout entire period of demolition.
- .4 If work is carried out in an occupied building and where building does not have a Fire Alarm system or similar automatic monitoring or protection equipment, provide regular inspections every hour for entire period of construction.

1.16 QUESTIONS OR CLARIFICATION

- .1 Direct questions or clarification on Fire Safety to Departmental Representative.
- .2 Departmental Representative will obtain clarifications from Senior Fire Fighter. Do not contact directly with Senior Fire Fighter for notification, authorization or any requests unless situation constitutes an immediate emergency.

1.17 FIRE INSPECTION

- .1 Co-ordinate site inspections by Senior Fire Fighter through Departmental Representative.
- .2 Allow Senior Fire Fighter unrestricted access to work site.
- .3 Co-operate with Senior Fire Fighter during routine fire safety inspection of work site.
- .4 Immediately remedy unsafe fire situations observed by Senior Fire Fighter.

Part 2 Products

2.1 NOT USED

- .1 Not Used

Part 3 Execution

3.1 NOT USED

- .1 Not Used

END OF SECTION

Part 1 General

1.1 REFERENCE STANDARDS

- .1 Canadian Construction Documents Committee (CCDC)
 - .1 CCDC 2-2008 Stipulated Price Contract.
- .2 U.S. Environmental Protection Agency (EPA)/Office of Water
 - .1 EPA 832/R-92-005-92, Storm Water Management for Construction Activities, Chapter 3.
 - .2 EPA General Construction Permit (GCP) 2012.

1.2 DEFINITIONS

- .1 Environmental Pollution and Damage: presence of chemical, physical, biological elements or agents which adversely affect human health and welfare; unfavourably alter ecological balances of importance to human life; affect other species of importance to humans; or degrade environment aesthetically, culturally and/or historically.
- .2 Environmental Protection: prevention/control of pollution and habitat or environment disruption during construction.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00- Submittal Procedures.
- .2 Product Data:
 - .1 Submit [2] copies of WHMIS MSDS in accordance with Section 01 35 43- Environmental Procedures and Section 01 35 29.06- Health and Safety Requirements.
 - .2 .

1.4 FIRES

- .1 Fires and burning of rubbish on site is not permitted .
- .2 Where fires or burning is permitted, prevent staining or smoke damage to structures, materials or vegetation which is to be preserved.
 - .1 Restore, clean and return to new condition stained or damaged work.
- .3 Provide supervision, attendance and fire protection measures as directed.

1.5 DRAINAGE

- .1 Ensure pumped water into waterways, sewer or drainage systems is free of suspended materials.
- .2 Control disposal or runoff of water containing suspended materials or other harmful substances in accordance with local authority requirements.

1.6 SITE CLEARING AND PLANT PROTECTION

- .1 Protect trees and plants on site and adjacent properties as indicated.
- .2 Protect trees and shrubs adjacent to construction work, storage areas and trucking lanes, and encase with protective wood framework from grade level to height of [2] m minimum.
- .3 Protect roots of designated trees to dripline during excavation and site grading to prevent disturbance or damage.
 - .1 Avoid unnecessary traffic, dumping and storage of materials over root zones.
- .4 Minimize stripping of topsoil and vegetation.

1.7 POLLUTION CONTROL

- .1 Maintain temporary erosion and pollution control features installed under this Contract.
- .2 Control emissions from equipment and plant in accordance with local authorities' emission requirements.
- .3 Prevent sandblasting and other extraneous materials from contaminating air and waterways beyond application area.
- .4 Cover or wet down dry materials and rubbish to prevent blowing dust and debris. Provide dust control for temporary roads.

Part 2 Products

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 00- Cleaning.
 - .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 Waste Management: separate waste materials for reuse, recycling in accordance with Section 01 74 19- Waste Management and Disposal.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 This Section references to laws, by laws, ordinances, rules, regulations, codes, orders of Authority Having Jurisdiction, and other legally enforceable requirements applicable to Work and that are; or become, in force during performance of Work.

1.2 REFERENCES TO REGULATORY REQUIREMENTS

- .1 Materials shall be new and work shall conform to the minimum applicable standards of the Canadian General Standards Board, the Canadian Standards Association, the National Building Code of Canada 2015 (NBC), the National Fire Code 2015 (NFC) and all applicable federal, provincial and municipal codes, laws and by-laws, and to all standards mentioned herein.
- .2 Perform Work in accordance with National Building Code of Canada (NBC) 2015 including amendments up to tender closing date and other codes of provincial or local application provided that in case of conflict or discrepancy, more stringent requirements apply.
- .3 Specific design and performance requirements listed in specifications or indicated on Drawings may exceed minimum requirements established by referenced Building Code; these requirements will govern over the minimum requirements listed in Building Code
 - .1 Meet or exceed requirements of:
 - .1 Contract documents.
 - .2 Specified standards, codes and referenced documents.

1.3 FEES & CERTIFICATES

- .1 Pay all fees and obtain all permits. Provide authorities with plans and By-laws information for acceptance certificates. Provide inspection certificates as evidence that work conforms to requirements of Authority having jurisdiction.
- .2 Building permit is not the contractor's responsibility under this contract.
- .3 The Contractor shall comply with all laws and regulations relating to the work, whether Federal, Provincial or Municipal, as if the work were for a person other than Her Majesty, and shall pay for all fees, permits and obtain all certificates required in respect of the work.

1.4 TAXES

- .1 Pay all taxes properly levied by law (including Federal, Provincial and Municipal).

1.5 PROPERTY OF HER MAJESTY

- .1 The Contractor shall be liable to Her Majesty for any loss or damage to any property of Her Majesty arising out of the performance of the work whether or not such loss arises from causes beyond his control.

1.6 FIRE SAFETY

- .1 Comply with both the National Building Code of Canada 2015 (NBC) and the National Fire Code of Canada 2015 (NFC) for safety of persons in buildings in the event of a fire and the protection of buildings from the effects of fire, as follows:
 - .1 The National Building Code (NBC): for fire safety and fire protection features that are required to be incorporated in a building during construction.
 - .2 The National Fire Code (NFC):
 - .1 The on-going maintenance and use of the fire safety and fire protection features incorporated in buildings.
 - .2 The conduct of activities that might cause fire hazards in and around buildings.
 - .3 Limitations on hazardous contents in and around buildings.
 - .4 The establishment of fire safety plans.
 - .5 Fire safety at construction and demolition sites.
- .2 Welding and cutting:
 - .1 Before welding, soldering, grinding, and/or cutting work, obtain a permit from the Real Property Service Provider or as directed by the Departmental Representative. No hot work shall be undertaken unless authorized by the Real Property Service Provider or Departmental Representative.
- .3 Retain services of manufacturer for fire protection systems on daily basis or as approved by Departmental Representative, to isolate and protect all devices relating to:
 - .1 Modification of fire alarms, fire suppression, extinguishing or protection systems; and/or
 - .2 Cutting, welding, soldering or other construction activities that might activate fire protection systems.
 - .3 Immediately upon completion of work, restore fire protection systems to normal operation and verify that all devices are fully operational.
 - .4 Inform fire alarm system monitoring agency and local fire department immediately prior to isolation and immediately upon restoration of normal operation.

1.7 HAZARDOUS MATERIAL DISCOVERY

- .1 Asbestos: demolition of spray or trowel-applied asbestos is hazardous to health. Stop work immediately when material resembling spray or trowel-applied asbestos is encountered during demolition work. Notify Departmental Representative immediately.
- .2 Mould: stop work immediately when material resembling mould is encountered during demolition work. Notify Departmental Representative immediately.
- .3 Comply with the requirements of the Workplace Hazardous Materials Information System (WHMIS), latest applicable, regarding use, handling, storage, and disposal of hazardous materials and regarding labeling and the provision of Safety Data Sheets (SDS).

- .4 For work in occupied buildings give the Departmental Representative 48 hours' notice for work involving designated substances (O.Reg. 490/09, Designated Substances in Ontario), and before painting, or caulking.
- .5 In the event that Hazardous Materials are brought on site, the Contractor will provide the Departmental Representative a Safety Data Sheet (SDS). These SDS will be put into the 3 ring binder located on site.

1.8 BUILDING SMOKING ENVIRONMENT

- .1 Comply with smoking restrictions and municipal by-laws.

Part 2 Products

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 NOT USED

- .1 Not Used.

END OF SECTION

Part 1 General

1.1 REFERENCE STANDARDS

- .1 Canadian Construction Documents Committee (CCDC)
 - .1 CCDC 2-2008, Stipulated Price Contract.
- .2 Underwriters Laboratories' of Canada (ULC)
 - .1 ULC-S115-2018, Standard Method of Fire Tests of Firestop Systems

1.2 INSPECTION

- .1 Allow Departmental Representative access to Work. If part of Work is in preparation at locations other than Place of Work, allow access to such Work whenever it is in progress.
- .2 Give timely notice requesting inspection if Work is designated for special tests, inspections or approvals by Departmental Representative instructions, or law of Place of Work.
- .3 If Contractor covers or permits to be covered Work that has been designated for special tests, inspections or approvals before such is made, uncover such Work, have inspections or tests satisfactorily completed and make good such Work.
- .4 Departmental Representative will order part of Work to be examined if Work is suspected to be not in accordance with Contract Documents. If, upon examination such work is found not in accordance with Contract Documents, correct such Work and pay cost of examination and correction. If such Work is found in accordance with Contract Documents, Departmental Representative will pay cost of examination and replacement.

1.3 INDEPENDENT INSPECTION AGENCIES

- .1 Independent Inspection/Testing Agencies will be engaged by Departmental Representative for purpose of inspecting and/or testing portions of Work. Cost of such services will be borne by Departmental Representative.
- .2 Provide equipment required for executing inspection and testing by appointed agencies.
- .3 Employment of inspection/testing agencies does not relax responsibility to perform Work in accordance with Contract Documents.
- .4 If defects are revealed during inspection and/or testing, appointed agency will request additional inspection and/or testing to ascertain full degree of defect. Correct defect and irregularities as advised by Departmental Representative at no cost to Departmental Representative. Pay costs for retesting and reinspection.

1.4 ACCESS TO WORK

- .1 Allow inspection/testing agencies access to Work, off site manufacturing and fabrication plants.
- .2 Co-operate to provide reasonable facilities for such access.

1.5 CUT, PATCH AND MAKE GOOD

- .1 Cut existing surfaces as required to accommodate new work.
- .2 Remove all items shown or specified.
- .3 Patch and make good surfaces cut, damaged or disturbed, to Departmental Representative's approval. Match existing material, colour, finish and texture.
- .4 Install firestops and smoke seals in accordance with ULC-S115, around pipe, ductwork, cables, and other objects penetrating fire separations to provide fire resistance not less than the fire resistance rating of surrounding floor, ceiling, and wall assembly.

1.6 EXAMINATION

- .1 Examine site and conditions likely to affect work and be familiar and conversant with existing conditions.
- .2 Provide the Departmental Representative photographs of surrounding properties, objects and structures liable to be damaged or be the subject of subsequent claims

1.7 PROCEDURES

- .1 Notify appropriate agency and Departmental Representative in advance of requirement for tests, in order that attendance arrangements can be made.
- .2 Submit samples and/or materials required for testing, as specifically requested in specifications. Submit with reasonable promptness and in orderly sequence to not cause delays in Work.
- .3 Provide labour and facilities to obtain and handle samples and materials on site. Provide sufficient space to store and cure test samples.

1.8 REJECTED WORK

- .1 Remove defective Work, whether result of poor workmanship, use of defective products or damage and whether incorporated in Work or not, which has been rejected by Departmental Representative as failing to conform to Contract Documents. Replace or re-execute in accordance with Contract Documents.
- .2 Make good other Contractor's work damaged by such removals or replacements promptly.
- .3 If in opinion of Departmental Representative it is not expedient to correct defective Work or Work not performed in accordance with Contract Documents, Owner will deduct from Contract Price difference in value between Work performed and that called for by Contract Documents, amount of which will be determined by Departmental Representative.

1.9 REPORTS

- .1 Submit one electronic copy and one hard copy of inspection and test reports to Departmental Representative.
- .2 Provide copies to subcontractor of work being inspected or tested.

1.10 TESTS AND MIX DESIGNS

- .1 Furnish test results and mix designs as requested.
- .2 Cost of tests and mix designs beyond those called for in Contract Documents or beyond those required by law of Place of Work will be appraised by Departmental Representative and may be authorized as recoverable.

1.11 EQUIPMENT AND SYSTEMS

- .1 Submit adjustment and balancing reports for mechanical, electrical and building systems.

1.12 FIELD QUALITY CONTROL

- .1 Carry out work using only qualified licensed certified workers or apprentices in accordance with Provincial act respecting manpower vocational training and qualifications.
- .2 Permit employees registered in Provincial apprenticeship program to perform specific tasks only if under direct supervision of qualified licensed workers.
- .3 Determine permitted activities and tasks by apprentices based on level of training attended and demonstration of ability to perform specific duties

Part 2 Products

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 NOT USED

- .1 Not Used.

END OF SECTION

Part 1 General

1.1 REFERENCE STANDARDS

- .1 Canadian Construction Documents Committee (CCDC)
 - .1 CCDC 2-2008, Stipulated Price Contract.
- .2 Conform to these reference standards, in whole or in part as specifically requested in specifications.
- .3 If there is question as to whether products or systems are in conformance with applicable standards, Departmental Representative reserves right to have such products or systems tested to prove or disprove conformance.
- .4 Cost for such testing will be born by Departmental Representative in event of conformance with Contract Documents and will be born by the Contractor in event of non-conformance.

1.2 QUALITY

- .1 Refer to CCDC 2.
- .2 Products, materials, equipment and articles incorporated in Work shall be new, not damaged or defective, and of best quality for purpose intended. If requested, furnish evidence as to type, source and quality of products provided.
- .3 Procurement policy is to acquire, in cost effective manner, items containing highest percentage of recycled and recovered materials practicable consistent with maintaining satisfactory levels of competition. Make reasonable efforts to use recycled and recovered materials and in otherwise utilizing recycled and recovered materials in execution of work.
- .4 Defective products, whenever identified prior to completion of Work, will be rejected, regardless of previous inspections. Inspection does not relieve responsibility, but is precaution against oversight or error. Remove and replace defective products at own expense and be responsible for delays and expenses caused by rejection.
- .5 Should disputes arise as to quality or fitness of products, decision rests strictly with Departmental Representative based upon requirements of Contract Documents.
- .6 Unless otherwise indicated in specifications, maintain uniformity of manufacture for any particular or like item throughout building.
- .7 Permanent labels, trademarks and nameplates on products are not acceptable in prominent locations, except where required for operating instructions, or when located in mechanical or electrical rooms.

1.3 AVAILABILITY

- .1 Immediately upon signing Contract, review product delivery requirements and anticipate foreseeable supply delays for items. If delays in supply of products are foreseeable, notify Departmental Representative of such, in order that substitutions or other remedial action may be authorized in ample time to prevent delay in performance of Work.

- .2 In event of failure to notify Departmental Representative at commencement of Work and should it subsequently appear that Work may be delayed for such reason, Departmental Representative reserves right to substitute more readily available products of similar character, at no increase in Contract Price or Contract Time.

1.4 STORAGE, HANDLING AND PROTECTION

- .1 Handle and store products in manner to prevent damage, adulteration, deterioration and soiling and in accordance with manufacturer's instructions when applicable.
- .2 Store packaged or bundled products in original and undamaged condition with manufacturer's seal and labels intact. Do not remove from packaging or bundling until required in Work.
- .3 Store products subject to damage from weather in weatherproof enclosures.
- .4 Store cementitious products clear of earth or concrete floors, and away from walls.
- .5 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.
- .6 Store and mix paints in heated and ventilated room. Remove oily rags and other combustible debris from site daily. Take every precaution necessary to prevent spontaneous combustion.
- .7 Remove and replace damaged products at own expense and to satisfaction of Departmental Representative.
- .8 Touch-up damaged factory finished surfaces to Departmental Representative's satisfaction. Use touch-up materials to match original. Do not paint over name plates.

1.5 TRANSPORTATION

- .1 Pay costs of transportation of products required in performance of Work.
- .2 Transportation cost of products supplied by Owner will be paid for by Departmental Representative. Unload, handle and store such products.

1.6 MANUFACTURER'S INSTRUCTIONS

- .1 Unless otherwise indicated in specifications, install or erect products in accordance with manufacturer's instructions. Do not rely on labels or enclosures provided with products. Obtain written instructions directly from manufacturers.
- .2 Notify Departmental Representative in writing, of conflicts between specifications and manufacturer's instructions, so that Departmental Representative will establish course of action.
- .3 Improper installation or erection of products, due to failure in complying with these requirements, authorizes Departmental Representative to require removal and re-installation at no increase in Contract Price or Contract Time.

1.7 QUALITY OF WORK

- .1 Ensure Quality of Work is of highest standard, executed by workers experienced and skilled in respective duties for which they are employed. Immediately notify Departmental Representative if required Work is such as to make it impractical to produce required results.

- .2 Do not employ anyone unskilled in their required duties. Departmental Representative reserves right to require dismissal from site, workers deemed incompetent or careless.
- .3 Decisions as to standard or fitness of Quality of Work in cases of dispute rest solely with Departmental Representative, whose decision is final.

1.8 CO-ORDINATION

- .1 Ensure co-operation of workers in laying out Work. Maintain efficient and continuous supervision.
- .2 The Contractor is responsible for coordination and placement of openings, sleeves and accessories.

1.9 CONCEALMENT

- .1 In finished areas conceal pipes, ducts and wiring in floors, walls and ceilings, except where indicated otherwise.
- .2 Before installation inform Departmental Representative if there is interference. Install as directed by Departmental Representative.

1.10 REMEDIAL WORK

- .1 Perform remedial work required to repair or replace parts or portions of Work identified as defective or unacceptable. Co-ordinate adjacent affected Work as required.
- .2 Perform remedial work by specialists familiar with materials affected. Perform in a manner to neither damage nor put at risk any portion of Work.

1.11 LOCATION OF FIXTURES

- .1 Consider location of fixtures, outlets, and mechanical and electrical items indicated as approximate.
- .2 Inform Departmental Representative of conflicting installation. Install as directed.

1.12 FASTENINGS

- .1 Provide metal fastenings and accessories in same texture, colour and finish as adjacent materials, unless indicated otherwise.
- .2 Prevent electrolytic action between dissimilar metals and materials.
- .3 Use non-corrosive hot dip galvanized steel fasteners and anchors for securing exterior work, unless stainless steel or other material is specifically requested in affected specification Section.
- .4 Space anchors within individual load limit or shear capacity and ensure they provide positive permanent anchorage. Wood, or any other organic material plugs are not acceptable.
- .5 Keep exposed fastenings to a minimum, space evenly and install neatly.
- .6 Fastenings which cause spalling or cracking of material to which anchorage is made are not acceptable.

1.13 FASTENINGS - EQUIPMENT

- .1 Use fastenings of standard commercial sizes and patterns with material and finish suitable for service.
- .2 Use heavy hexagon heads, semi-finished unless otherwise specified. Use No. 304 stainless steel for exterior areas.
- .3 Bolts may not project more than one diameter beyond nuts.
- .4 Use plain type washers on equipment, sheet metal and soft gasket lock type washers where vibrations occur. Use resilient washers with stainless steel.

1.14 PROTECTION OF WORK IN PROGRESS

- .1 Prevent overloading of parts of building. Do not cut, drill or sleeve load bearing structural member, unless specifically indicated without written approval of Departmental Representative.

1.15 EXISTING UTILITIES

- .1 When breaking into or connecting to existing services or utilities, execute Work at times directed by local governing authorities, with minimum of disturbance to Work, and/or building occupants and pedestrian and vehicular traffic.
- .2 Protect, relocate or maintain existing active services. When services are encountered, cap off in manner approved by authority having jurisdiction. Stake and record location of capped service.

Part 2 Products

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 NOT USED

- .1 Not Used.

END OF SECTION

Part 1 General

1.1 REFERENCE STANDARDS

- .1 Owner's identification of existing survey control points and property limits.

1.2 QUALIFICATIONS OF SURVEYOR

- .1 Qualified registered land surveyor, licensed to practise in Place of Work, acceptable to Departmental Representative.

1.3 SURVEY REFERENCE POINTS

- .1 Existing base horizontal and vertical control points are designated on drawings.
- .2 Locate, confirm and protect control points prior to starting site work. Preserve permanent reference points during construction.
- .3 Make no changes or relocations without prior written notice to Departmental Representative.
- .4 Report to Departmental Representative when reference point is lost or destroyed or requires relocation because of necessary changes in grades or locations.
- .5 Require surveyor to replace control points in accordance with original survey control.

1.4 SURVEY REQUIREMENTS

- .1 Establish two permanent benchmarks on site, referenced to established benchmarks by survey control points. Record locations, with horizontal and vertical data in Project Record Documents.
- .2 Establish lines and levels, locate and lay out, by instrumentation.
- .3 Stake for grading, fill placement.
- .4 Stake slopes.
- .5 Establish pipe invert elevations.
- .6 Stake batter boards for foundations.
- .7 Establish foundation column locations and floor elevations.
- .8 Establish lines and levels for mechanical and electrical work.

1.5 EXISTING SERVICES

- .1 Before commencing work, establish location and extent of service lines in area of Work and notify Departmental Representative of findings.
- .2 Remove abandoned service lines within 2 m of structures. Cap or otherwise seal lines at cut-off points as directed by Departmental Representative.

1.6 LOCATION OF EQUIPMENT AND FIXTURES

- .1 Location of equipment, fixtures and outlets indicated or specified are to be considered as approximate.

- .2 Locate equipment, fixtures and distribution systems to provide minimum interference and maximum usable space and in accordance with manufacturer's recommendations for safety, access and maintenance.
- .3 Inform Departmental Representative of impending installation and obtain approval for actual location.
- .4 Submit field drawings to indicate relative position of various services and equipment when required by Departmental Representative.

1.7 RECORDS

- .1 Maintain a complete, accurate log of control and survey work as it progresses.
- .2 On completion of foundations and major site improvements, prepare a certified survey showing dimensions, locations, angles and elevations of Work.
- .3 Record locations of maintained, re-routed and abandoned service lines.

1.8 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit name and address of Surveyor to Departmental Representative.
- .2 On request of Departmental Representative, submit documentation to verify accuracy of field engineering work.
- .3 Submit certificate signed by surveyor certifying and noting those elevations and locations of completed Work that conform and do not conform with Contract Documents.

1.9 SUBSURFACE CONDITIONS

- .1 Promptly notify Departmental Representative in writing if subsurface conditions at Place of Work differ materially from those indicated in Contract Documents, or a reasonable assumption of probable conditions based thereon.
- .2 After prompt investigation, should Departmental Representative determine that conditions do differ materially, instructions will be issued for changes in Work as provided in Changes and Change Orders.

Part 2 Products

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 NOT USED

- .1 Not Used.

END OF SECTION

Part 1 General

1.1 REFERENCE STANDARDS

- .1 Canadian Construction Documents Committee (CCDC)
 - .1 CCDC 2-2008, Stipulated Price Contract.

1.2 PROJECT CLEANLINESS

- .1 Maintain Work in tidy condition, free from accumulation of waste products and debris, including other than that caused by Owner or other Contractors.
- .2 Remove waste materials from site at daily regularly scheduled times or dispose of as directed by Departmental Representative. Do not burn waste materials on site, unless approved by Departmental Representative.
- .3 Clear snow and ice from access to building, remove from site bank/pile snow in designated areas only.
- .4 Make arrangements with and obtain permits from authorities having jurisdiction for disposal of waste and debris.
- .5 Provide and use marked separate bins for recycling. Refer to Section 01 74 19- Waste Management and Disposal.
- .6 Dispose of waste materials and debris at designated dumping areas on Crown property off site.
- .7 Clean interior areas prior to start of finishing work and maintain areas free of dust and other contaminants during finishing operations.
- .8 Store volatile waste in covered metal containers and remove from premises at end of each working day.
- .9 Provide adequate ventilation during use of volatile or noxious substances. Use of building ventilation systems is not permitted for this purpose.
- .10 Use only cleaning materials recommended by manufacturer of surface to be cleaned, and as recommended by cleaning material manufacturer.
- .11 Schedule cleaning operations so that resulting dust, debris and other contaminants will not fall on wet, newly painted surfaces nor contaminate building systems.

1.3 FINAL CLEANING

- .1 Refer to CCDC 2, GC 3.14.
- .2 When Work is Substantially Performed remove surplus products, tools, construction machinery and equipment not required for performance of remaining Work.
- .3 Remove waste products and debris other than that caused by others, and leave Work clean and suitable for occupancy.
- .4 Prior to final review remove surplus products, tools, construction machinery and equipment.

- .5 Remove waste products and debris including other than that caused by Owner or other Contractors.
- .6 Remove waste materials from site at regularly scheduled times or dispose of as directed by Departmental Representative. Do not burn waste materials on site, unless approved by Departmental Representative.
- .7 Make arrangements with and obtain permits from authorities having jurisdiction for disposal of waste and debris.
- .8 Clean and polish glass, mirrors, hardware, wall tile, stainless steel, chrome, porcelain enamel, baked enamel, plastic laminate, and mechanical and electrical fixtures. Replace broken, scratched or disfigured glass.
- .9 Clean lighting reflectors, lenses, and other lighting surfaces.
- .10 Vacuum clean and dust building interiors, behind grilles, louvres and screens.
- .11 Wax, seal, shampoo or prepare floor finishes, as recommended by manufacturer.
- .12 Inspect finishes, fitments and equipment and ensure specified workmanship and operation.
- .13 Broom clean and wash exterior walks, steps and surfaces; rake clean other surfaces of grounds.
- .14 Remove dirt and other disfiguration from exterior surfaces.
- .15 Clean and sweep roofs, gutters, areaways, and sunken wells.
- .16 Sweep and wash clean paved areas.
- .17 Clean equipment and fixtures to sanitary condition; clean or replace filters of mechanical equipment.
- .18 Clean roofs, downspouts, and drainage systems.
- .19 Remove debris and surplus materials from crawl areas and other accessible concealed spaces.
- .20 Remove snow and ice from access to building.

1.4 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate waste materials for recycling and reuse in accordance with Section 01 74 19- Waste Management and Disposal.

Part 2 Products

2.1 NOT USED

Part 3 Execution

3.1 NOT USED

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 This Section includes requirements for management of construction waste and disposal, which forms the Contractor's commitment to reduce and divert waste materials from landfill and includes the following:
 - .1 Preparation of a Construction Waste Management Plan that provides guidance on a logical progression of tasks and procedures to be followed in a pollution prevention program to reduce or eliminate the generation of waste, the loss of natural resources, and process emissions through source reduction, reuse, recycling, and reclamation.

1.2 REFERENCE STANDARDS

- .1 American Society for Testing and Materials (ASTM):
 - .1 ASTM E1609 01, Standard Guide for Development and Implementation of a Pollution Prevention Program
- .2 Recycling Certification Institute (RCI):
 - .1 RCI Certification Construction and Demolition Materials Recycling

1.3 DEFINITIONS

- .1 Clean Waste: Untreated and unpainted; not contaminated with oils, solvents, sealants or similar materials.
- .2 Construction and Demolition Waste: Solid wastes typically including building materials, packaging, trash, debris, and rubble resulting from construction, re modeling operations. repair and demolition
- .3 Hazardous: Exhibiting the characteristics of hazardous substances including properties such as ignitability, corrosiveness, toxicity or reactivity.
- .4 Non hazardous: Exhibiting none of the characteristics of hazardous substances, including properties such as ignitability, corrosiveness, toxicity, or reactivity.
- .5 Non toxic: Not poisonous to humans either immediately or after a long period of exposure.
- .6 Recyclable: The ability of a product or material to be recovered at the end of its life cycle and remanufactured into a new product for reuse by others.
- .7 Recycle: To remove a waste material from the project site to another site for remanufacture into a new product for reuse by others.
- .8 Recycling: The process of sorting, cleansing, treating and reconstituting solid waste and other discarded materials for the purpose of using the altered form; recycling does not include burning, incinerating, or thermally destroying waste.
- .9 Return: To give back reusable items or unused products to vendors for credit.
- .10 Reuse: To reuse a construction waste material in some manner on the project site.
- .11 Salvage: To remove a waste material from the project site to another site for resale or reuse by others.

- .12 Sediment: Soil and other debris that has been eroded and transported by storm or well production run off water.
- .13 Source Separation: The act of keeping different types of waste materials separate beginning from the first time they become waste.
- .14 Toxic: Poisonous to humans either immediately or after a long period of exposure.
- .15 Trash: Any product or material unable to be reused, returned, recycled, or salvaged.
- .16 Volatile Organic Compounds (VOC's): Chemical compounds common in and emitted by many building products over time through outgassing:
 - .1 Solvents in paints and other coatings;
 - .2 Wood preservatives; strippers and household cleaners;
 - .3 Adhesives in particleboard, fiberboard, and some plywood; and foam insulation.
 - .4 When released, VOC's can contribute to the formation of smog and can cause respiratory tract problems, headaches, eye irritations, nausea, damage to the liver, kidneys, and central nervous system, and possibly cancer.
- .17 Waste: Extra material or material that has reached the end of its useful life in its intended use. Waste includes salvageable, returnable, recyclable, and reusable material.
- .18 Construction Waste Management Plan : A project related plan for the collection, transportation, and disposal of the waste generated at the construction site; the purpose of the plan is to ultimately reduce the amount of material being landfilled.

1.4 ADMINISTRATIVE REQUIREMENTS

- .1 Coordination: Coordinate waste management requirements with all Divisions of the Work for the project and ensure that requirements of the Construction Waste Management Plan are followed.
- .2 Preconstruction Meeting: Arrange a pre-construction meeting in accordance with Section 01 31 19 – Project Meetings before starting any Work of the Contract attended by the Owner, Contractor, affected Subcontractor's and Departmental Representative to discuss the Contractor's Construction Waste Management Plan and to develop mutual understanding of the requirements for a consistent policy towards waste reduction and recycling.

1.5 SUBMITTALS

- .1 Provide required information in accordance with Section 01 33 00 – Submittal Procedures.

1.6 PROJECT CLOSEOUT SUBMISSIONS

- .1 Record Documentation : Submit as constructed information in accordance with Section 01 78 00– Closeout Submittals.

1.7 QUALITY ASSURANCE

- .1 Certifications: Provide proof of the following during the course of the Work:
 - .1 Compliance Certification: Provide proof that recycling center is third party verified and is listed as a Certified Facility through the registration and certification requirements of the Recycling Certification Institute.

1.8 DELIVERY, STORAGE AND HANDLING

- .1 Storage Requirements: Implement a recycling/reuse program that includes separate collection of waste materials as appropriate to the project waste and the available recycling and reuse programs in the project area.
- .2 Handling Requirements: Clean materials that are contaminated before placing in collection containers and ensure that waste destined for landfill does not get mixed in with recycled materials:
 - .1 Deliver materials free of dirt, adhesives, solvents, petroleum contamination, and other substances deleterious to recycling process.
 - .2 Arrange for collection by or delivery to the appropriate recycling or reuse facility.
- .3 Hazardous Waste and Hazardous Materials: Handle in accordance with applicable regulations.

Part 2 Products

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 (CWM PLAN) IMPLEMENTATION

- .1 Manager: Contractor is responsible for designating an on site party or parties responsible for instructing workers and overseeing and documenting results of the CWM Plan for the project.
- .2 Distribution: Distribute copies of the CWM Plan to the job site foreman, each Subcontractor, the Owner, the Departmental Representative, Consultant and other site personnel as required to maintain CWM Plan .
- .3 Separation Facilities: Lay out and label a specific area to facilitate separation of materials for potential recycling, salvage, reuse, composting and return:
 - .1 Recycling and waste bin areas are to be kept neat and clean and clearly marked in order to avoid contamination of materials.
 - .2 Hazardous wastes shall be separated, stored, and disposed of in accordance with local regulations.

3.2 SUBCONTRACTOR'S RESPONSIBILITY

- .1 Subcontractor 's shall cooperate fully with the Contractor to implement the CWM Plan .
- .2 Failure to cooperate may result in the Owner not achieving their environmental goals, and may result in penalties being assessed by the Contractor to the responsible Subcontractor's.

3.3 SAMPLE CONSTRUCTION WASTE MANAGEMENT FORMS

- .1 Sample waste tracking form below can be used by the Contractor to establish their own forms for recording management of construction waste:

.2 SAMPLE WASTE MANAGEMENT FORM

Material Stream	Diverted Waste by Report Date	Total	Units				
Sept	Oct	Nov	Dec				
Material Streams Contributing to Credit	Plastic	1.25	2.5	10	5	18.75	m ³
Carpet	2.5	2.5	2.5	0	7.5	m ³	
Paper/Cardboard	5	2.5	2.5	5	15	m ³	
Clean Wood	0	25	0	1.25	26.25	m ³	
Metal	1.25	2.5	5.5	7	16.25	m ³	
Gypsum Board	2.5	2.5	4	5	14	m ³	
Brick/Concrete	10.5	2.5	5.5	8.75	27.25	m ³	
Asphalt Shingles	10	0	0	0	10	m ³	
Total Diverted Waste	135	m ³					
Material Streams not Contributing to Credit	Landfill	10.75	7.5	15	10	43.25	m ³
Screen Fines (ADC)	5	1.25	0	2.5	8.75	m ³	
150 mm Minus (ADC)	1.25	1.25	5	5.5	13	m ³	
Total Landfill/ADC Waste	65			m ³			
Total Waste	200	m ³					
Percent Diverted	67.5	%					

END OF SECTION

Part 1 General

1.1 REFERENCE STANDARDS

- .1 Canadian Environmental Protection Act (CEPA)
 - .1 SOR/2008-197, Storage Tank Systems for Petroleum Products and Allied Petroleum Products Regulations.

1.2 ADMINISTRATIVE REQUIREMENTS

- .1 Pre-warranty Meeting:
 - .1 Convene meeting one week prior to contract completion with Departmental Representative and contractor's representative, in accordance with Section 01 31 19- Project Meetings to:
 - .1 Verify Project requirements.
 - .2 Review installation and warranty requirements.
 - .2 Departmental Representative to establish communication procedures for:
 - .1 Notifying construction warranty defects.
 - .2 Determine priorities for type of defects.
 - .3 Determine reasonable response time.
 - .3 Contact information for bonded and licensed company for warranty work action: provide name, telephone number and address of company authorized for construction warranty work action.
 - .4 Ensure contact is located within local service area of warranted construction, is continuously available, and is responsive to inquiries for warranty work action.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00- Submittal Procedures.
- .2 Two weeks prior to Substantial Performance of the Work, submit to the Departmental Representative, four final copies of operating and maintenance manuals in English and French. If French documents from the supplier are not readily available, English only documents will be considered acceptable.
- .3 Provide spare parts, maintenance materials and special tools of same quality and manufacture as products provided in Work.
- .4 Provide evidence, if requested, for type, source and quality of products supplied.

1.4 OPERATIONS AND MAINTENANCE MANUALS

- .1 Two (2) weeks prior to any scheduled training, submit to the Departmental Representative six (6) copies of approved Operations Data and Maintenance Manual in both official languages, compiled as follows:
 - .1 Bind data in vinyl hard cover 3 "D" ring type loose leaf binders for 212 x 275 mm size paper. Binders must not exceed 75 mm thick or be more than 2/3 full.

- .2 Enclose title sheet labelled "Operation Data and Maintenance Manual," Project Name, Project Number, Date and List of Contents. Project name must appear on binder face and spine.
- .3 Organize contents into applicable sections of work to parallel project specifications breakdown. Mark each section by labelled tabs protected with celluloid covers fastened to hard paper dividing sheets.
- .2 Include following information plus data specified.
 - .1 Maintenance instruction for finished surface and materials.
 - .2 Copy of hardware and paint schedules.
 - .3 Description: Operation of the equipment and systems defining start-up, shut-down and emergency procedures, and any fixed or adjustable set points that affect the efficiency of the operation. Include nameplate information such as make, size, capacity and serial number.
 - .4 Maintenance: Use clear drawings, diagrams or manufacturers' literature which specifically apply and detail the following:
 - .1 lubrication products and schedules.
 - .2 trouble shooting procedures.
 - .3 adjustment techniques.
 - .4 operational checks.
 - .5 Suppliers' names, addresses and telephone numbers and components supplied by them must be included in this section. Components must be identified by a description and manufacturers part number.
 - .5 Guarantees showing:
 - .1 Name and address of projects.
 - .2 Guarantee commencement date (date of Interim Certificate of Completion).
 - .3 Duration of guarantee.
 - .4 Clear indication of what is being guaranteed and what remedial action will be taken under guarantee.
 - .5 Signature and seal of Guarantor.
 - .6 Additional material used in project listed under various sections showing name of manufacturer and source of supply.
- .3 Spare parts: List all recommended spares to be maintained on site to ensure optimum efficiency. List all special tools appropriate to unique application. All parts/tools detailed must be identified as to manufacturer, manufacturer part number and supplier (including address).
- .4 Include one complete set of final shop drawings (bound separately) indicating corrections and changes made during fabrication and installation.
- .5 Provide a soft copy of all manuals

1.5 AS -BUILT DOCUMENTS AND SAMPLES

- .1 Maintain, in addition to requirements in General Conditions, at site for Departmental Representative one record copy of:
 - .1 Contract Drawings.

- .2 Specifications.
- .3 Addenda.
- .4 Change Orders and other modifications to Contract.
- .5 Reviewed shop drawings, product data, and samples.
- .6 Field test records.
- .7 Inspection certificates.
- .8 Manufacturer's certificates.
- .2 Store record documents and samples in field office apart from documents used for construction.
 - .1 Provide files, racks, and secure storage.
- .3 Label record documents and file in accordance with Section number listings in List of Contents of this Project Manual.
 - .1 Label each document "PROJECT RECORD" in neat, large, printed letters.
- .4 Maintain record documents in clean, dry and legible condition.
 - .1 Do not use record documents for construction purposes.
- .5 Keep record documents and samples available for inspection by Departmental Representative.

1.6 RECORDING INFORMATION ON PROJECT RECORD DOCUMENTS

- .1 Record information on set of black line drawings, and in copy of Project Manual, provided by Departmental Representative.
- .2 Use felt tip marking pens, maintaining separate colours for each major system, for recording information.
- .3 Record information concurrently with construction progress.
 - .1 Do not conceal Work until required information is recorded.
- .4 Contract Drawings and shop drawings: mark each item to record actual construction, including:
 - .1 Measured depths of elements of foundation in relation to finish first floor datum.
 - .2 Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
 - .3 Measured locations of internal utilities and appurtenances, referenced to visible and accessible features of construction.
 - .4 Field changes of dimension and detail.
 - .5 Changes made by change orders.
 - .6 Details not on original Contract Drawings.
 - .7 Referenced Standards to related shop drawings and modifications.
- .5 Specifications: mark each item to record actual construction, including:
 - .1 Manufacturer, trade name, and catalogue number of each product actually installed, particularly optional items and substitute items.
 - .2 Changes made by Addenda and change orders.

- .6 Other Documents: maintain inspection certifications, manufacturer's certifications, field test records, required by individual specifications sections.

1.7 FINAL SURVEY

- .1 Submit final site survey certificate in accordance with Section 01 71 00- Examination and Preparation, certifying that elevations and locations of completed Work are in conformance, or non-conformance with Contract Documents.

1.8 EQUIPMENT AND SYSTEMS

- .1 For each item of equipment and each system include description of unit or system, and component parts.
 - .1 Give function, normal operation characteristics and limiting conditions.
 - .2 Include performance curves, with engineering data and tests, and complete nomenclature and commercial number of replaceable parts.
- .2 Panel board circuit directories: provide electrical service characteristics, controls, and communications.
- .3 Include installed colour coded wiring diagrams.
- .4 Operating Procedures: include start-up, break-in, and routine normal operating instructions and sequences.
 - .1 Include regulation, control, stopping, shut-down, and emergency instructions.
 - .2 Include summer, winter, and any special operating instructions.
- .5 Maintenance Requirements: include routine procedures and guide for trouble-shooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.
- .6 Provide servicing and lubrication schedule, and list of lubricants required.
- .7 Include manufacturer's printed operation and maintenance instructions.
- .8 Include sequence of operation by controls manufacturer.
- .9 Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.
- .10 Provide installed control diagrams by controls manufacturer.
- .11 Provide Contractor's co-ordination drawings, with installed colour coded piping diagrams.
- .12 Provide charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.
- .13 Provide list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.
- .14 Include test and balancing reports as specified in Section 01 45 00- Quality Control and Section 01 91 13- General Commissioning Requirements.
- .15 Additional requirements: as specified in individual specification sections.

1.9 MATERIALS AND FINISHES

- .1 Building products, applied materials, and finishes: include product data, with catalogue number, size, composition, and colour and texture designations.
 - .1 Provide information for re-ordering custom manufactured products.
- .2 Instructions for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.
- .3 Moisture-protection and weather-exposed products: include manufacturer's recommendations for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.
- .4 Additional requirements: as specified in individual specifications sections.

1.10 MAINTENANCE MATERIALS

- .1 Spare Parts:
 - .1 Provide spare parts, in quantities specified in individual specification sections.
 - .2 Provide items of same manufacture and quality as items in Work.
 - .3 Deliver to site; place and store.
 - .4 Receive and catalogue items.
 - .1 Submit inventory listing to Departmental Representative.
 - .2 Include approved listings in Maintenance Manual.
 - .5 Obtain receipt for delivered products and submit prior to final payment.
- .2 Extra Stock Materials:
 - .1 Provide maintenance and extra materials, in quantities specified in individual specification sections.
 - .2 Provide items of same manufacture and quality as items in Work.
 - .3 Deliver to site; place and store.
 - .4 Receive and catalogue items.
 - .1 Submit inventory listing to Departmental Representative.
 - .2 Include approved listings in Maintenance Manual.
 - .5 Obtain receipt for delivered products and submit prior to final payment.
- .3 Special Tools:
 - .1 Provide special tools, in quantities specified in individual specification section.
 - .2 Provide items with tags identifying their associated function and equipment.
 - .3 Deliver to site; place and store.
 - .4 Receive and catalogue items.
 - .1 Submit inventory listing to Departmental Representative.
 - .2 Include approved listings in Maintenance Manual.

1.11 DELIVERY, STORAGE AND HANDLING

- .1 Store spare parts, maintenance materials, and special tools in manner to prevent damage or deterioration.

- .2 Store in original and undamaged condition with manufacturer's seal and labels intact.
- .3 Store components subject to damage from weather in weatherproof enclosures.
- .4 Store paints and freezable materials in a heated and ventilated room.
- .5 Remove and replace damaged products at own expense and for review by Departmental Representative.

1.12 WARRANTIES AND BONDS

- .1 Develop warranty management plan to contain information relevant to Warranties.
- .2 Submit warranty management plan, 30 days before planned pre-warranty conference, to Departmental Representative approval.
- .3 Warranty management plan to include required actions and documents to assure that Departmental Representative receives warranties to which it is entitled.
- .4 Provide plan in narrative form and contain sufficient detail to make it suitable for use by future maintenance and repair personnel.
- .5 Submit, warranty information made available during construction phase, to Departmental Representative for approval prior to each monthly pay estimate.
- .6 Assemble approved information in binder, submit upon acceptance of work and organize binder as follows:
 - .1 Separate each warranty or bond with index tab sheets keyed to Table of Contents listing.
 - .2 List subcontractor, supplier, and manufacturer, with name, address, and telephone number of responsible principal.
 - .3 Obtain warranties and bonds, executed in duplicate by subcontractors, suppliers, and manufacturers, within ten days after completion of applicable item of work.
 - .4 Verify that documents are in proper form, contain full information, and are notarized.
 - .5 Co-execute submittals when required.
 - .6 Retain warranties and bonds until time specified for submittal.
- .7 Except for items put into use with Owner's permission, leave date of beginning of time of warranty until Date of Substantial Performance is determined.
- .8 Conduct joint (4) month and (9) month warranty inspection, measured from time of acceptance, by Departmental Representative.
- .9 Include information contained in warranty management plan as follows:
 - .1 Roles and responsibilities of personnel associated with warranty process, including points of contact and telephone numbers within the organizations of Contractors, subcontractors, manufacturers or suppliers involved.
 - .2 Listing and status of delivery of Certificates of Warranty for extended warranty items, to include roofs, motors, pumps, transformers, HVAC balancing, fire protection, sprinkler systems, alarm systems, commissioned systems, lightning protection systems.

- .3 Provide list for each warranted equipment, item, feature of construction or system indicating:
 - .1 Name of item.
 - .2 Model and serial numbers.
 - .3 Location where installed.
 - .4 Name and phone numbers of manufacturers or suppliers.
 - .5 Names, addresses and telephone numbers of sources of spare parts.
 - .6 Warranties and terms of warranty: include one-year overall warranty of construction. Indicate items that have extended warranties and show separate warranty expiration dates.
 - .7 Cross-reference to warranty certificates as applicable.
 - .8 Starting point and duration of warranty period.
 - .9 Summary of maintenance procedures required to continue warranty in force.
 - .10 Cross-Reference to specific pertinent Operation and Maintenance manuals.
 - .11 Organization, names and phone numbers of persons to call for warranty service.
 - .12 Typical response time and repair time expected for various warranted equipment.
- .4 Contractor's plans for attendance at 4 and 9 month post-construction warranty inspections.
- .5 Procedure and status of tagging of equipment covered by extended warranties.
- .6 Post copies of instructions near selected pieces of equipment where operation is critical for warranty and/or safety reasons.
- .10 Respond in timely manner to oral or written notification of required construction warranty repair work.
- .11 Written verification to follow oral instructions.
 - .1 Failure to respond will be cause for the Departmental Representative to proceed with action against Contractor.

1.13 WARRANTY TAGS

- .1 Tag, at time of installation, each warranted item. Provide durable, oil and water resistant tag approved by Departmental Representative.
- .2 Attach tags with copper wire and spray with waterproof silicone coating.
- .3 Leave date of acceptance until project is accepted for occupancy.
- .4 Indicate following information on tag:
 - .1 Type of product/material.
 - .2 Model number.
 - .3 Serial number.
 - .4 Contract number.
 - .5 Warranty period.

- .6 Inspector's signature.
- .7 Construction Contractor.

Part 2 Products

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 NOT USED

- .1 Not Used.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 01 91 13 – General Commissioning (Cx) Requirements.
- .2 Section 23 05 93 – Testing, Adjusting and Balancing for HVAC.
- .3 Section 23 07 13 – Duct Insulation.
- .4 Section 23 09 33 – Electric and Electronic Controls Systems for HVAC.
- .5 Section 23 81 40 – Air Source Unitary Heat Pump.
- .6 Section 26 05 00 – Common Work Results for Electrical.
- .7 Section 26 05 05 – Selective Demolition for Electrical.

1.2 DESCRIPTION

- .1 Demonstrate operation and maintenance of equipment and systems to the Departmental Representative prior to date of interim completion.
- .2 The Departmental Representative will provide list of personnel to receive instructions, and will coordinate their attendance at agreed-upon times. Allow for a minimum of five (5) people over five (5) days.

1.3 QUALITY CONTROL

- .1 When specified in individual Sections, require manufacturer to provide authorized representative to demonstrate operation of equipment and systems, instruct the Departmental Representative, and provide written report that demonstration and instructions have been completed.

1.4 SUBMITTALS

- .1 Submit schedule of time and date for demonstration of each item of equipment and each system. Training schedule shall be incorporated into the Commissioning and Performance Verification Schedule.
- .2 Submit reports within one (1) week after completion of demonstration, that demonstration and instructions have been satisfactorily completed.
- .3 Give time and date of each demonstration, with list of persons present.

1.5 CONDITIONS FOR DEMONSTRATIONS

- .1 Equipment has been inspected and put into operation in accordance with Section 01 91 13 – General Commissioning (Cx) Requirements.

- .2 Testing, adjusting, and balancing have been performed in accordance with Section 01 91 13 – General Commissioning (Cx) Requirements and equipment and systems are fully operational.
- .3 Provide copies of completed operation and maintenance manuals for use in demonstrations and instructions.

1.6 PREPARATION

- .1 Verify that conditions for demonstration and instructions comply with requirements.
- .2 Verify that designated personnel are present.

1.7 DEMONSTRATION AND INSTRUCTIONS

- .1 Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, and maintenance of each item of equipment.
- .2 Schedule demonstration and training of the installed systems. The systems and equipment provided under this contract requiring integration are:
 - .1 Air conditioners AC-3, AC-4, AC-5, and AC-6 and associated condensers.
 - .2 Heating Controls.
 - .3 Electrical Distribution
- .3 Instruct personnel in all phases of operation and maintenance using operation and maintenance manuals as the basis of instruction.
- .4 Review contents of manual in detail to explain all aspects of operation and maintenance.
- .5 Prepare and insert additional data in operations and maintenance manuals when the need for additional data becomes apparent during instructions.

Part 2 Products

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 NOT USED

- .1 Not Used.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Includes general requirements for commissioning facilities and facility systems.

1.2 PRECEDENCE

- .1 Division 1 Sections take precedence over technical specification sections in other Divisions of this Project Manual.

1.3 RELATED SECTIONS

- .1 Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.
- .2 Section 23 09 33 - Electric and Electronic Control System for HVAC.
- .3 Section 23 81 40 - Air Source Unitary Heat Pumps.
- .4 Section 23 84 13 - Humidifiers.

1.4 RESPONSIBILITY FOR COMMISSIONING

- .1 Refer to sections listed above in 1.3 for carrying out all the commissioning activities.
- .2 Co-operate with the Owner's own commissioning expert.

1.5 REFERENCES

- .1 Associated Air Balance Council (AABC): National Standards for Field Measurements and Instrumentation, Total Systems Balance, Air Distribution-Hydronics Systems.

1.6 SUBMITTALS

- .1 Prior to start of Work, submit name(s) of Contractor personnel proposed to perform commissioning services. Designate who has managerial responsibilities for coordination of entire testing, adjusting and balancing.
- .2 Submit 3 preliminary specimen copies of each of report forms proposed for use.
- .3 Fifteen days prior to Substantial Performance, submit 3 copies of final reports on applicable forms.
- .4 Report forms shall consist of the following:
 - .1 Start-up checklists:
 - .1 For all sections listed in item 1.3 of this Section, manufacturer's start-up lists are acceptable.
 - .2 Performance verification:
 - .1 Use only the PV form for air-conditioning equipment attached to this specification section.

1.7 PROCEDURES - GENERAL

- .1 Comply with procedural standards of certifying association under whose standard services will be performed.
- .2 Notify Departmental Representative 3 days prior to beginning of commissioning activities.
- .3 Accurately record data for each step.
- .4 Report to Departmental Representative any deficiencies or defects noted during performance of services.

1.8 FINAL REPORTS

- .1 Refer to sections listed above in 1.3 for confirmation of whom shall complete and issue the reports.
- .2 Ensure each form bears signature of recorder, and that of supervisor of reporting organization.
- .3 Identify each instrument used, and latest date of calibration of each.

1.9 CONTRACTOR RESPONSIBILITIES

- .1 Prepare each system for testing and balancing (TAB).
- .2 Cooperate with TAB testing organization and provide access to equipment and systems.
- .3 Provide personnel and operate systems at designated times, and under conditions required for proper testing, adjusting, and balancing.
- .4 Notify TAB testing organization, seven (7) days prior to time project will be ready for testing, adjusting, and balancing.

1.10 PREPARATION

- .1 Provide instruments required for testing, adjusting, and balancing operations.
- .2 Make instruments available to Departmental Representative to facilitate spot checks during testing.
- .3 Retain possession of instruments and remove at completion of services.
- .4 Verify systems installation is complete and in continuous operation.
- .5 Verify lighting is turned on when lighting is included in cooling load.
- .6 Verify equipment such as computers, and electronic equipment are in full operation.

1.11 EXECUTION

- .1 Test equipment, balance distribution systems, and adjust devices for temperature and humidity set-points for all air conditioning systems installed, and their related accessories.

1.12 SCHEDULE OF SYSTEMS REQUIRING TESTING, ADJUSTING, AND BALANCING SERVICES

- .1 Section 23 81 40 - Air Source Unitary Heat Pumps:
 - .1 AC-03 and condenser C-03
 - .2 AC-04 and condenser C-04
 - .3 AC-05 and condenser C-05
 - .4 AC-06 and condenser C-06
- .2 Section 23 84 13 – Humidifiers
 - .1 H-01
- .3 Section 23 09 33 - Electric and Electronic Control System for HVAC:
 - .1 Contactors provided for perimeter heating lockout under cooling conditions:
 - .1 Confirm all electric baseboards in the space served by each air-conditioning system are de-energized when heating mode is activated.
 - .2 Confirm manual-auto operation of perimeter heating contactor control panel LCP-01.

Part 2 Products

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 NOT USED

- .1 Not Used.

END OF SECTION

APPENDIX

AC UNIT CONSTRUCTION CHECKLIST

AC Unit Construction Checklist/Formulaire de renseignements Unité de climatisation

Project/Projet:	
Date:	
Identification:	
Building:	
Location:	

Submittal / Approvals

Submittal. The above equipment and systems integral to them are complete and ready for functional testing. The checklist items are complete and have been checked off only by parties having direct knowledge of the event, as marked below, respective to each responsible contractor. This construction checklist is submitted for approval, subject to an attached list of outstanding items yet to be completed. A Statement of Correction will be submitted upon completion of any outstanding areas. None of the outstanding items preclude safe and reliable functional tests being performed.

Soumission / Approbation

Soumission. L'équipement et les systèmes ci-dessus qui en font partie intégrante sont complets et prêts pour les tests fonctionnels. Les éléments de la liste de contrôle sont complets et n'ont été cochés que par des parties ayant une connaissance directe de l'événement, comme indiqué ci-dessous, pour chaque entrepreneur responsable. Cette liste de contrôle de construction est soumise pour approbation, sous réserve d'une liste ci-jointe des éléments en suspens encore à compléter. Une déclaration de correction sera soumise à la fin de toutes les zones en suspens. Aucun des éléments en suspens n'empêche la réalisation de tests fonctionnels sûrs et fiables.

☐ List attached/Liste ci-jointe

Mechanical Contractor/Entrepreneur mécanique	Date	Controls Contractor /entrepreneur de controles	Date
Electrical Contractor/Entrepreneur électrique	Date		
TAB Contractor/Balanceur	Date	General Contractor/Entrepreneur général	Date

Construction checklist items are to be completed as part of start-up & initial checkout, preparatory to performing test procedures/ Les éléments de la liste de contrôle de construction doivent être complétés dans le cadre du démarrage et de la vérification initiale, préparatoires à l'exécution des procédures de test..

- This checklist augments but is not meant to replace recommendations or requirements for installation, checkout and start-up from standards, manufacturers, codes or governing bodies/ Cette liste de contrôle augmente mais n'est pas destinée à remplacer les recommandations ou les exigences d'installation, de vérification et de démarrage des normes, des fabricants, des codes ou des organes directeurs.

- If this form is not used for documenting, a CxA approved form of similar rigor may be used/ Si ce formulaire n'est pas utilisé pour la documentation, un formulaire approuvé par CxA de rigueur similaire peut être utilisé.
- Contractor's assigned responsibility for sections of the checklist shall be responsible to see that checklist items by their subcontractors are completed and checked off/La responsabilité assignée à l'entrepreneur pour les sections de la liste de contrôle doit être responsable de voir que les éléments de la liste de contrôle par leurs sous-traitants sont remplis et cochés.

CxA Approvals/Approbation du CxA

This filled-out checklist has been reviewed. Its completion is approved with the exceptions noted below. / Cette liste de contrôle remplie a été révisée. Son achèvement est approuvé avec les exceptions indiquées ci-dessous.

Commissioning Authority/Autorité de mise en service	Date	Owner's Representative/ Représentant du propriétaire	Date

AC Unit Condenser Information/ Informations sur le condenseur de l'unité AC					
Make/Manufacturier			Model Number/Numéro de model		
Serial Number/Numéro de série			Function/Service		
Volts/ Phase			Amperage/ampérage		
Motor HP/HP moteur		Motor Eff./Eff. Du moteur		RPM	
AC Unit Evaporator Information/Informations sur l'évaporateur de l'unité AC					
Make/Manufacturier			Model Number/Numéro de model		
Serial Number/Numéro de série			Function/Service		
Volts/ Phase			Amperage/ampérage		
Motor HP/HP moteur		Motor Eff./Eff. Du moteur.		RPM	
Comments/commentaires:					

Requested documentation submitted/Documents demandés soumis	Rec'd /Recu	Comments/Commentaires
Manufacturer's cut sheets/Fiches techniques du fabricant	<input type="checkbox"/>	
Performance data/ Données de performance	<input type="checkbox"/>	
O&M manuals/ Manuels d'exploitation et de maintenance	<input type="checkbox"/>	
Factory test results/Résultats des tests en usine	<input type="checkbox"/>	
Sequences and control strategies/ Séquences et stratégies de contrôle	<input type="checkbox"/>	
Warranty Certificate/Certificat de garantie	<input type="checkbox"/>	
Vibration testing report/ Rapport d'essai de vibration	<input type="checkbox"/>	
Comments/Commentaires:		

Installation Checks/ Vérifications d'installation			
Check if acceptable, provide comment if unacceptable/ Vérifier si acceptable, fournir un commentaire si inacceptable	NA	Comment #	
General/Général			
General appearance good, no apparent damage/ Aspect général bon, aucun dommage apparent	<input type="checkbox"/>	<input type="checkbox"/>	
Installation is per manufacturer's instructions/ L'installation est conforme aux instructions du fabricant	<input type="checkbox"/>	<input type="checkbox"/>	

Installation Checks/ Vérifications d'installation			
Check if acceptable, provide comment if unacceptable/ Vérifier si acceptable, fournir un commentaire si inacceptable		NA	Comment #
Manufacturers recommended spare parts are provided/Les pièces de rechange recommandées par les fabricants sont fournies	<input type="checkbox"/>	<input type="checkbox"/>	
System has been charged with refrigerant and tested/ Le système a été chargé de réfrigérant et testé	<input type="checkbox"/>	<input type="checkbox"/>	
Equipment label permanently affixed/ Etiquette d'équipement apposée de façon permanente	<input type="checkbox"/>	<input type="checkbox"/>	
Casing condition good: no dents, leaks, door gaskets installed/Bon état du boîtier : pas de bosses, de fuites, joints de porte installés	<input type="checkbox"/>	<input type="checkbox"/>	
Refrigerant piping is adequate/ La tuyauterie de réfrigérant est adéquate	<input type="checkbox"/>	<input type="checkbox"/>	
Maintenance access acceptable for unit and components/ Accès de maintenance acceptable pour l'unité et les composants	<input type="checkbox"/>	<input type="checkbox"/>	
Sound attenuation installed (Pads)/ Atténuation sonore installée (Pads)	<input type="checkbox"/>	<input type="checkbox"/>	
Thermal insulation properly installed and according to specification/Isolation thermique correctement installée et conforme au cahier des charges	<input type="checkbox"/>	<input type="checkbox"/>	
Wall penetrations have been sealed according to specification/Les pénétrations murales ont été scellées conformément aux spécifications	<input type="checkbox"/>	<input type="checkbox"/>	
Clean up of equipment completed per contract documents/Nettoyage de l'équipement effectué selon les documents contractuels	<input type="checkbox"/>	<input type="checkbox"/>	
Condenser Fan/ Ventilateur du condenseur			
Fan area clean/ Aire du ventilateur propre	<input type="checkbox"/>	<input type="checkbox"/>	
Electrical wiring has been verified/ Le câblage électrique a été vérifié	<input type="checkbox"/>	<input type="checkbox"/>	
Evaporator Section/ Section évaporateur			
Unit is properly installed and location is as per contract documents/ L'unité est correctement installée et l'emplacement est conforme aux documents contractuels	<input type="checkbox"/>	<input type="checkbox"/>	
Condensate drain pipe is properly sloped to drain/ Le tuyau d'évacuation des condensats est correctement incliné vers l'évacuation	<input type="checkbox"/>	<input type="checkbox"/>	
Electrical wiring has been verified/ Le câblage électrique a été vérifié	<input type="checkbox"/>	<input type="checkbox"/>	
Electrical/Électrique			
Power disconnects in place and labeled/ Coupe-circuits en place et étiquetés	<input type="checkbox"/>	<input type="checkbox"/>	
Control system interlocks connected and functional/ Système de contrôle des verrouillages connectés et fonctionnels	<input type="checkbox"/>	<input type="checkbox"/>	
All control devices and wiring complete/Tous les dispositifs de commande et le câblage sont terminés	<input type="checkbox"/>	<input type="checkbox"/>	
Filter/Filtre			
Filter installed correctly/ Filtre correctement installé	<input type="checkbox"/>	<input type="checkbox"/>	
Access acceptable for filter removal and replacement/ Accès acceptable pour le retrait et le remplacement du filtre	<input type="checkbox"/>	<input type="checkbox"/>	
Functional Testing/ Test fonctionnel			

Installation Checks/ Vérifications d'installation			
Check if acceptable, provide comment if unacceptable/ Vérifier si acceptable, fournir un commentaire si inacceptable	NA	Comment #	
Controls/Contrôles			
Apply power to both units/ Mettre sous tension les deux unités	<input type="checkbox"/>	<input type="checkbox"/>	
Adjust thermostat setpoint to 15 Degree Celcius. Unit should start cooling/ Réglez le point de consigne du thermostat à 15 degrés Celsius. L'unité devrait commencer à refroidir	<input type="checkbox"/>	<input type="checkbox"/>	
Verify that both units are operating without abnormal vibrations or noises/Vérifiez que les deux unités fonctionnent sans vibrations ou bruits anormaux	<input type="checkbox"/>	<input type="checkbox"/>	
Measure and record current and voltage of compressor(s)/ Mesurer et enregistrer le courant et la tension du ou des compresseurs	<input type="checkbox"/>	<input type="checkbox"/>	
Measure and record discharge temperature of the unit/ Mesurer et enregistrer la température de refoulement de l'unité	<input type="checkbox"/>	<input type="checkbox"/>	
Measure and record Outside air temperature and humidity/Mesurer et enregistrer la température et l'humidité de l'air extérieur	<input type="checkbox"/>	<input type="checkbox"/>	
Sensors and Gages/ Capteurs et jauges			
Temperature, pressure and flow gages and sensors installed, as per details/ Manomètres et capteurs de température, de pression et de débit installés, selon les détails	<input type="checkbox"/>	<input type="checkbox"/>	
Piping gages, BAS and associated panel temperature and pressure readouts match/ Les jauges de tuyauterie, le BAS et les relevés de température et de pression du panneau associés correspondent.	<input type="checkbox"/>	<input type="checkbox"/>	
TAB			
Installation of system and balancing devices allowed balancing to be completed following specified NEBB or AABC procedures and contract documents/ L'installation du système et des dispositifs d'équilibrage a permis d'effectuer l'équilibrage conformément aux procédures spécifiées du NEBB ou de l'AABC et aux documents contractuels	<input type="checkbox"/>	<input type="checkbox"/>	

Sensor and Actuator Calibration/Étalonnage du capteur et de l'actionneur

All field-installed sensors and gages, and all actuators (dampers and valves) on this piece of equipment shall be calibrated in accordance with Specifications./Tous les capteurs et jauges installés sur le terrain, et tous les actionneurs (registres et vannes) sur cette pièce d'équipement doivent être étalonnés conformément aux spécifications.

All test instruments shall have had a certified calibration within the last 12 months/Tous les instruments de test doivent avoir eu un étalonnage certifié au cours des 12 derniers mois: ☐Y/☐N☐.

Sensors installed in the unit at the factory with calibration certification provided need not be field calibrated./ Les capteurs installés dans l'unité en usine avec la certification d'étalonnage fournie n'ont pas besoin d'être étalonnés sur le terrain.

Sensor or Actuator Tag & Location	Location OK	1 st Gage or BAS Value	Instrument Measured Value	Final Gage or BAS Value	Pass Y / N
	<input type="checkbox"/> Y/ <input type="checkbox"/> N <input type="checkbox"/>				<input type="checkbox"/> Y/ <input type="checkbox"/> N <input type="checkbox"/>
	<input type="checkbox"/> Y/ <input type="checkbox"/> N <input type="checkbox"/>				<input type="checkbox"/> Y/ <input type="checkbox"/> N <input type="checkbox"/>
	<input type="checkbox"/> Y/ <input type="checkbox"/> N <input type="checkbox"/>				<input type="checkbox"/> Y/ <input type="checkbox"/> N <input type="checkbox"/>

Sensor or Actuator Tag & Location	Location OK	1 st Gage or BAS Value	Instrument Measured Value	Final Gage or BAS Value	Pass Y / N
	<input type="checkbox"/> Y/ <input type="checkbox"/> N				<input type="checkbox"/> Y/ <input type="checkbox"/> N
	<input type="checkbox"/> Y/ <input type="checkbox"/> N				<input type="checkbox"/> Y/ <input type="checkbox"/> N
	<input type="checkbox"/> Y/ <input type="checkbox"/> N				<input type="checkbox"/> Y/ <input type="checkbox"/> N

Comments:

Part 1 General

1.1 REFERENCES

- .1 CSA International
 - .1 CSA S350-M1980 (R003), Code of Practice for Safety in Demolition of Structures.
- .2 Environment Canada, (EC)/Environmental Protection Services (EPS)
 - .1 Environmental Code of Practice for Elimination of Fluorocarbons Emissions from Refrigeration and Air Conditioning Systems SOR/2003-289.
 - .2 Federal Halocarbon Regulations, 2003 (FHR 2003).

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 – Submittal Procedures.

1.3 DELIVERY, STORAGE AND PROTECTION

- .1 Perform work in accordance Section 01 61 00 - Common Product Requirements.
- .2 Protect existing items to remain and items designated for salvage. In event of damage to such items, immediately replace or make repairs to approval of Departmental Representative and at no cost to DND.
- .3 Remove and store materials to be salvaged, in manner to prevent damage.
- .4 Store and protect in accordance with requirements for maximum preservation of material.
- .5 Handle salvaged materials as new materials.

1.4 SITE CONDITIONS

- .1 Site Environmental Requirements:
- .2 Perform work in accordance with article 1.1.2 of this Section:
 - .1 Fill and submit to the Departmental Representative the form attached to this Section in appendix in conformance with this article.
- .3 Ensure that selective demolition work does not adversely affect adjacent watercourses, groundwater and wildlife, or contribute to excess air and noise pollution.
- .4 Take precautions to protect environment.
- .5 If material resembling spray or trowel-applied asbestos or other designated substance, stop work, take preventative measures, and notify Departmental Representative immediately.
- .6 Proceed only after receipt of written instructions has been received from Departmental Representative.
- .7 Notify Departmental Representative before disrupting access or services.

Part 2 Products

2.1 EQUIPMENT

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

Part 3 Execution

3.1 COMPLIANCE

- .1 Environmental Code of Practice for Elimination of Fluorocarbons Emissions from Refrigeration and Air Conditioning Systems SOR/2003-289.
- .2 The contractor must complete all necessary forms and submit to the Departmental Representatives for records. Utilize the forms appended to this specification section.

3.2 EXAMINATION

- .1 Inspect building and site with Departmental Representative and verify extent and location of items designated for removal, disposal, alternative disposal, recycling, salvage and items to remain.
- .2 Locate and protect utilities. Preserve active utilities traversing site in operating condition.
- .3 Notify and obtain approval of utility companies before starting demolition.
- .4 Immediately notify Departmental Representative and utility company concerned in case of damage to any utility or service, designated to remain in place.
- .5 Immediately notify the Departmental Representative should uncharted utility or service be encountered, and await instruction in writing regarding remedial action.

3.3 PREPARATION

- .1 Protection of In-Place Conditions:
 - .1 Prevent movement, settlement, or damage to adjacent structures, utilities, and landscaping features and parts of building to remain in place. Provide bracing and shoring required.
 - .2 Keep noise, dust, and inconvenience to occupants to minimum.
 - .3 Protect building systems, services and equipment.
 - .4 Provide temporary dust screens, covers, railings, supports and other protection as required.
- .2 Demolition/Removal:
 - .1 Remove items as indicated.
 - .2 Items to be salvaged: to be determined by the Departmental Representative.
 - .3 Do not disturb items designated to remain in place.
- .3 Disposal of Material:
 - .1 Dispose of materials not designated for salvage or re-use, off-site, any costs to be included in Tender.
- .4 Trim edges of partially demolished building elements to tolerances as defined by Departmental Representative to suit future use.

3.4 RESTORATION

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

3.5 CLEANING

- .1 Progress Cleaning: Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment.

END OF SECTION

**APPENDIX – FORM 588 –
HALOCARBON SERVICE REPORT**



HALOCARBON SERVICE REPORT RAPPORT D'ENTRETIEN DES HALOCARBURES

A. GENERAL INFORMATION - INFORMATION GÉNÉRALE

DFRP No. - N° du RBIF	Building No. - N° de l'immeuble
Name and Address of System Owner Nom et adresse du propriétaire du système	Facility Name and Civic Address Nom et adresse municipale de l'immeuble
Location of System (floor & room no.) Emplacement du système (étage et n° de pièce)	Operator Name Nom de l'opérateur

B. DESCRIPTION OF SYSTEM - DESCRIPTION DU SYSTÈME

Type of System Type de système	<input type="checkbox"/> Air Conditioning Climatisation	<input type="checkbox"/> Refrigeration Réfrigération	<input type="checkbox"/> Fire-extinguishing Extinction d'incendie
Manufacturer - Fabricant	Model No. - N° du modèle	Serial No. - N° de série	
Type of Halocarbon - Type d'halocarbure	Model No. - N° du modèle	Serial No. - N° de série	
Charging/design cap. of syst. - Cap. de charge/conception du syst. _____ <input type="checkbox"/> kg <input type="checkbox"/> lbs livres	Refrigeration Capacity - Capacité de réfrigération _____ <input type="checkbox"/> kW <input type="checkbox"/> Ton Tonnes <input type="checkbox"/> BTU/h		

C. CERTIFIED TECHNICIAN - TECHNICIEN CERTIFIÉ

Name of Certified Technician Nom du technicien certifié	Name of Technician's Employer Nom de l'employeur du technicien
Trade Qualification Certificate No. N° du certificat de qualification professionnelle	Environmental Awareness Certificate No. N° de certificat du cours de sensibilisation à l'environnement
Certified Technician Signature Signature du technicien certifié	Service Date - Date du service

D. LEAK TEST NOTICE - AVIS D'ESSAI DE DÉTECTION DES FUITES

Activity - Activité	Yes Oui	No Non	Date (Y-A-MM-D-J)
Leak test performed Essai de détection des fuites effectué	<input type="checkbox"/>	<input type="checkbox"/>	
Passed Réussi	<input type="checkbox"/>	<input type="checkbox"/>	
Leak detected Fuite détectée	<input type="checkbox"/>	<input type="checkbox"/>	
Leak repaired Fuite réparée	<input type="checkbox"/>	<input type="checkbox"/>	
Leak component isolated Composant qui fuit isolé	<input type="checkbox"/>	<input type="checkbox"/>	
Date of the previous test (1) Date de l'essai précédent (1)	Contractor Service Report No. N° du rapport d'entretien de l'entrepreneur		
Date of the previous test (2) Date de l'essai précédent (2)	Contractor Service Report No. N° du rapport d'entretien de l'entrepreneur		

D. LEAK TEST NOTICE - AVIS D'ESSAI DE DÉTECTION DES FUITES

Amount of halocarbon - Quantité d'halocarbure	Yes Oui	No Non	Date (Y-A-MM-D-J)
Charged Chargée <input type="checkbox"/> kg <input type="checkbox"/> lbs livres	<input type="checkbox"/>	<input type="checkbox"/>	
Recovered Récupérée <input type="checkbox"/> kg <input type="checkbox"/> lbs livres	<input type="checkbox"/>	<input type="checkbox"/>	
Released Rejetée <input type="checkbox"/> kg <input type="checkbox"/> lbs livres	<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/> This unit no longer contains halocarbon Cette unité ne contient plus d'halocarbure			

E. HALOCARBON RELEASE REPORT - RAPPORT SUR LES REJETS D'HALOCARBURES (See instructions - Voir Instruction)

ECCCC reference No. No. de référence d'ECCC		
Quantity of halocarbon released Quantité d'halocarbure rejeté _____ <input type="checkbox"/> kg <input type="checkbox"/> lbs livres		Date of release detected Date de la détection du rejet
Circumstances leading to the release Circonstances ayant mené au rejet	Corrective action Mesures correctives	Actions to prevent subsequent releases Préventives pour éviter d'autres rejets

**F. REMOVAL OF HALOCARBON CONTAINING EQUIPMENT
RETRAIT DE MATÉRIEL CONTENANT DES HALOCARBURES**

<input type="checkbox"/> Short term on site storage (4 months or so) Entreposage sur les lieux à court terme (4 mois ou moins)	<input type="checkbox"/> Long term storage (more than 4 months) Entreposage à long terme (plus de 4 mois)
<input type="checkbox"/> Transfer of ownership Transfert de propriété	<input type="checkbox"/> Dismantling, decommissioning or destroying Désassemblage, mise hors service ou destruction
Name and address of final destination of the system Nom et adresse de la destination finale du système	Name and address of final destination of the halocarbon Nom et adresse de la destination finale de l'halocarbure
Amount of halocarbon recovered Montant d'halocarbure récupérée _____ <input type="checkbox"/> kg <input type="checkbox"/> lbs livres	Date recovered Date de la récupération ►
<input type="checkbox"/> This unit no longer contains any halocarbon Cette unité ne contient plus d'halocarbure	
THIS NOTICE MUST NOT BE REMOVED FROM THE EQUIPMENT/SYSTEM UNLESS A NEW NOTICE IS AFFIXED (D & F only) RECORDS MUST BE KEPT FOR 5 YEARS	CET AVIS NE DOIT PAS ÊTRE RETIRÉ DU MATÉRIEL/SYSTÈME À MOINS QU'UN NOUVEL AVIS SOIT APOSÉ (D ET F seulement) LES DOSSIERS DOIVENT ÊTRE CONSERVÉS PENDANT 5 ANS
Comments - Commentaires	

- Affix on system/component
Apposer sur le système/composant
- Attach to the Service Log for a Refrigeration, Air Conditioning or Fire Extinguishing System (ELF 67)
Joindre au Registre d'entretien d'un système de réfrigération, de climatisation ou d'extinction d'incendie (FEL 67)

1 ton/tonne Refrigeration = 12,000 BTU/h = 3.5 kW 19 kW = 5.4 ton/tonnes 1 lb = 0.454 kg 1 oz. = 0.02835 kg

INSTRUCTIONS

Purpose

In accordance with FHR 2003, the Halocarbon Service Report is used whenever halocarbon containing equipment is serviced, leak-tested, charged, removed from service or if any other work is performed on it.

Objectif

En conformité avec le RFH 2003, l'avis d'entretien pour l'équipement contenant des halocarbures est utilisé chaque fois qu'un système est réparé, essai de détection des fuites, chargé, mise hors service ou si tout autre travail est effectué sur le système.

Section - Partie	Field - Champ	Information
Top right box Boîte à la droite en haut	Service Report No. N° de rapport de service	A number that references the Service Technician's Service Report
		Un numéro qui fait référence au rapport de service du technicien de service
A. General Information Information générale	DFRP No. N° de RBIF	Enter the Directory of Federal Real Property (DFRP) number which may be accessed at http://www.tbs-sct.gc.ca/dfrp-rbif/home-accueil-eng.aspx
		Entrez le numéro du Répertoire des biens immobiliers fédéraux (RBIF) qui peut être consulté à http://www.tbs-sct.gc.ca/dfrp-rbif/home-accueil-fra.aspx
	Building No. N° du bâtiment	Where a DFRP number refers to multiple buildings, indicate the building number which is found on the DFRP website (link above)
		Où un numéro du RBIF réfère à plusieurs bâtiments, indiquez le numéro de bâtiment qui se trouve sur le site-web du RBIF (lien ci-dessus)
	Name and address of system owner Nom et adresse du propriétaire du système	Asset Ownership and Management Type
		Government Services and Procurement Canada (PSPC) owned and PSPC managed
		Name: PSPC Address: civic address where the system is located
		PSPC owned and Real Property Contractor (RPC) managed
		This form does not apply as the RPC is required to use their own form
		OGD owned and PSPC managed
		Name: OGD Address: civic address where the system is located
		OGD owned and RPC managed
		This form does not apply as the RPC is required to use their own form
		PSPC leased
		Name: Building owner Address: civic address where the system is located
		Type de propriété et de gestion du bien
		Nom et adresse
		Appartenant à Service publics et Approvisionnement Canada (SPAC) et géré par celui-ci
		Nom : SPAC Adresse : adresse civique où le système est situé
		Appartenant à SPAC et géré par l'entrepreneur des Biens immobiliers
		Ce formulaire ne s'applique pas car l'entrepreneur des Biens immobiliers utilise son propre formulaire
		Appartenant à un autre ministère et géré par SPAC
		Nom : nom de l'autre ministère Adresse : adresse civique où le système est situé
		Appartenant à un autre ministère et géré par l'entrepreneur des Biens immobiliers
		Ce formulaire ne s'applique pas car l'entrepreneur des Biens immobiliers utilise son propre formulaire
		Loué par SPAC
		Nom : Propriétaire du bâtiment Adresse : adresse civique où le système est situé
	Name of Operator Nom de l'opérateur	For PSPC managed, enter PSPC For RPC managed, this form does not apply
		Pour les sites gérés par SPAC, entrez SPAC Pour les sites gérés par un entrepreneur des Biens immobiliers, ce formulaire ne s'applique pas

Section - Partie	Field - Champ	Information
B. Description of System Description du système	Charging/design cap. of syst. Cap. de charge/conception du syst.	Refers to the maximum capacity that the system was designed for. Charging capacity is also known as design capacity
		Réfère à la capacité maximale pour laquelle le système a été conçu. La capacité de charge est également connue comme la capacité de conception
	Refrigeration capacity Capacité de réfrigération	Refrigeration capacity is also known as cooling capacity
		La capacité de refroidissement est également connue comme la capacité de réfrigération
C. Certified Technician Technicien certifié	Environmental awareness certificate No. N° de certificat de sensibilisation à l'environnement	Training that is required to be considered as a certified person under the <i>Federal Halocarbon Regulations, 2003</i> . An environmental awareness training program is available in all provinces. This training complements, but does not replace trade qualifications
		Formation qui est nécessaire pour être considéré comme une personne certifiée en vertu du Règlement fédéral sur les halocarbures, 2003. Un programme de formation de sensibilisation environnementale est disponible dans toutes les provinces. Cette formation vient compléter, mais ne remplace pas, les qualifications professionnelles
	Trade qualification certificate No. N° d'accréditation professionnelle	Refers to the provincial trade certification received by a technician for successfully completing an Ozone Depleting Substances (ODS) course in all provinces except Ontario or an Ozone Depleting Prevention (ODP) course in Ontario
		Fait référence à la certification de qualification provinciale reçue par un technicien pour avoir complété avec succès un cours sur les substances appauvrissant la couche d'ozone (dans tous les provinces sauf Ontario) ou un cours pour la prévention d'un appauvrissement de la couche d'ozone (en Ontario)
	Service Report Number N° du rapport de service	A number that references the Service Technician's Service Report
		Un numéro qui fait référence au rapport du technicien de service
E. Halocarbon release report Rapport sur les rejets d'halocarbures	N/A	<p>For halocarbon releases over 100 kg (or of unknown quantities that could exceed 100 kg):</p> <ul style="list-style-type: none"> • Within 24 hours of release: Call the regional Environment and Climate Change Canada (ECCC) contact to report the release: NB, PE, NS: 1-800-565-1633 or (902) 426-6030 NL: 1-800-563-9089 or (709) 772-2083 QC: 1-866-283-2333 or (514) 283-2333 ON: 1-800-268-6060 or (416) 325-3000 MB: (204) 944-4888 SK: 1-800-667-7525 AB: (780) 422-4505 or 1-800-222-6514 NT, NU: (867) 920-8130 BC: 1-800-663-3456 YT: (867) 667-7244 • Record the ECCC reference number in section E • Call the National Service Call Centre (NSCC) at 1-800-463-1850 to report the release • Within 14 days of release: Submit section A, B, C and E of this report electronically to the regional Environment and Climate Change Canada (ECCC) contact NB, PE, NS, NL: fh2003@ec.gc.ca QC: ec.installationsfederalesqc-federalfacilitiesqc.ec@canada.ca ON: ec.fhr.ontario.ec@canada.ca MB, SK, AB, NT, NU: ec.rfh2003.dale-rpn-fhr2003.eed-pnr.ec@canada.ca BC, YT: 1-800-663-3456 FHR.PYR@ec.gc.ca • Forward email notification from item 4 (with the completed Halocarbon Service Report) to the regional subject matter expert for halocarbon management within 14 days. <p>For releases between 10 and 100 kg:</p> <ul style="list-style-type: none"> • Within 14 days of release: Call the NSCC at 1-800-463-1850 to report the release • Within 14 days of release being detected: Submit section A, B, C and E of this report electronically to the regional subject matter expert for halocarbon management

Section - Partie	Field - Champ	Information
E. Halocarbon release report Rapport sur les rejets d'halocarbures	S/O	<p>Pour les fuites d'halocarbures de plus de 100 kg (ou de quantités inconnues pouvant dépasser 100 kg) :</p> <ul style="list-style-type: none"> · Dans les 24 heures du rejet : appeler la personne-ressource d'Environnement et Changement climatique Canada de votre région pour signaler la fuite : NB, PE, NS : 1-800-565-1633 ou (902) 426-6030 NL : 1-800-563-9089 ou (709) 772-2083 QC : 1-866-283-2333 ou (514) 283-2333 ON : 1-800-268-6060 ou (416) 325-3000 MB : (204) 944-4888 SK : 1-800-667-7525 AB : (780) 422-4505 ou 1-800-222-6514 NT, NU : (867) 920-8130 BC : 1-800-663-3456 YT : (867) 667-7244 · Enregistrer le numéro de référence d'ECCC dans le section E. · Appeler le Centre national d'appel de service (CNAS) au 1-800-463-1850 pour signaler la fuite. · Dans les 14 jours du rejet : STransmettre les sections A, B, C et E de ce rapport à la personne-ressource d'Environnement et Changement climatique Canada de votre région. NB, PE, NS, NL : fhr2003@ec.gc.ca QC : ec.installationsfederalesqc-federalfacilitiesqc.ec@canada.ca ON : ec.fhr.ontario.ec@canada.ca MB, SK, AB, NT, NU : ec.rfh2003.dale-rpn-fhr2003.eed-pnr.ec@canada.ca BC, YT : 1-800-663-3456 FHR.PYR@ec.gc.ca · Transmettre l'avis par courriel du point 4 (ainsi que le Rapport d'entretien des halocarbures dûment rempli) à l'expert en gestion d'halocarbures de SPAC de votre région. <p>Pour les fuites d'halocarbures entre 10 et 100 kg</p> <ul style="list-style-type: none"> · Dans les 24 heures suivant la détection d'une fuite: Appeler le CNAS au 1-800-463-1850 pour signaler la fuite. · Dans les 14 jours suivant la détection d'une fuite: Transmettre les sections A, B, C et E de ce rapport et le soumettre à l'expert en gestion d'halocarbures de SPAC de votre région pour inclusion dans le rapport semi-annuel sur les halocarbures de SPAC.

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 23 81 40 – Air and Water Source Unitary Heat Pumps.

1.2 REFERENCES

- .1 Underwriters Laboratory of Canada (ULC):
 - .1 CAN/ULC-S107-10, Method of Fire Tests of Roof Coverings.
 - .2 CAN/ULC-S704-11, Standard for Thermal Insulation, Polyurethane and Polyisocyanurate Boards, Faced.
- .2 American Society of Testing and Materials International (ASTM):
 - .1 ASTM E96/E96M-13, Standard Test Methods for Water Vapor Transmission of Materials.
 - .2 ASTM C-578-19, Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation
 - .3 ASTM C1177/C1177M-13, Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing.
 - .4 ASTM D41-11(2016), Standard Specification for Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing.
 - .5 ASTM D448-12(2017), Standard Classification for Sizes of Aggregate for Road and Bridge Construction
 - .6 ASTM D6163/D6163M-16, Standard Specification for Styrene Butadiene Styrene (SBS) Modified Bituminous Sheet Materials Using Glass Fibre Reinforcements.
 - .7 ASTM D6164/6164M-16, Standard Specification for Styrene Butadiene Styrene (SBS) Modified Bituminous Sheet Materials Using Polyester Reinforcements.
- .3 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-1.108-M89, Bituminous Solvent Type Paint.
 - .2 CAN/CGSB-37.29-M89, Rubber-Asphalt Sealing Compound.
 - .3 CGSB 37-GP-56M-80, Membrane, Modified, Bituminous, Prefabricated and Reinforced for Roofing.
- .4 Canadian Standards Association (CSA)
 - .1 CSA O121-08 (R2013), Douglas Fir Plywood.
 - .2 CSA O151-09 (R2014), Canadian Softwood Plywood.
 - .3 CSA A123.21-10, Standard test method for the dynamic wind uplift resistance of membrane-roofing systems.
- .5 Canadian Roofing Contractors Association (CRCA)
 - .1 Canadian Roofing Reference Manual, latest edition.

1.3 SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Provide most recent technical product data including product characteristics, performance criteria, physical size, finish and limitations.
 - .1 Organize product data based on sequential installation or materials starting at deck covering and continuing in order to membrane. Include accessories after membrane.
 - .2 Manufacturer's installations instructions.
 - .3 Manufacturer's certificate: certify that products meet or exceed specified requirements.
 - .4 Contractor and Manufacturer's warranty certificate.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Transport, store and handle materials in accordance with Section 01 61 00 – Common Product Requirements.
- .2 Shipping and receiving: deliver material to site in the original packaging, which must bear the name and address of the manufacturer.
- .3 Waste management and disposal:
- .4 Separate waste materials for reuse/recycling in accordance with Section 01 74 19 – Waste Management and Disposal.
 - .1 Remove from site and dispose of packaging materials at appropriate recycling facilities.
 - .2 Collect and separate for disposal paper, plastic, polystyrene and corrugated cardboard packaging material for recycling in accordance with the waste management plan.
 - .3 Separate steel, metal and plastic materials in designated containers for recycling in accordance with the waste management plan.
 - .4 Divert unused metal materials from landfill to metal recycling facility.

1.5 SITE CONDITIONS

- .1 Do not install roofing when temperature remains below -18 C for torch application, or to manufacturers' recommendations for mop application.
- .2 Minimum temperature for solvent-based adhesive is -5 C or otherwise specified by the manufacturer.
- .3 Install roofing on dry deck, free of snow and ice, use only dry materials and apply only during weather that will not introduce moisture into roofing system.
- .4 All adjacent parts of the building shall be protected from damage caused by roofing operations. Cover walls and other surfaces in the vicinity of hoisting apparatus with heavy canvas or other suitable protective material. Damage shall be repaired to match the original materials and appearance.

- .5 Conduct operations so as to leave deck exposed for minimum period of time and no more than can be completely waterproofed in the same day. Protect as required to prevent infiltration or environmental damage to building interior.
- .6 Insulation shall not be left exposed to the elements nor shall more be laid than can be completely covered in the same day.
- .7 Strictly adhere to all safety guidelines for the torching of Modified Bituminous Membrane.

Part 2 PRODUCTS

2.1 PRIMER

- .1 Primer composed of SBS synthetic rubber, adhesive resins and VOC-free solvents used to improve adhesion of membranes.

2.2 ADHESIVE

- .1 Single component polyurethane adhesive formulated to adhere insulation to substrate as approved by manufacturer.

2.3 INSULATION

- .1 Polyisocyanurate, foam core bonded on each side to inorganic coated polymer bonder glass fibre mat facers on both major surfaces.
 - .1 Minimum long-term thermal resistance: 4.16 per 100mm.

2.4 MEMBRANE

- .1 Membrane System: Two-ply system made from prefabricated modified bitumen membranes containing a minimum of 15% elastomer Styrene Butadiene Styrene (SBS) and reinforced with non-flammable, fireproof and stress resistant insert of glass fibre or polyester in accordance with ASTM D6163/6163M or ASTM D6164/6164M. Membranes employing a combined reinforcement in a ply are not acceptable.
- .2 Base sheet membrane: to CGSB37-GP-56M.
 - .1 Styrene-Butadiene-Styrene (SBS) prefabricated sheet:
 - .1 Minimum thickness: 2.5mm.
 - .2 Strain energy (longitudinal/transversal): 7.8/7.2 kN/m.
 - .3 Breaking strength (longitudinal/transversal): 15.0/13.5N 5 cm.
 - .4 Ultimate elongation (longitudinal/transversal): 60/65%.
 - .5 Tear resistance: 125N.
 - .6 Cold bending at -30°C: no cracking.
- .3 Cap sheet membrane: to CGSB37-GP-56M.
 - .1 Styrene-Butadiene-Styrene (SBS) prefabricated sheet:
 - .1 Minimum thickness: 4.0mm.
 - .2 Strain energy (longitudinal/transversal): 7.8/7.2 kN/m.
 - .3 Breaking strength (longitudinal/transversal): 15.0/13.5 kN/m.

- .4 Ultimate elongation (longitudinal/transversal): 60/65 %.
 - .5 Tear resistance: 125 N.
 - .6 Cold bending at -30 degrees C: No cracking.
 - .7 Softening point: 110 degrees C.
 - .8 Static puncture resistance: > 400.
 - .9 Dimensional Stability: -0.2 /0.2%.
- .4 Cap Sheet Flashing: to CGSB37-GP-56M.
- .1 To be reinforced with non-woven polyester mat with a minimum membrane thickness of 4 mm. Top face shall be covered with granules.

2.5 BALLAST:

- .1 Stockpile existing gravel ballast for reuse, assume 80% reusable.
- .2 Gravel ballast to ASTM D448, Gradation 57 opaque, non-porous, washed, free from fines particles, long splinters, moisture, ice, and snow.

2.6 SHEATHING AND NAILS

- .1 Sheathing:
 - .1 Douglas Fir Plywood grade meeting the requirements of CSA O121.
 - .2 Canadian Softwood Plywood grade meeting the requirements of CSA O151.
- .2 Nails: 2.5" common round steel wire nails or pneumatic nails (p nails).
 - .1 Common nail diameter 0.128" (3.25mm)
 - .2 P nail diameter 0.131" (3.33mm)

2.7 PROTECTION BOARD

- .1 For application over membrane system and under insulation:
 - .1 Multi-ply, semi-rigid asphalt protection board with non-woven glass facer, thickness to match existing.
 - .2 Asphalt impregnated fiberboard to CAN/ULC-S706, thickness to match existing.

2.8 FABRIC

- .1 UV resistant, black woven polyolefin fabric for installation between insulation and stone ballast. Fabric to meet recommendation of insulation manufacturer.

2.9 FLASHING AND TRIM

- .1 Prefinished metallic-coated sheet steel: 0.71mm thickness, hot-dip process and prepainted by the coil-coating process to comply with ASTM A 755/A 755M, factory-applied epoxy primer and silicone modified polyester (SMP) topcoat.
- .2 All flashings and trims to closely match existing.

2.10 CABLE PENETRATION GOOSENECK STANDPIPE

- .1 Construction:
 - .1 Aluminum base standpipe
 - .2 Solvent welded PVC hooded outlet
 - .3 3 cable openings plus 3 additional knockouts
 - .4 Minimum height 450 mm above membrane to cable gland
- .2 Size:
 - .1 Overall Height: 550 mm minimum
 - .2 Flange Diameter: 260 mm
 - .3 Opening Above Deck: 490 mm minimum
 - .4 Flashing Width: 100 mm minimum

Part 3 Execution

3.1 GENERAL

- .1 All work to be done in accordance with related codes and regulations and as per the manufacturer's recommended installation instructions. If conflicts arise between standards, the more stringent is to apply.
- .2 Patching of the cap sheet membrane shall be carried out utilizing patches with a minimum size of 450 mm by 450 mm.
- .3 Minimum length of cap sheet on flat run of roof shall not be less than 1000 mm.
- .4 Wrinkled or deformed ends of cap sheet rolls will not be tolerated and therefore must be discarded prior to application.
- .5 Splices in delivered rolls of membrane shall be removed. Cut back the roll 450 mm on both sides of the splice and remove prior to installation.

3.2 DECK COVERING (MECHANICALLY FASTENED)

- .1 The deck covering is to be mechanically fastened to the substrate.
- .2 Place with long axis of each sheet transverse to steel deck ribs, with end joints staggered and fully supported on ribs.
- .3 Mechanically fasten Plywood Sheathing with screws to steel supports, spaced at 400 mm on center or as otherwise required to meet wind uplift requirements.

3.3 FLASHING

- .1 Complete installation of flashing base sheet stripping prior to installing membrane cap sheet.
- .2 Adhere base sheet flashing and torch cap sheet flashing onto substrate in 1 m wide strips.
- .3 Lap flashing base sheet to membrane base sheet minimum 150 mm and seal by mopping or torch welding.
- .4 Lap flashing cap sheet to membrane cap sheet 250 mm minimum and torch weld.

- .5 Provide 75 mm minimum side lap and seal.
- .6 Properly secure flashings to their support, without sags, blisters, fishmouths or wrinkles.
- .7 Do work in accordance with manufacturer's instructions.

3.4 ROOF PENETRATIONS

- .1 Install roof drain pans, vent stack covers and other roof penetration flashings and seal to membrane in accordance with manufacturer's recommendations and details.
- .2 Extend existing vent pipes as required to a minimum height of 350 mm above the completed membrane surface. Provide sufficient allowance for pipe expansion or contraction.
- .3 Prime the aluminum flange, and centre over existing vent stack. Set the flange into a coat of hot asphalt on top of the base sheet. Flash with one ply of base-sheet flashing membrane, for reinforcement, to extend a minimum of 200 mm beyond flange. Complete installation with application of the cap sheet membrane.
- .4 Install batt insulation between vent stack and aluminum stack flashing. Install fire resistant batt insulation at hot pipes.

3.5 BASE SHEET APPLICATION (HEAT-WELDING)

- .1 The base sheet will be heat-welded onto the primer-coated substrate in conformance with the manufacturers' recommendations.
- .2 Unroll membrane onto substrate for alignment purposes and allow time to relax prior heat-welding.
- .3 Starting at the low point of the roof, lay out the membrane to ensure the plies are installed perpendicular to the roof slope, shingled to prevent back-water laps
- .4 Overlap side laps by 75 mm and end laps by 150 mm. Laps shall be staggered a minimum of 900 mm apart.
- .5 Torch the membrane until visible beads of bitumen appear on the surface to ensure that there is complete vapour barrier adherence.
- .6 Application to be free of blisters, wrinkles and fishmouths
- .7 Do work in accordance with manufacturer's instructions.

3.6 CAP SHEET APPLICATION (HEAT-WELDED)

- .1 The cap sheet will be heat-welded onto the base sheet in conformance with the manufacturer's recommendations.
- .2 Unroll membrane onto base membrane for alignment purposes and allow time to relax prior heat-welding.
- .3 Starting at the low point of the roof, lay out the membrane to ensure the plies are installed perpendicular to the roof slope, shingled to prevent back-water laps
- .4 Overlap side laps by 75 mm and end laps by 150 mm. Laps shall be staggered a minimum of 900 mm apart. Stagger cap sheet side and end laps away from base sheet laps a minimum of 450 mm apart.

- .5 Torch the membrane until visible beads of bitumen appear on the surface to ensure that there is complete vapour barrier adherence.
- .6 Application to be free of blisters, wrinkles and fishmouths.
- .7 Do work in accordance with manufacturer's instructions.

3.7 PROTECTION BOARD

- .1 Embed the protection board into the freshly torched membrane.

3.8 INSULATION

- .1 Place insulation loose laid in parallel rows with ends staggered.

3.9 FILTER FABRIC

- .1 Apply continuous layer of filter fabric unbounded, lapping joints 300 mm minimum.
- .2 Cut fabric around drains, vents and other penetrations and extend up protrusions and place under metal flashings.

3.10 BALLAST

- .1 Apply stone ballast, dry, as soon as possible after placement of fabric, following insulation manufacturer's recommendations.
- .3 Spread stone ballast to an even thickness over entire roof area.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 Master Painters Institute (MPI)
 - .1 MPI Architectural Painting Specifications Manual, 2019.
- .2 National Fire Code of Canada - 2015
- .3 Society for Protective Coatings (SSPC)
 - .1 SSPC Painting Manual, Volume Two, 8th Edition, Systems and Specifications Manual-2011.

1.2 SCHEDULING

- .1 Submit work schedule for various stages of painting to Departmental Representative for review. Submit schedule minimum of 48 hours in advance of proposed operations.
- .2 Obtain written authorization from Departmental Representative for changes in work schedule.
- .3 Schedule painting operations to prevent disruption of occupants.

1.3 SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Product Data:
 - .1 Submit product data and instructions for each paint and coating product to be used.
 - .2 Submit product data for the use and application of paint thinner.
 - .3 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 01 33 00 – Submittal Procedures. Indicate VOCs during application and curing.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Packing, Shipping, Handling and Unloading: Pack, ship, handle and unload materials in accordance with Section 01 61 00 – Common Product Requirements and manufacturer's written instructions.
- .2 Acceptance at Site:
 - .1 Identify products and materials with labels indicating:
 - .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.
- .3 Remove damaged, opened and rejected materials from site.

- .4 Storage and Protection:
 - .1 Provide and maintain dry, temperature controlled, secure storage.
 - .2 Store materials and supplies away from heat generating devices.
 - .3 Store materials and equipment in well ventilated area with temperature range 7 degrees C to 30 degrees C.
- .5 Store temperature sensitive products above minimum temperature as recommended by manufacturer.
- .6 Keep areas used for storage, cleaning and preparation clean and orderly. After completion of operations, return areas to clean condition.
- .7 Remove paint materials from storage only in quantities required for same day use.
- .8 Waste Management and Disposal:
 - .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 19 – Waste Management and Disposal.
 - .2 Remove from site and dispose of packaging materials at appropriate recycling facilities.
 - .3 Collect and separate for disposal paper, plastic, polystyrene, corrugated cardboard packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan (WMP).
 - .4 Separate for reuse and recycling and place in designated containers Steel, Metal, and Plastic waste in accordance with Waste Management Plan (WMP).
 - .5 Place materials defined as hazardous or toxic in designated containers.
 - .6 Handle and dispose of hazardous materials in accordance with CEPA, TDGA, regulations.
 - .7 Ensure emptied containers are sealed and stored safely.
 - .8 Paint, stain and wood preservative finishes and related materials (thinners, and solvents) are regarded as hazardous products and are subject to regulations for disposal. Information on these controls can be obtained from Provincial Ministries of Environment and Regional levels of Government.
 - .9 Material which cannot be reused must be treated as hazardous waste and disposed of in an appropriate manner.
 - .10 Place materials defined as hazardous or toxic waste, including used sealant and adhesive tubes and containers, in containers or areas designated for hazardous waste.
 - .11 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).

1.5 SITE CONDITIONS

- .1 Heating, Ventilation and Lighting:
 - .1 Provide heating facilities to maintain ambient air and substrate temperatures above 10 degrees C for 24 hours before, during and after paint application until paint has cured sufficiently.
 - .2 Provide continuous ventilation for seven days after completion of application of paint.
 - .3 Provide temporary ventilating and heating equipment where permanent facilities are not available.
 - .4 Provide minimum lighting level of 323 Lux on surfaces to be painted.
- .2 Temperature, Humidity and Substrate Moisture Content Levels:
 - .1 Unless pre-approved written approval by Paint Inspection Agency Authority and product manufacturer, perform no painting when:
 - .1 Ambient air and substrate temperatures are below 10 degrees C.
 - .2 Substrate temperature is above 32 degrees C unless paint is specifically formulated for application at high temperatures.
 - .3 Substrate and ambient air temperatures are not expected to fall within MPI or paint manufacturer's prescribed limits.
 - .4 The relative humidity is under 85% or when the dew point is more than 3 degrees C variance between the air/surface temperature. Paint should not be applied if the dew point is less than 3 degrees C below the ambient or surface temperature. Use sling psychrometer to establish the relative humidity before beginning paint work.
 - .5 Rain or snow are forecast to occur before paint has thoroughly cured or when it is foggy, misty, raining or snowing at site.
 - .6 Ensure that conditions are within specified limits during drying or curing process, until newly applied coating can itself withstand 'normal' adverse environmental factors.
 - .2 Perform painting work when maximum moisture content of the substrate is below:
 - .1 Allow new concrete and masonry to cure minimum of 28 days.
 - .2 15% for wood.
 - .3 12% for plaster and gypsum board.
 - .3 Test for moisture using calibrated electronic Moisture Meter. Test concrete floors for moisture using "cover patch test".
 - .4 Test concrete, masonry and plaster surfaces for alkalinity as required.
- .3 Surface and Environmental Conditions:
 - .1 Apply paint finish 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 to adequately prepared surfaces and to surfaces within moisture limits.

- .3 Apply paint when previous coat of paint is dry or adequately cured.
- .4 Additional interior application requirements:
 - .1 Apply paint finishes when temperature at location of installation can be satisfactorily maintained within manufacturer's recommendations.

Part 2 Products

2.1 STEEL STUDS

2.2 Non-load bearing Steel Framing, General

- .1 Steel sheet components shall comply with ASTM C645 requirements for metal, unless otherwise indicated.
- .2 Steel for non-load bearing members shall have metallic coatings that conform to ASTM A653M with minimum metallic coating weights (mass) of Z120 and AZM150 respectively.

2.3 STANDARD GYPSUM BOARD

- .1 Panel Physical Characteristics
 - .1 Core: Regular gypsum core
 - .2 Surface Paper: 100 percent recycled content paper on front, back and long edges
 - .3 Long Edges: Tapered
 - .4 Overall thickness: 12mm
 - .5 Panel complies with requirements of ASTM C 1396

2.4 MATERIALS

- .1 Paint materials listed in the MPI Approved Products List (APL) are acceptable for use on this project.
- .2 Provide paint materials for paint systems from single manufacturer.
- .3 Only qualified products with E2 "Environmentally Friendly" rating are acceptable for use on this project. (or meet provisions of GS-11, GS-03 and SCAQMD Rule #1113, whichever is more stringent).
- .4 Conform to latest MPI requirements for interior painting work including preparation and priming.
- .5 Materials (primers, paints, coatings, varnishes, stains, lacquers, fillers, thinners, solvents, etc.) in accordance with MPI Architectural Painting Specification Manual "Approved Product" listing.

2.5 COLOURS

- .1 Colours are to match existing.
- .2 Selection of colours from manufacturer's full range of colours.
- .3 Where specific products are available in restricted range of colours, selection based on limited range.

- .4 Second coat in three coat system to be tinted slightly lighter colour than top coat to show visible difference between coats.

2.6 MIXING AND TINTING

- .1 Perform colour tinting operations prior to delivery of paint to site. Obtain written approval from Departmental Representative for tinting of painting materials.
- .2 Use and add thinner in accordance with paint manufacturer's recommendations. Do not use kerosene or similar organic solvents to thin water-based paints.
- .3 Thin paint for spraying in accordance with paint manufacturer's instructions.
- .4 Re-mix paint in containers prior to and during application to ensure break-up of lumps, complete dispersion of settled pigment, and colour and gloss uniformity.

2.7 INTERIOR PAINTING SYSTEMS

- .1 vertical surfaces:
 - .1 INT 3. 1A - Latex G3 finish (over sealer).
 - .2 INT 3.1M - Institutional low odour/low VOC G3 finish.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and data sheet.

3.2 GENERAL

- .1 Perform preparation and operations for interior painting in accordance with MPI Architectural Painting Specifications Manual except where specified otherwise.
- .2 Apply paint materials in accordance with paint manufacturer's written application instructions.

3.3 EXAMINATION

- .1 Investigate existing substrates for problems related to proper and complete preparation of surfaces to be painted. Report to Departmental Representative damages, defects, unsatisfactory or unfavourable conditions before proceeding with work.
- .2 Conduct moisture testing of surfaces to be painted using properly calibrated electronic moisture meter, except test concrete floors for moisture using simple "cover patch test". Do not proceed with work until conditions fall within acceptable range as recommended by manufacturer.
- .3 Maximum moisture content as follows:
 - .1 Stucco, plaster and gypsum board: 12%.

3.4 PATCHING OF WALLS

- .1 As required, extend wall tight to new mechanical equipment, building with new steel stud and gypsum. Use joint filler and tape to create smooth transition between existing and new gypsum.

3.5 PREPARATION

- .1 Protection:
 - .1 Protect existing building surfaces and adjacent structures from paint spatters, markings and other damage by suitable non-staining covers or masking. If damaged, clean and restore surfaces as directed by Departmental Representative.
 - .2 Protect items that are permanently attached such as Fire Labels on doors and frames.
 - .3 Protect factory finished products and equipment.
- .2 Surface Preparation:
 - .1 Remove electrical cover plates, light fixtures, surface hardware on doors, bath accessories and other surface mounted equipment, fittings and fastenings prior to undertaking painting operations. Identify and store items in secure location and re-installed after painting is completed.
 - .2 Move and cover furniture and portable equipment as necessary to carry out painting operations. Replace as painting operations progress.
 - .3 Place "WET PAINT" signs in occupied areas as painting operations progress. Signs to approval of Departmental Representative.
- .3 Clean and prepare surfaces in accordance with MPI Architectural Painting Specification Manual requirements. Refer to MPI Manual in regard to specific requirements and as follows:
 - .1 Remove dust, dirt, and other surface debris by wiping with dry, clean cloths or compressed air.
 - .2 Wash surfaces with a biodegradable detergent and clean warm water using a stiff bristle brush to remove dirt, oil and other surface contaminants.
 - .3 Rinse scrubbed surfaces with clean water until foreign matter is flushed from surface.
 - .4 Allow surfaces to drain completely and allow to dry thoroughly.
 - .5 Prepare surfaces for water-based painting, water-based cleaners should be used in place of organic solvents.
 - .6 Use trigger operated spray nozzles for water hoses.
 - .7 Many water-based paints cannot be removed with water once dried. Minimize use of mineral spirits or organic solvents to clean up water-based paints.
- .4 Clean following surfaces with high pressure water washing: concrete block if required.
- .5 Prevent contamination of cleaned surfaces by salts, acids, alkalis, other corrosive chemicals, grease, oil and solvents before prime coat is applied and between applications of remaining coats. Apply primer, paint, or pre-treatment as soon as possible after cleaning and before deterioration occurs.

- .6 Where possible, prime non-exposed surfaces of new wood surfaces before installation. Use same primers as specified for exposed surfaces.
 - .1 Apply vinyl sealer to MPI #36 over knots, pitch, sap and resinous areas.
 - .2 Apply wood filler to nail holes and cracks.
 - .3 Tint filler to match stains for stained woodwork.
- .7 Sand and dust between coats as required to provide adequate adhesion for next coat and to remove defects visible from a distance up to 1000mm.
- .8 Clean metal surfaces to be painted by removing rust, loose mill scale, welding slag, dirt, oil, grease and other foreign substances in accordance with MPI requirements. Remove traces of blast products from surfaces, pockets and corners to be painted by brushing with clean brushes, blowing with clean dry compressed air or vacuum cleaning.
- .9 Touch up of shop primers with primer as specified.

3.6 APPLICATION

- .1 Apply paint by brush, roller, or air sprayer. Conform to manufacturer's application instructions unless specified otherwise.
- .2 Brush and Roller Application:
 - .1 Apply paint in uniform layer using brush and/or roller type suitable for application.
 - .2 Work paint into cracks, crevices and corners.
 - .3 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.
 - .4 Brush and/or roll out runs and sags, and over-lap marks. Rolled surfaces free of roller tracking and heavy stipple.
 - .5 Remove runs, sags and brush marks from finished work and repaint.
- .3 Spray application:
 - .1 Provide and maintain equipment that is suitable for intended purpose, capable of 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 uniform layer, with overlapping at edges of spray pattern. Back roll first coat application.
 - .4 Brush out immediately all runs and sags.
 - .5 Use brushes and rollers to work paint into cracks, crevices and places which are not adequately painted by spray.
- .4 Use dipping, sheepskins or daubers only when no other method is practical in places of difficult access.
- .5 Apply coats of paint continuous film of uniform thickness. Repaint thin spots or bare areas before next coat of paint is applied.

- .6 Allow surfaces to dry and properly cure after cleaning and between subsequent coats for minimum time period as recommended by manufacturer.
- .7 Sand and dust between coats to remove visible defects.

3.7 SITE TOLERANCES

- .1 Walls: no defects visible from a distance of 1000mm at 90 degrees to surface.
- .2 Ceilings: no defects visible from floor at 45 degrees to surface when viewed using final lighting source.
- .3 Final coat to exhibit uniformity of colour and uniformity of sheen across full surface area.

3.8 FIELD QUALITY CONTROL

- .1 Interior painting and decorating work shall be inspected by a Paint Inspection Agency (inspector) acceptable to the specifying authority and local Painting Contractor's Association. Painting contractor shall notify Paint Inspection Agency a minimum of one week prior to commencement of work and provide a copy of project painting specification, plans and elevation drawings (including pertinent details) as well as a Finish Schedule.
- .2 Interior surfaces requiring painting shall be inspected by Paint Inspection Agency who shall notify Departmental Representative and General Contractor in writing of defects or problems, prior to commencing painting work, or after prime coat shows defects in substrate.
- .3 Standard of Acceptance:
 - .1 Walls: no defects visible from a distance of 1000 mm at 90 degrees to surface.
 - .2 Ceilings: no defects visible from floor at 45 degrees to surface when viewed using final lighting source.
 - .3 Final coat to exhibit uniformity of colour and uniformity of sheen across full surface area.
- .4 Field inspection of painting operations to be carried out by independent inspection firm as designated by Departmental Representative.
- .5 Advise Departmental Representative when surfaces and applied coating is ready for inspection. Do not proceed with subsequent coats until previous coat has been approved.
- .6 Cooperate with inspection firm and provide access to areas of work.
- .7 Retain purchase orders, invoices and other documents to prove conformance with noted MPI requirements when requested by Departmental Representative.

3.9 RESTORATION

- .1 Clean and re-install 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 Departmental Representative. 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.

END OF SECTION

Part 1 General

1.1 SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for mechanical equipment, materials and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop drawings:
 - .1 Drawings to show:
 - .1 Mounting arrangements.
 - .2 Operating and maintenance clearances.
 - .2 Drawings and product data accompanied by:
 - .1 Detailed drawings of bases, supports, and anchor bolts.
 - .2 Acoustical sound power data, where applicable.
 - .3 Points of operation on performance curves.
 - .4 Manufacturer to certify current model production.
 - .5 Certification of compliance to applicable codes.
 - .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 for all equipment for incorporation into manual.
 - .1 Operation and maintenance manual approved by, and final copies deposited with, the Departmental Representative before final inspection.
 - .2 Operation data to include:
 - .1 Control schematics for systems including environmental controls.
 - .2 Description of systems and their controls.
 - .3 Description of operation of systems at various loads together with reset schedules and seasonal variances.
 - .4 Operation instruction for systems and component.
 - .5 Description of actions to be taken in event of equipment failure.
 - .3 Maintenance data to include:
 - .1 Servicing, maintenance, operation and trouble-shooting instructions for each item of equipment.
 - .2 Data to include schedules of tasks, frequency, tools required and task time.

- .4 Performance data to include:
 - .1 Equipment manufacturer's performance datasheets with point of operation as left after commissioning is complete.
 - .2 Equipment performance verification test results.
 - .3 Special performance data as specified.
 - .4 Testing, adjusting and balancing reports as specified in Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.
- .5 Approvals:
 - .1 Submit 2 copies of draft Operation and Maintenance Manual to Departmental Representative for approval. Submission of individual data will not be accepted unless directed by Departmental Representative.
 - .2 Make changes as required and re-submit as directed by Departmental Representative.
- .6 Additional data:
 - .1 Prepare and insert into operation and maintenance manual additional data when need for it becomes apparent during specified demonstrations and instructions.
- .7 Site records:
 - .1 Departmental Representative 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 Transfer information weekly to reproducibles, revising reproducibles to show work as actually installed.
 - .3 Use different colour waterproof ink for each service.
 - .4 Make available for reference purposes and inspection.
- .8 As-Built drawings:
 - .1 Prior to start of Testing, Adjusting and Balancing for HVAC, finalize production of as-built drawings.
 - .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).
 - .3 Submit to Departmental Representative for approval and make corrections as directed.
 - .4 Perform testing, adjusting and balancing for HVAC using as-built drawings.
 - .5 Submit completed reproducible as-built drawings with Operating and Maintenance Manuals.
- .9 Submit copies of as-built drawings for inclusion in final TAB report.

1.3 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 – Common Product Requirements and with manufacturer's written instructions.

- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect equipment and devices from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.
- .4 Packaging Waste Management: remove for reuse and recycling of pallets, crates, padding, and packaging materials as specified in Section 01 74 19 – Waste Management and Disposal.

Part 2 Products

2.1 MATERIALS

- .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 installation of equipment in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 PAINTING REPAIRS AND RESTORATION

- .1 Prime and touch up marred finished paintwork to match original.
- .2 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.

3.4 FIELD QUALITY CONTROL

- .1 Manufacturer's Field Services:
 - .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.
 - .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.
- .4 Departmental Representative will record these demonstrations on video tape for future reference.

3.6 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 – Cleaning.
 - .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 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 19 – Waste Management and Disposal.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.7 PROTECTION

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

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 09 91 23 - Interior Painting.
- .2 Section 21 05 01 – Common Work Requirements for Mechanical.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for plumbing equipment and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Indicate on drawings:
 - .1 Mounting arrangements.
 - .2 Operating and maintenance clearances.
 - .2 Shop drawings and product data accompanied by:
 - .1 Detailed drawings of bases, supports, and anchor bolts.
 - .2 Acoustical sound power data, where applicable.
 - .3 Points of operation on performance curves.
 - .4 Manufacturer to certify current model production.
 - .5 Certification of compliance to applicable codes.
 - .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.

1.3 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 – Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for plumbing equipment for incorporation into manual.
 - .1 Operation and maintenance manual approved by, and final copies deposited with, Departmental Representative before final inspection.
 - .2 Operation data to include:
 - .1 Control schematics for systems including environmental controls.
 - .2 Description of systems and their controls.
 - .3 Description of operation of systems at various loads together with reset schedules and seasonal variances.
 - .4 Operation instruction for systems and component.
 - .5 Description of actions to be taken in event of equipment failure.
 - .6 Valves schedule and flow diagram.

- .7 Colour coding chart.
- .3 Maintenance data to include:
 - .1 Servicing, maintenance, operation and trouble-shooting instructions for each item of equipment.
 - .2 Data to include schedules of tasks, frequency, tools required and task time.
- .4 Performance data to include:
 - .1 Equipment manufacturer's performance datasheets with point of operation as left after commissioning is complete.
 - .2 Equipment performance verification test results.
 - .3 Special performance data as specified.
- .5 Additional data:
 - .1 Prepare and insert into operation and maintenance manual additional data when need for it becomes apparent during specified demonstrations and instructions.
- .6 Site records:
 - .1 Departmental Representative will provide one (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 Transfer information weekly to reproducibles, revising reproducibles to show work as actually installed.
 - .3 Use different colour waterproof ink for each service.
 - .4 Make available for reference purposes and inspection.
- .7 As-built drawings:
 - .1 Prior to start of Testing, Adjusting and Balancing for HVAC, finalize production of as-built drawings.
 - .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).
 - .3 Submit to Departmental Representative for approval and make corrections as directed.
 - .4 Perform testing, adjusting and balancing for HVAC using as-built drawings.
 - .5 Submit completed reproducible as-built drawings with Operating and Maintenance Manuals.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 – Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

- .3 Storage and Handling Requirements:
 - .1 Store materials off ground indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Replace defective or damaged materials with new.
- .4 Packaging Waste Management: remove for reuse and recycling of pallets, crates, padding, packaging materials as specified in Construction Waste Management Plan in accordance with Section 01 74 19 – Waste Management and Disposal.

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 installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

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 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.

- .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.
- .4 Departmental Representative will record these demonstrations on video tape for future reference.

3.6 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 – Cleaning.
 - .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 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 19 – Waste Management and Disposal.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.7 PROTECTION

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

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 21 05 01 - Common Work Results for Mechanical.
- .2 Section 23 05 15 - Common Installation Requirements for HVAC Pipework.

1.2 REFERENCES

- .1 American National Standards Institute (ANSI)/American Society of Mechanical Engineers International (ASME)
 - .1 ANSI/ASME B16.15-2013, Cast Bronze Threaded Fittings, Classes 125 and 250.
 - .2 ANSI/ASME B16.18-2012, Cast Copper Alloy Solder Joint Pressure Fittings.
 - .3 ANSI/ASME B16.22-2013, Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
 - .4 ANSI/ASME B16.24-2011, Cast Copper Alloy Pipe Flanges and Flanged Fittings, Class 150, 300, 400, 600, 900, 1500 and 2500.
- .2 ASTM International Inc.
 - .1 ASTM A307-14, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
 - .2 ASTM A536-84(2014), Standard Specification for Ductile Iron Castings.
 - .3 ASTM B88M-14, Standard Specification for Seamless Copper Water Tube (Metric).
- .3 American National Standards Institute/American Water Works Association (ANSI)/(AWWA)
 - .1 ANSI/AWWA C111/A21.11-2012, Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
- .4 National Research Council (NRC)/Institute for Research in Construction
 - .1 NRCC 47668, National Plumbing Code of Canada (NPC) - 2015.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Product Data:
 - .1 Provide manufacturer's printed product literature and datasheets for insulation and adhesives, and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Closeout Submittals:
 - .1 Provide maintenance data for incorporation into manual specified in Section 01 78 00 – Closeout Submittals.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Store and manage hazardous materials in accordance with Section 01 61 00 – Common Product Requirements.

- .2 Packaging Waste Management: remove for reuse and recycling by manufacturer of pallets crates padding packaging materials in accordance with Section 01 74 19 – Waste Management and Disposal.
- .3 Place materials defined as hazardous or toxic in designated containers.
- .4 Handle and dispose of hazardous materials in accordance with Regional and Municipal regulations.

Part 2 Products

2.1 PIPING

- .1 Domestic hot, cold and recirculation systems, within building.
 - .1 Above ground: copper tube, hard drawn, type L: to ASTM B88M.

2.2 FITTINGS

- .1 Bronze pipe flanges and flanged fittings, Class 150 : to ANSI/ASME B16.24.
- .2 Cast bronze threaded fittings, Class 125 : to ANSI/ASME B16.15.
- .3 Cast copper, solder type: to ANSI/ASME B16.18.
- .4 Wrought copper and copper alloy, solder type: to ANSI/ASME B16.22.
- .5 NPS 1 and smaller: wrought copper to ANSI/ASME B16.22 ; with stainless steel internal components and EPDM seals. Suitable for operating pressure to 1380 kPa.

2.3 JOINTS

- .1 Rubber gaskets, 1.6 mm thick: to AWWA C111.
- .2 Bolts, nuts, hex head and washers: to ASTM A307, heavy series.
- .3 Solder: lead free.
- .4 Teflon tape: for threaded joints.
- .5 Dielectric connections between dissimilar metals: dielectric fitting, complete with thermoplastic liner.

2.4 BALL VALVES

- .1 NPS 2 and under, soldered:
 - .1 To ANSI/ASME B16.18, Class 150.
 - .2 Bronze body, chrome plated brass stainless steel ball, PTFE adjustable packing, brass gland and PTFE Bunan seat, steel lever handle.

Part 3 Execution

3.1 APPLICATION

- .1 Manufacturer's Instructions: comply with manufacturer's written recommendations, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 INSTALLATION

- .1 Install in accordance with NPC.
- .2 Install pipe work in accordance with Section 23 05 15 - Common Installation Requirements for HVAC Pipework supplemented as specified herein.
- .3 Assemble piping using fittings manufactured to ANSI standards.
- .4 Install CWS piping below and away from HWS and HWC and other hot piping so as to maintain temperature of cold water as low as possible.
- .5 Connect to fixtures and equipment in accordance with manufacturer's written instructions unless otherwise indicated.

3.3 VALVES

- .1 Isolate equipment, fixtures and branches with ball valves.

3.4 PRESSURE TESTS

- .1 Conform to requirements of Section 21 05 01 - Common Work Results for Mechanical.
- .2 Test pressure: greater of 1.5 times maximum system operating pressure or 860 kPa.

3.5 FLUSHING AND CLEANING

- .1 Flush entire system for 8 h. Ensure outlets flushed for 2 hours. Let stand for 24 hours, then draw one sample off longest run. Submit to testing laboratory to verify that system is clean copper to Provincial Federal potable water guidelines. Let system flush for additional 2 hours, then draw off another sample for testing.

3.6 DISINFECTION

- .1 Flush out, disinfect and rinse system to approval of Departmental Representative.
- .2 Upon completion, provide laboratory test reports on water quality for Departmental Representative approval.

3.7 CLEANING

- .1 Clean in accordance with Section 01 74 00 – Cleaning.
- .2 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 19 – Waste Management and Disposal.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 23 05 15 – Common Installation Requirements for HVAC Pipework.
- .2 Section 23 05 29 – Hangers and Supports for HVAC Piping and Equipment.

1.2 REFERENCES

- .1 National Plumbing Code (NPC), 2015.
- .2 ASTM International Inc.
 - .1 ASTM B32-08 (2014), Standard Specification for Solder Metal.
 - .2 ASTM B306-13, Standard Specification for Copper Drainage Tube (DWV).
 - .3 ASTM C564-20a, Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings.
- .3 Canadian Standards Association (CSA International).
 - .1 CSA B67-1972(R1996), Lead Service Pipe, Waste Pipe, Traps, Bends and Accessories.
 - .2 CAN/CSA-B70-12(R2016), Cast Iron Soil Pipe, Fittings and Means of Joining.
 - .3 CAN/CSA-B125.3-12, Plumbing Fittings.
- .4 Green Seal Environmental Standards (GSES)
 - .1 Standard GS-36-13, Commercial Adhesives.
- .5 South Coast Air Quality Management District (SCAQMD), California State
 - .1 SCAQMD Rule 1168-A2017, Adhesive and Sealant Applications.

1.3 SUBMITTALS

- .1 Submit documents in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Product data:
 - .1 Submit manufacturer's printed product literature, specifications and data sheet for piping and accessories.
- .3 Shop drawings:
 - .1 Shop drawings must include the seal and signature of a professional Engineer recognized in Canada, in the province of Ontario.
- .4 Certificates:
 - .1 Submit certificates signed by the manufacturer certifying that the products and materials comply with the specified performance and physical requirements.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Transport, store and handle hazardous materials in accordance with Section 01 61 00 – Common Product Requirements.
- .2 Shipping and receiving: deliver material to site in the original packaging, which must bear the name and address of the manufacturer.
- .3 Waste management and disposal:
 - .1 Separate waste materials for recycling in accordance with Section 01 74 19 – Waste Management and Disposal.
 - .2 Remove from site and dispose of packaging materials at appropriate recycling facilities.
 - .3 Collect and separate for disposal paper, plastic, polystyrene and corrugated cardboard packaging material for recycling in accordance with the waste management plan.
 - .4 Separate steel, metal and plastic materials in designated containers for recycling in accordance with the waste management plan.
 - .5 Divert unused metal materials from landfill to metal recycling facility.

Part 2 Products

2.1 COPPER TUBE AND FITTINGS

- .1 Above ground sanitary and vent Type DWV to: ASTM B306.
 - .1 Fittings.
 - .1 Cast brass: to CAN/CSA-B125.3.
 - .2 Wrought copper: to CAN/CSA-B125.3.
 - .2 Solder: lead free, to ASTM B32.

2.2 CAST IRON PIPING AND FITTINGS

- .1 Above ground sanitary and vent: to CAN/CSA-B70.
 - .1 Joints:
 - .1 Mechanical joints:
 - .1 Neoprene or butyl rubber compression gaskets with stainless steel clamps.

Part 3 Execution

3.1 INSTALLATION

- .1 Install in accordance with National Plumbing Code and manufacturer instructions.

.2 Slopes:

- .1 The drainage and horizontal vent piping must slope in the direction of flow.
Unless otherwise indicated, an incline of 2% for NPS 3 pipes and under and 1%
for NPS 4 or larger pipes.

3.2 PERFORMANCE VERIFICATION

- .1 Test to ensure traps are fully and permanently primed.
- .2 Affix applicable label (storm, sanitary, vent, pump discharge etc.) c/w directional arrows
every floor or 4.5 m (whichever is less).

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.

1.2 SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Shop drawings to show and include:
 - .1 Mounting arrangements and connections.
 - .2 Operating and maintenance clearances.
 - .3 Wiring and controls diagrams.
 - .4 Capacities.
 - .5 Detailed drawings of bases, supports, and anchor bolts.
 - .6 Acoustical sound power data, where applicable.
 - .7 Points of operation on performance curves.
 - .8 Manufacturer to certify current model production.
 - .9 Certification of compliance to applicable codes.
- .3 Shop drawings shall be specific to the project and identified with the name of the project, date of submission, name of the Departmental Representative and equipment identification code as indicated on the drawings and specifications. Catalogue cuts will not be accepted.
- .4 Review of shop drawings by the Departmental Representative is a general review to reduce the risk of errors in the manufacturing process. It does not relieve the contractor from its responsibilities to provide an installation that is compliant with the drawings and specifications.
- .5 Shop drawings shall be submitted in English.
- .6 Insert the copy of the shop drawings stamped as reviewed by the Departmental Representative in the Operations and Maintenance manuals.
- .7 Provide a list of Identifications legends for piping and valves.
- .8 Closeout Submittals:
 - .1 Provide operation and maintenance data for incorporation into manual specified in Section 01 78 00 – Closeout Submittals.
 - .2 Operation and maintenance manual approved by, and final copies deposited with, Departmental Representative before final inspection.
 - .3 Site records:
 - .1 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 Use different colour waterproof ink for each service.

- .3 Make available for reference purposes and inspection.
- .4 As-built drawings:
 - .1 Prior to start of Testing, Adjusting and Balancing for HVAC, finalize production of as-built drawings.
 - .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).
 - .3 Submit to Departmental Representative for approval and make corrections as directed.
 - .4 Perform testing, adjusting and balancing for HVAC using as-built drawings.
 - .5 Submit completed as-built drawings with Operating and Maintenance Manuals.
- .5 Submit copies of as-built drawings for inclusion in final TAB report.

1.3 INTERFERENCE DRAWINGS

- .1 General Requirements:
 - .1 Interference drawings, also called coordination and integration drawings, are required in all cases where interference between the various trades render such drawings necessary.
 - .2 The interference drawings must clearly and precisely show all relevant work done by the concerned section or these done by others.
- .2 Description:
 - .1 Interference drawings consist of dimensioned and scaled drawings showing location of equipment, ducts, piping, valves and other accessories with all necessary sections and details. Drawings shall be complete with dimensions of piping and ducts, location of sleeves, openings, anchors and supports, including their location relative to structural and architectural works and other mechanical and electrical works.
- .3 Preparation:
 - .1 Each trade shall be responsible for the information provided on the interference drawings for its own works.
 - .2 All mechanical and electrical sub-contractors shall be responsible for the coordination of interference drawings for all Division 23 sections covering Heating, Ventilating & Air Conditioning (HVAC). These sections shall cover all the data, drawings and diagrams required for this coordination.
 - .3 All drawings with no exception shall be coordinated by the General Contractor with the collaboration of all mechanical and electrical sections, including structural and architectural elements.
 - .4 All interference drawings for a given area shall be submitted all at once for review.

- .4 Collaboration:
 - .1 A close collaboration is required between the various mechanical and electrical trades to determine the location of their works and to avoid any possible interference.
- .5 Distribution of interference drawings:
 - .1 Submit to the Departmental Representative, for information, two copies approved by the contractor and signed by all parties involved.
 - .2 Drawings to be corrected and resubmit if required.
- .6 Responsibility:
 - .1 Each section shall be solely responsible for the exact location and dimensioning of openings, holes and sleeves, location of equipment, piping and ductwork, whether the structural, architectural or engineering drawings bear dimensions or not.
 - .2 No compensation will be given in the event of changes to works rendered necessary for purposes of coordination or integration of the various electrical and mechanical systems.
 - .3 Notwithstanding the responsibility for coordination and integration, the works shall not be executed prior approval of the interference drawings. Each section shall do over, at its own cost, all works not in accordance with the interference drawings and will be given no compensation based on a misinterpretation of the scope. Such misinterpretations shall not relieve the concerned section from its responsibilities and obligations to turn over systems that are complete, properly tested, ready to operate and fully integrated.
 - .4 Existing works: interference drawings shall take into account existing or future mechanical, electrical, structural and architectural works.

1.4 OPERATION AND MAINTENANCE MANUALS

- .1 Provide operation and maintenance data for incorporation into manual specified in Section 01 78 00 – Closeout Submittals.
- .2 Operation and maintenance manual approved by, and final copies deposited with, Departmental Representative before final inspection and prior to any scheduled training.
- .3 Bind data in vinyl hard cover 3 "D" ring type loose leaf binders for 212 x 275 mm size paper. Binders must not exceed 75 mm thick or be more than 2/3 full.
- .4 Enclose title sheet labelled "Operation Data and Maintenance Manual," project name, date and list of contents. Project name must appear on binder face and spine.
- .5 Include one complete set of final shop drawings (bound separately) indicating corrections and changes made during fabrication and installation.
- .6 Organize contents into applicable sections of work to parallel project specifications breakdown. Mark each section by labelled tabs protected with celluloid covers fastened to hard paper dividing sheets.
- .7 Operation data to include:
 - .1 Control schematics for systems including environmental controls.
 - .2 Description of systems and their controls.

- .3 Description of operation of systems at various loads together with reset schedules and seasonal variances.
- .4 Operation instruction for systems and component.
- .5 Description of actions to be taken in event of equipment failure.
- .6 Colour coding chart.
- .8 Maintenance data to include:
 - .1 Servicing, maintenance, and operation instructions for each item of equipment.
 - .2 Data to include schedules of tasks, frequency, tools required and task time.
 - .3 Lubrication products and schedules.
 - .4 Trouble shooting procedures.
 - .5 Adjustment techniques.
 - .6 Operational checks.
 - .7 Suppliers' names, addresses and telephone numbers and components supplied by suppliers must be included. Identify components by description and manufacturer's part number.
- .9 Performance data to include:
 - .1 Equipment manufacturer's performance datasheets with point of operation as left after commissioning is complete.
 - .2 Equipment performance verification test results.
 - .3 Special performance data as specified.
 - .4 Testing, adjusting and balancing reports as specified in Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.
- .10 Guarantees showing:
 - .1 Name and address of projects.
 - .2 Guarantee commencement date (date of Interim Certificate of Completion).
 - .3 Duration of guarantee.
 - .4 Clear indication of what is being guaranteed and what remedial action will be taken under guarantee.
 - .5 Signature and seal of Guarantor.
- .11 Spare parts: list recommended spares parts and materials to be maintained on site to ensure optimum efficiency. List special tools appropriate to unique application. Parts and tools detailed must be identified as to manufacturer, manufacturer part number and supplier.
- .12 Approvals:
 - .1 Submit 2 copies of draft Operation and Maintenance Manual to Departmental Representative for verification. Submission of individual data will not be accepted unless directed by Departmental Representative.
 - .2 Make changes as required and re-submit as directed by Departmental Representative.
- .13 Additional data:
 - .1 Prepare and insert into operation and maintenance manual additional data when need for it becomes apparent during specified demonstrations and instructions.

1.5 AS-BUILT DRAWINGS

- .1 Prior to start of Testing, Adjusting and Balancing for HVAC, finalize production of as-built drawings.
- .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).
- .3 Submit to Departmental Representative for approval and make corrections as directed.
- .4 Perform testing, adjusting and balancing for HVAC using as-built drawings.
- .5 Submit completed reproducible as-built drawings with Operating and Maintenance Manuals.
- .6 Submit copies of as-built drawings for inclusion in final TAB report.

1.6 LETTERS OF CONFORMANCE

- .1 At the end of the works, every subcontractor has to submit to the Departmental Representative the certificate of compliance which provides evidence that all the works were executed according to drawings and specifications and according to the current applicable codes and standards.

1.7 MAINTENANCE

- .1 Furnish spare parts in accordance with Section 01 61 00 – Common Product Requirements as follows:
 - .1 One set of packing for each pump.
 - .2 One casing joint gasket for each size pump.
 - .3 One head gasket set for each heat exchanger.
 - .4 One glass for each gauge glass.
 - .5 One filter cartridge or set of filter media for each filter or filter bank in addition to final operating set.
- .2 Provide one set of special tools required to service equipment as recommended by manufacturers.
- .3 Furnish one commercial quality grease gun, grease and adapters to suit different types of grease and grease fittings.

1.8 DELIVERY, STORAGE, AND HANDLING

- .1 Separate and recycle waste materials in accordance with Section 01 74 19 – Waste Management and Disposal.

1.9 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 19 – Waste Management and Disposal.

Part 2 Products

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 PAINTING REPAIRS AND RESTORATION

- .1 Prime and touch up marred finished paintwork to match original.
- .2 Restore to new condition, finishes which have been damaged.

3.2 CLEANING

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

3.3 FIELD QUALITY CONTROL

- .1 Manufacturer's Field Services:
 - .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 - SUBMITTALS.
 - .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.

3.4 DEMONSTRATION

- .1 Departmental Representative will use equipment and systems for test purposes prior to acceptance. Supply labour, material, and instruments required for testing.
- .2 Trial usage to apply to following equipment and systems:
 - .1 Air conditioning and heat pump units.
 - .2 Humidifier
- .3 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.
- .4 Use operation and maintenance manual, as-built drawings, and audio visual aids as part of instruction materials.
- .5 Instruction duration time requirements as specified in appropriate sections.

3.5 PROTECTION

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

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 22 13 16.13 – Sanitary Waste and Vent Piping: Cast Iron and Copper
- .2 Section 23 23 00 – Refrigerant Piping

1.2 REFERENCES

- .1 Canadian General Standards Board (CGSB):
 - .1 CAN/CGSB-1.181-99 – Ready Mixed Organic Zinc-Rich Coating.
- .2 Canadian Standards Association (CSA)/CSA International:
 - .1 CSA B139-Series:09 (R2014), Installation Code for Oil-Burning Equipment.
- .3 Green Seal Environmental Standards (GSES):
 - .1 Standard GS-11-2021, Edition 4.0 – Environmental Standard for Paints and Coatings.
- .4 National Fire Code of Canada (NFC 2015)
- .5 South Coast Air Quality Management District (SCAQMD), California State, Regulation XI. Source Specific Standards:
 - .1 SCAQMD Rule 1113-A2016 – Architectural Coatings.
 - .2 SCAQMD Rule 1168-A2017 – Adhesive and Sealant Applications.

1.3 SUBMITTALS

- .1 Submit the documents and samples required in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Product data:
 - .1 Submit manufacturer's printed product literature, specifications and data sheet for piping and accessories. Data sheets must include product characteristics, performance criteria, dimensions, limits and finish.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Transport, store and handle materials in accordance with Section 01 61 00 – Common Product Requirements.
- .2 Shipping and receiving:
 - .1 Deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

Part 2 Product

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 PIPING CONNECTIONS TO DEVICES

- .1 Unless otherwise specified, comply with the manufacturer's instructions.
- .2 Use valves with union fittings or flanges to isolate the piping network's devices and to facilitate the maintenance and the assembly/disassembly of the components.
- .3 Use double joint fittings when the devices are mounted on vibration pads and when the piping is susceptible to movement.

3.2 UNIONS, FLANGES, MECHANICAL COUPLINGS

- .1 To permit easy dismantling of the piping and the devices, install unions, flanges, or mechanical seals at all devices, manifolds, pumps, chilled water coils, hot water coils, glycol coils, steam coils, cooling towers, tanks, fan-coil units, etc.
- .2 Piping NPS 2 or smaller: unions.

3.3 CLEARANCE

- .1 Provide a clearance around the devices to facilitate the inspection, the maintenance and the observation of their operation, according to the manufacturer's recommendations and the National Fire Code of Canada requirements.
- .2 Also, provide sufficient working space, as per the indications, to dismantle and remove devices or pieces of equipment, where appropriate, without needing to interrupt the operation of other network devices or units.

3.4 DIELECTRIC UNIONS

- .1 Use dielectric joints appropriate to the type of piping and suitable for the network's nominal pressure.
- .2 Use dielectric unions to connect parts made of different metals.
- .3 Dielectric unions with a nominal diameter equal to or smaller than NPS 2: bronze union fittings or valves.
- .4 Dielectric fittings with a nominal diameter larger than NPS 2: flanges.
- .5 On the steam and condensate piping, perform the connections between two pipes of different metals, such as copper and steel, using cast iron connectors and brass adapters or flanges with gaskets. Install the bolts in isolated sleeves. Nuts and bolt heads with isolated washers.
- .6 Between the copper pipes and the cast iron pipes, perform the connections by means of a 19 mm ring welded to the copper piping and caulked into the neck of the cast iron pipe.

3.5 PIPING

- .1 Piping must not be in contact with the concrete or the ground.
- .2 All galvanized piping must be so on the inside and the outside.
- .3 Install all pipes so as to not induce any tensile or compressive stress.
- .4 Do not bend the piping in any way whatsoever.
- .5 The piping identification must always be visible to facilitate its inspection.
- .6 For each type of piping, the elbows, the elbow reducers, the adapters, the couplings, and the unions must be of the same brand as the tees.
- .7 In general, use long radius elbows.
- .8 Cover the fitting threads with Teflon tape.
- .9 Prevent the introduction of foreign materials into the unconnected openings.
- .10 Install the piping so that the various devices can be isolated and thus enable the disassembly or removal of the latter, if necessary, without needing to interrupt the operation of other network devices or units.
- .11 Connect the pipes using fittings manufactured in compliance with the relevant ANSI standards.
- .12 Connection saddles can be used on the main pipes if the connected bypass branch diameter is not greater than half the diameter of the main pipe.
 - .1 Before welding the saddle, create an opening with a saw or a drill in the main pipe with a diameter equal to the full internal diameter of the branching pipe to be connected, and deburr the edges.
- .13 Install the exposed piping, appliances, rectangular cleanouts, and other similar components in parallel or perpendicularly to the building lines.
- .14 Install the concealed piping in such a way as to minimize the space reserved for furring and maximize the headroom and the available space.
- .15 Except where otherwise indicated, install the piping giving it a slope in the direction of the fluid's flow to promote the free drainage of the latter and the network's free ventilation.
- .16 Except where otherwise indicated, install piping in such a way as to allow the thermal insulation of each pipe.
- .17 Deburr the pipe ends and rid them of slag and foreign matter accumulated prior to the assembly.
- .18 Use eccentric reducers at the diameter changes to ensure the free flow of the fluid and the network's free ventilation.
- .19 Provide means to compensate for the piping thermal expansion, as indicated.

3.6 SLEEVES

- .1 Install the sleeves where the piping passes through masonry, concrete, and fireproofing constructions, and the other indicated locations.

- .2 Install the sleeves so that they are flush with the concrete or masonry surfaces.
- .3 Before installing the sleeves, cover the exposed exterior surfaces with a thick layer of zinc rich paint compliant with the CAN/CGSB-1.181 standard.
- .4 The diameter of the sleeve must be sufficient to allow the installation of the piping and its thermal insulation. Leave a 6 mm annular clearance between the sleeves and the pipes or between the sleeves and the thermal insulation that covers the pipes.
- .5 The sleeve must be of a diameter leaving little opening clearance between the wall and the outside of the sleeve.
- .6 Steel sleeves:
 - .1 Manufactured with schedule 40 pipe, held in place by three supports, spot-welded to the steel frame.
- .7 Sealed steel sleeves:
 - .1 Manufactured with schedule 40 pipe provided with a sealing plate, 3 mm on the outer perimeter. Seam weld the plate to the outer wall of the pipe. The plates can be round or square. They can also be common for a series of sleeves placed one near the other. Each plate must be fixed to the floor.
 - .2 Steel sleeves with sealing plates must be installed for any apparent pipe or pipe in counter, and through a slab not on the ground. This applies to mechanical and electrical.
 - .3 Steel sleeves with sealing plates must be installed for all visible or concealed mechanical and electrical pipes, crossing the floors of the following locations:
 - .1 Mechanical room.

3.7 SEALING OF OPENINGS

- .1 General:
 - .1 The seal must meet water, fire, smoke, and acoustic requirements.
 - .2 The seal applies to the sleeves and the openings.
 - .3 The seals must be done by each relevant mechanical and electrical section, in cooperation with the other sections, under the Contractor's coordination.
 - .4 Each section must provide the sealing method to be used.
 - .5 At the foundation walls and the floors under ground level, the seal between the foundation wall and the outside of the sleeve must be ensured by the relevant section with non-shrink concrete. The space between the inside of the sleeve and the piping must be filled with putty that is fire retardant, waterproof, and will not harden.
 - .6 Elsewhere:
 - .1 Provide space for the installation of a fire-stop material or device.
 - .2 Be sure to respect the required fire resistance rating.
 - .7 Fill the sleeves that are in place for future use of a lime-based coating or another filler material that is easy to remove.
 - .8 Prevent all contact between the pipes or between the copper pipes and the sleeves.

- .2 Exterior walls other than foundation walls:
 - .1 For exterior walls, the seal between the sleeve and the pipe must be done with dry tow, PC-4, and molten lead on each side of the wall.
- .3 Fire protection, firestop walls and floors:
 - .1 For all drilled holes, sleeves, or openings in the fire partitions and in all other fireproof constructions, the space between the pipe or conduit and the sleeve or opening should be caulked using tightly packed fiberglass and an application of resilient putty, fire proof, 25 mm deep, on each side of the opening.
 - .2 If the gap to be caulked on the periphery of the pipe or pipes exceeds 25 mm, close this space with collars or angle irons of each side of the opening, after the placement of the fiberglass and resilient putty. Have the arrangement and the installation of the product approved by the representative of resilient product.
- .4 Smoke seals and acoustic seals:
 - .1 Unless otherwise indicated, seal the space between the pipe and the sleeve or the opening, the space between the duct and the sleeve or the opening, using tightly packed fiberglass and an application of resilient fireproof putty, 25 mm deep, on each side of the opening. When the space on the periphery of the pipes and conduits exceeds 25 mm, close this space with collars or angle irons of each side of the opening, after the placement of the fiberglass and resilient putty.
- .5 Watertight seals:
 - .1 The part between the inside of the sheath, the low wall (or concrete, at the places not requiring sheaths) and the piping or the ventilation duct must be made water tight by the concerned section by caulking the opening with tightly packed fiberglass and a resilient fireproof putty application, 25 mm deep. When the space to be caulked on the periphery of the pipes and conduits exceeds 25 mm, close this space with collars or angle irons of each side of the opening, after the placement of the fiberglass and resilient putty.
 - .2 Any piping, other than cast iron piping, and all ventilation ducts going through a roof must be fitted with counter flashing supplied and installed by the relevant section. The flashing and the casing surrounding pipes and conduits are to responsibility of other sections and allow the expansion of the piping.
 - .3 The small walls, the removable covers and the watertight pipe seals going through the roof of these walls are at the expense of the Contractor.

3.8 ESCUTCHEON PLATES

- .1 Install the escutcheons (chrome-plated rings) in places where pipes pass through walls, partitions, floors, ceilings, and in the finished areas and rooms. This article does not apply to mechanical rooms, parking lots, or warehouses.
- .2 Manufacturing: single piece escutcheons, fixed by a locking screw.
 - .1 Material: chrome or nickel-plated brass or stainless steel grade 302.

- .3 Dimensions: outer diameter greater than that of the opening or sleeve.
 - .1 Inner diameter appropriate to outer diameter of the pipes on which they are mounted, or their insulation.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 23 05 48 – Vibration and Seismic Controls for HVAC.

1.2 REFERENCES

- .1 American Society of Mechanical Engineers (ASME):
 - .1 ASME B31.1-20, Power Piping.
- .2 ASTM International:
 - .1 ASTM-A125-1996 (2018), Standard Specification for Steel Springs, Helical, Heat-Treated.
 - .2 ASTM-A307-21, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
 - .3 ASTM-A563-15, Standard Specification for Carbon and Alloy Steel Nuts.
- .3 Factory Mutual (FM).
- .4 Manufacturer's Standardization Society of the Valves and Fittings Industry (MSS):
 - .1 MSS SP58-2018 – Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation.
- .5 Underwriters' Laboratories of Canada (ULC).

1.3 SUBMITTALS

- .1 Submit the documents and samples required in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Product data:
 - .1 Submit manufacturer's printed product literature, specifications and data sheet for hangers and supports. Data sheets must include product characteristics, performance criteria, dimensions, limits and finish.
- .3 Shop drawings:
 - .1 Submit shop drawings for the following elements:
 - .1 Supports, bases and suspensions.
 - .2 Attachments to the devices and to the building structure.
 - .3 Structural assemblies.
- .4 Certificates:
 - .1 Submit certificates signed by the manufacturer certifying that the products and materials comply with the specified performance and physical requirements.
- .5 Manufacturer instructions:
 - .1 Submit installation instructions provided by manufacturer.

1.4 CLOSEOUT SUBMITTALS

- .1 Submit required documents in accordance with Section 01 78 00 – Closeout Submittals.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Transport, store and handle materials in accordance with Section 01 61 00 – Common Product Requirements.
- .2 Shipping and receiving:
 - .1 Deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

Part 2 Product

2.1 SYSTEM DESCRIPTION

- .1 Design requirements:
 - .1 The piping support must be executed according to manufacturer's recommendations, by means of common parts, components, and assemblies.
 - .2 The maximum load ratings must be determined from the indications concerning allowable stresses, contained in the standards ASME B31.1 or MSS SP58.
 - .3 The supports, the guides, and the anchors must not transmit excessive heat to the building's structural members.
 - .4 The supports and the hangers must be designed to support the pipes, the air ducts, and the mechanical equipment in operating conditions, allow the contraction and the expansion movements of supported elements, and prevent excessive stress on the pipes and the devices to which these are connected.
 - .5 The supports and the hangers must be vertically adjustable after their installation and during the commissioning of the installations. The extent of the adjustment must conform to MSS SP58.

2.2 GENERAL

- .1 The components covered by this section must be used for support purposes only. They must not be used to lift, raise, or support other components or devices.
- .2 Submit shop drawings of all the types of supports before their manufacturing and installation.
- .3 Prohibited work:
 - .1 The use of perforated or non-perforated metal strips or any other type of non-adjustable supports is prohibited.
 - .2 No pipe must be used as an attachment point to support another pipe.

2.3 PIPE HANGERS

- .1 Finishes:
 - .1 Pipe hangers and supports: galvanized after manufacture.
 - .2 Use hot dipped galvanizing process.
 - .3 Ensure steel hangers in contact with copper piping are epoxy coated.
- .2 Anchoring components for hangers fixed to the bottom flange of an I-beam:
 - .1 Cold pipes with nominal diameter equal to or smaller than NPS 2: malleable cast iron C mounting clamps, with hardened steel cup point setscrew.
 - .2 Cold pipes with nominal diameter equal to or larger than NPS 2½ and hot piping of all diameters: fixation for beams, consisting of a clamp, an eye rod, and an extension in malleable iron, with a carbon steel clamping ring, hanger rod, nuts, and washers.
- .3 Anchoring components for hangers fixed to the top flange of an I-beam:
 - .1 Cold pipes with nominal diameter equal to or smaller than NPS 2: ductile iron C mounting clamps for the beam top, with non-welded hardened steel cup point set screws, carbon steel locknut and clamping ring.
 - .2 Cold pipes with nominal diameter equal to or larger than NPS 2½ and hot piping of all diameters: malleable cast iron fasteners for the beam top, consisting of a clamp, a hook shank, a spring washer, a plain washer, and a nut.
- .4 Anchoring components for hangers fixed in concrete structures:
 - .1 Components to anchor in ceilings carbon steel welded eye rod, clevis plate, clevis pin and cotters with weldless forged steel eye nut. Ensure eye 6 mm minimum greater than rod diameter.
 - .2 Supports cast in concrete: with wedge and protective plate fitted with a breakable tablet, compliant with MSS SP58.
- .5 Hanger rods: threaded, compliant with MSS SP58.
 - .1 The suspension rods must not be subjected to stresses other than tensile loads.
 - .2 Hinge components must be provided as required to allow the horizontal movement and the vertical movement of the supported pipe.

2.4 ROD DIAMETERS AND SPACING OF MECHANICAL SUPPORTS

- .1 Mild steel support rods, of suitable diameter, and provided with threading of sufficient length to permit level adjustment of the pipes. Each rod with washers, two clamping bolts.

.2 Spacing:

- .1 The distance between the supports must be within the maximum allowable spacing indicated in the following tables. Also, provide a supports at very direction change.

.1 Steel piping:

Piping nominal diameter	Rod diameter	Maximum horizontal spacing
NPS ½	9.5 mm	1.5 m
NPS ¾	9.5 mm	1.8 m
NPS 1	9.5 mm	2.1 m
NPS 1¼	9.5 mm	2.4 m
NPS 1½	9.5 mm	2.7 m
NPS 2	9.5 mm	3 m
NPS 2½	12.7 mm	3.4 m
NPS 3	12.7 mm	3.7 m
NPS 4	15.9 mm	4.3 m
NPS 5	15.9 mm	4.9 m
NPS 6	19 mm	5.2 m
NPS 8	22.2 mm	5.8 m

.2 Copper or brass piping:

Piping nominal diameter	Rod diameter	Maximum horizontal spacing
NPS 1 or smaller	9.5 mm	1.8 m
NPS 1¼	9.5 mm	2.1 m
NPS 1½	9.5 mm	2.4 m
NPS 2	9.5 mm	2.7 m
NPS 2½	12.7 mm	3 m
NPS 3	12.7 mm	3.4 m
NPS 3½	12.7 mm	3.7 m
NPS 4	15.9 mm	3.7 m
NPS 5	15.9 mm	3.7 m
NPS 6	19 mm	4.3 m
NPS 8	22.2 mm	4.9 m

2.5 SUPPORTS FOR HORIZONTAL PIPING

- .1 Adjustable clevis: material to MSS SP58, clevis bolt with nipple spacer and vertical adjustment nuts above and below clevis.

- .1 Ensure "U" has hole in bottom for riveting to insulation shields.

- .2 U-bolts: carbon steel, compliant with MSS SP58, with two (2) nuts at each end compliant with the standard ASTM-A563.
- .3 Steel piping:
 - .1 Adjustable Clevis type hanger.
- .4 Copper or brass piping:
 - .1 Piping NPS 4 or smaller:
 - .1 Hangers in contact with the piping, adjustable Clevis type, copper plated.
- .5 Cast iron drainage plumbing and vent with mechanical joints:
 - .1 Hangers painted with minimum (red lead).
- .6 Installation:
 - .1 Horizontal aboveground piping: depending on the material and diameter, support the horizontal pipe at the following maximum distances:
 - .1 Steel, copper, or brass: as indicated in paragraph "ROD DIAMETERS AND SPACING OF MECHANICAL SUPPORTS".
 - .2 Lead: over its entire length.
 - .3 Cast iron: at each socket or each joint, the interval between two supports should not exceed 3 m, at every meter when adjacent connections spaced by 300 mm or less are installed on piping with mechanical seals.
 - .2 Support for a vent above the roof:
 - .1 When a vent pipe extends above a roof, it must be securely supported and anchored so as to maintain its alignment.
 - .3 Supports at mechanical joints:
 - .1 Install the supports so as to allow the joints to slide and to prevent the direct transmission of vibration by the piping. Install the supports in accordance with the manufacturer's instructions.

2.6 SUPPORTS FOR VERTICAL PIPING

- .1 Steel or cast iron piping, drainage, and vents, steel pipe clamps, compliant with the standard MSS SP58, or corrugated steel and U-bolts.
- .2 Copper or brass piping, copper plated carbon steel clamps, compliant with MSS SP58.
- .3 If the liquid's temperature does not exceed 100°C, a support with plastic covering may be used.
- .4 Bolts: compliant with the standard ASTM-A307.
- .5 Nuts: compliant with the standard ASTM-A563.
- .6 Installation: support or guide the pipes at each floor.
 - .1 To prevent piping slip:
 - .1 Cast iron piping with mechanical joints: use fittings with outer shoulders.
 - .2 Steel pipe: weld steel furring to the plumbing.

- .3 Copper or brass pipe: weld copper rings to the pipe.
- .2 The maximum distance between two supports must never exceed 6 m (20').
- .3 Depending on the material and the diameter, vertical piping must be supported at the following maximum distances:
 - .1 Lead: every 1.2 m.
 - .2 Copper or brass: every 2 m for NPS 1¼ or smaller or every 3 m for NPS 1½ and larger.
 - .3 Cast iron with mechanical joints or compression fittings: at all joints.
- .4 The base of a cast iron column must rest on a concrete pillar, a masonry pillar, or another equivalent material, unless properly suspended or anchored to the building framework.

2.7 SADDLES AND PROTECTION SHIELDS

- .1 Thermally insulated cold pipes:
 - .1 Insulation protection shields with a density of 64 kg/m³: compliant with MSS SP58, galvanized carbon steel sheet; length calculated for spans up to 3 m.
- .2 Thermally insulated hot pipes:
 - .1 Shields consist of a 300 mm long curved plate, with raised edges, with welded central reinforcement for pipes of nominal diameters equal to or larger than NPS 12, carbon steel, compliant with the standard MSS SP58.

2.8 SUPPORTS FOR DEVICES

- .1 When they not provided by the devices' manufacturer, the components for their support must be made of structural steel. Submit the calculations with the shop drawings.

.2 Devices rigidly suspended by four threaded rods:

MAXIMUM WEIGHT OF THE SUSPENDED DEVICE, ACCORDING TO THE LENGTH AND THE DIAMETER OF THE RODS, FOR INSTALLATION WITHOUT STIFFENER OR BRACING POUNDS (KG)										
Maximum length of the threaded rods		Threaded rod diameter								
		in	¼	3/8	½	5/8	¾	7/8	1	1 ¼
in	mm	mm	6.4	9.5	12.7	15.9	19	22.2	25.5	31.8
15	381		870 (395)	2210 (1005)	4100 (1864)	6580 (2991)	9850 (4477)	13700 (6227)	18030 (8195)	29090 (13223)
18	457		830 (377)	2210 (1005)	4100 (1864)	6580 (2991)	9850 (4477)	13700 (6227)	18030 (8195)	29090 (13223)
21	533		670 (305)	2210 (1005)	4100 (1864)	6580 (2991)	9850 (4477)	13700 (6227)	18030 (8195)	29090 (13223)
24	610		550 (250)	2210 (1005)	4100 (1864)	6580 (2991)	9850 (4477)	13700 (6227)	18030 (8195)	29090 (13223)
27	686		460 (209)	2210 (1005)	4100 (1864)	6580 (2991)	9850 (4477)	13700 (6227)	18030 (8195)	29090 (13223)
30	762		390 (177)	1960 (891)	4100 (1864)	6580 (2991)	9850 (4477)	13700 (6227)	18030 (8195)	29090 (13223)
33	838		320 (145)	1720 (782)	4100 (1864)	6580 (2991)	9850 (4477)	13700 (6227)	18030 (8195)	29090 (13223)
36	914		270 (123)	1520 (691)	4100 (1864)	6580 (2991)	9850 (4477)	13700 (6227)	18030 (8195)	29090 (13223)
39	991		230 (105)	1350 (614)	3870 (1759)	6580 (2991)	9850 (4477)	13700 (6227)	18030 (8195)	29090 (13223)
42	1067		200 (91)	1200 (545)	3490 (1586)	6580 (2991)	9850 (4477)	13700 (6227)	18030 (8195)	29090 (13223)
45	1143		180 (82)	1080 (491)	3170 (1441)	6580 (2991)	9850 (4477)	13700 (6227)	18030 (8195)	29090 (13223)
48	1219		160 (73)	960 (436)	2890 (1314)	6460 (2936)	9850 (4477)	13700 (6227)	18030 (8195)	29090 (13223)
51	1295		140 (64)	850 (386)	2650 (1205)	5950 (2705)	9850 (4477)	13700 (6227)	18030 (8195)	29090 (13223)
54	1372		---	770 (350)	2440 (1109)	5490 (2495)	9850 (4477)	13700 (6227)	18030 (8195)	29090 (13223)
57	1448		---	690 (314)	2240 (1018)	5090 (2314)	9850 (4477)	13700 (6227)	18030 (8195)	29090 (13223)
60	1524		---	630 (286)	2070 (941)	4730 (2150)	9380 (4264)	13700 (6227)	18030 (8195)	29090 (13223)
63	1600		---	570 (259)	1910 (868)	4410 (2005)	8770 (3986)	13700 (6227)	18030 (8195)	29090 (13223)
66	1676		---	530 (241)	1750 (795)	4120 (1873)	8220 (3736)	13700 (6227)	18030 (8195)	29090 (13223)

MAXIMUM WEIGHT OF THE SUSPENDED DEVICE, ACCORDING TO THE LENGTH AND THE DIAMETER OF THE RODS, FOR INSTALLATION WITHOUT STIFFENER OR BRACING POUNDS (KG)										
Maximum length of the threaded rods		Threaded rod diameter								
		in	¼	0.375	½	0.625	¾	0.875	1	1 ¼
in	mm	mm	6.4	9.5	12.7	15.9	19	22.2	25.5	31.8
9	229		470 (214)	1340 (609)	2580 (1173)	4230 (1923)	6410 (2914)	8980 (4082)	11830 (5377)	19100 (8682)
12	305		410 (186)	1260 (573)	2490 (1132)	4130 (1877)	6290 (2859)	8840 (4018)	11710 (5323)	19100 (8682)
15	381		330 (150)	1170 (532)	2390 (1086)	4010 (1823)	6160 (2800)	8690 (3950)	11550 (5250)	18930 (8605)
18	457		260 (118)	1070 (486)	2270 (1032)	3880 (1764)	6020 (2736)	8540 (3882)	11380 (5173)	18730 (8514)
21	533		210 (95)	960 (436)	2150 (977)	3740 (1700)	5860 (2664)	8370 (3805)	11200 (5091)	18520 (8418)
24	610		170 (77)	830 (377)	2010 (914)	3590 (1632)	5700 (2591)	8190 (3723)	11000 (5000)	18290 (8314)
27	686		140 (64)	710 (323)	1870 (850)	3430 (1559)	5520 (2509)	8000 (3636)	10800 (4909)	18060 (8209)
30	762		120 (55)	620 (282)	1710 (777)	3260 (1482)	5340 (2427)	7800 (3545)	10580 (4809)	17810 (8095)
33	838		100 (45)	540 (245)	1530 (695)	3080 (1400)	5140 (2336)	7580 (3445)	10360 (4709)	17550 (7977)
36	914		80 (36)	480 (218)	1360 (618)	2880 (1309)	4930 (2241)	7360 (3345)	10120 (4600)	17290 (7859)
39	991		70 (32)	420 (191)	1220 (555)	2680 (1218)	4710 (2141)	7120 (3236)	9870 (4486)	17010 (7732)
42	1067		60 (27)	380 (173)	1100 (500)	2440 (1109)	4480 (2036)	6880 (3127)	9610 (4368)	16720 (7600)
45	1143		50 (23)	340 (155)	1000 (455)	2220 (1009)	4230 (1923)	6620 (3009)	9340 (4245)	16410 (7459)
48	1219		50 (23)	300 (136)	910 (414)	2040 (927)	3980 (1809)	6350 (2886)	9050 (4114)	16100 (7318)
51	1295		40 (18)	270 (123)	830 (377)	1870 (850)	3680 (1673)	6070 (2759)	8760 (3982)	15780 (7173)
54	1372		40 (18)	240 (109)	770 (350)	1730 (786)	3410 (1550)	5780 (2627)	8450 (3841)	15440 (7018)
57	1448		30 (14)	220 (100)	710 (323)	1600 (727)	3170 (1441)	5480 (2491)	8140 (3700)	15090 (6859)
60	1524		30 (14)	190 (86)	650 (295)	1490 (677)	2960 (1345)	5120 (2327)	7810 (3550)	14740 (6700)
63	1600		30 (14)	180 (82)	600 (273)	1390 (632)	2770 (1259)	4800 (2182)	7470 (3395)	14370 (6532)
66	1676		20 (9)	160 (73)	550 (250)	1300 (591)	2590 (1177)	4510 (2050)	7110 (3232)	13990 (6359)

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

3.2 HANGER INSTALLATION

- .1 Install the hangers so that the rods are properly vertical during operating conditions.
- .2 Adjust the height of the rods so that the load is evenly distributed among the hangers.
- .3 Fix the hangers to the framework. In this regard, supply and install any additional metal framing members necessary if there are no structural supports provided at to mounting points or if the anchoring sleeves are not arranged at the required locations.

3.3 HORIZONTAL MOVEMENT

- .1 The inclination of the suspension rods resulting from the horizontal movement of the pipe from the "cold" to the "hot" position must not exceed 4° relatively to the vertical.
- .2 When the horizontal movement of the pipe is less than 13 mm, shift the supports or the hangers so that the rods are vertical in the "hot" position.

3.4 FINAL ADJUSTMENT

- .1 Hangers and Supports:
 - .1 Ensure that rod is vertical under operating conditions.
 - .2 Balance the loads.
- .2 Adjustable cradles:
 - .1 Tighten the vertical adjustment nut to optimize the performance of the cradle.
 - .2 Tighten the locknut once the adjustment is completed.
- .3 C-clamps:
 - .1 Fix the C-clamps to the bottom flange of the beams in accordance with the manufacturer's recommendations, and tighten to the torque specified by the latter.
- .4 Beam fixation:
 - .1 Using a hammer, firmly secure the clamp to the beam's lower flange.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
- .2 National Fire Protection Association (NFPA)
 - .1 NFPA (Fire) 13, Standard for the Installation of Sprinkler Systems. 2013 Edition.
- .3 National Building Code of Canada (NBC) - 2015

1.2 SUBMITTALS

- .1 Submittals: in accordance with Section 01 33 00 – Submittal Procedures.
 - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 – Submittal Procedures. Include product characteristics, performance criteria, and limitations.
- .2 Submit shop drawings in accordance with Section 21 05 01 – Common Work Requirements for Mechanical.
 - .1 Shop drawings: submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.
 - .2 Provide separate shop drawings for each isolated system complete with performance and product data.
 - .3 Provide detailed drawings of seismic control measures for equipment and piping. Submit design data including:
 - .1 Full details of design criteria.
 - .2 Working drawings, materials lists, schematics, full specifications for components of each SRS to be provided.
 - .3 Design calculations (including restraint loads resulting from seismic forces in accordance with National Building Code, detailed work sheets, tables).
 - .4 Separate shop drawings for each SRS and devices for each system, equipment.
 - .5 Identification of location of devices.
 - .6 Schedules of types of SRS equipment and devices.
 - .7 Details of fasteners and attachments to structure, anchorage loadings, attachment methods.
 - .8 Installation procedures and instructions.
 - .4 Design calculations including restraint loads to NBC and Supplement.
 - .1 Detailed work sheets, tables.

- .3 Quality assurance submittals: submit following in accordance with Section 01 45 00 – Quality Control.
 - .1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
 - .2 Instructions: submit manufacturer's installation instructions.
 - .3 Manufacturer's Field Reports: manufacturer's field reports specified.

1.3 DESCRIPTION

- .1 Seismic Restraint System (SRS) fully integrated into, and compatible with:
 - .1 Noise and vibration controls specified elsewhere.
 - .2 Structural, mechanical, electrical design of project.
- .2 Systems, equipment not required to be operational during and after seismic event.
- .3 During seismic event, SRS to prevent systems and equipment from causing personal injury and from moving from normal position.
- .4 Designed by Professional Engineer specializing in design of SRS and registered in Province of Ontario.

1.4 LEVEL OF PROTECTION

- .1 Install SRS for ventilation ductwork, equipment, tanks and piping other than sprinkler system in conformance with ASHRAE - A Practical Guide To Seismic Restraint and ANSI/SMACNA 001.
- .2 Level of Protection:
 - .1 SHL-C for piping and ducts
 - .2 SHL-B for equipment
- .3 $V_p = 0.26 W_p$.

1.5 SRS MANUFACTURER

- .1 SRS to be from one manufacturer.

1.6 DELIVERY, STORAGE, AND HANDLING

- .1 Packing, shipping, handling and unloading:
 - .1 Deliver, store and handle in accordance with Section 01 61 00 – Common Product Requirements.
 - .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.

Part 2 Products

2.1 GENERAL

- .1 Size and shape of bases type and performance of vibration isolation as indicated.
- .2 SRS to provide gentle and steady cushioning action and avoid high impact loads.

- .3 SRS to restrain seismic forces in every direction.
- .4 Fasteners and attachment points to resist same load as seismic restraints.
- .5 SRS of Piping systems compatible with:
 - .1 Expansion, anchoring and guiding requirements.
 - .2 Equipment vibration isolation and equipment SRS.
- .6 SRS utilizing cast iron, threaded pipe, other brittle materials not permitted.
- .7 Attachments to RC structure:
 - .1 Use high strength mechanical expansion anchors.
 - .2 Drilled or power driven anchors not permitted.
- .8 Seismic control measures not to interfere with integrity of firestopping.

2.2 SRS FOR STATIC EQUIPMENT, SYSTEMS

- .1 Floor-mounted equipment, systems:
 - .1 Anchor equipment to equipment supports.
 - .2 Anchor equipment supports to structure.
 - .3 Use size of bolts scheduled in approved shop drawings.
- .2 Suspended equipment, systems:
 - .1 Use one or combination of following methods:
 - .1 Install tight to structure.
 - .2 Cross-brace in every direction.
 - .3 Brace back to structure.
 - .4 Slack cable restraint system.
 - .2 SCS to prevent sway in horizontal plane, "rocking" in vertical plane, sliding and buckling in axial direction.
 - .3 Hanger rods to withstand compressive loading and buckling.

2.3 SRS FOR VIBRATION ISOLATED EQUIPMENT

- .1 Floor mounted equipment, systems:
 - .1 Use one or combination of following methods:
 - .1 Vibration isolators with built-in snubbers.
 - .2 Vibration isolators and separate snubbers.
 - .3 Built-up snubber system consisting of structural elements and elastomeric layer.
 - .2 SRS to resist complete isolator unloading.
 - .3 SRS not to jeopardize noise and vibration isolation systems. Provide 4-8 mm clearance between seismic restraint snubbers and equipment during normal operation of equipment and systems.
 - .4 Cushioning action: gentle and steady by utilizing elastomeric material or other means in order to avoid high impact loads.

- .2 Suspended equipment, systems:
 - .1 Use one or combination of following methods:
 - .1 Slack cable restraint system.
 - .2 Brace back to structure via vibration isolators and snubbers.

2.4 SLACK CABLE RESTRAINT SYSTEM (SCS)

- .1 Use elastomer materials or similar to avoid high impact loads and provide gentle and steady cushioning action.
- .2 SCS to prevent sway in horizontal plane, "rocking" in vertical plane, sliding and buckling in axial direction.
- .3 Hanger rods to withstand compressive loading and buckling.

2.5 ELASTOMERIC PADS

- .1 Type EP1 - neoprene waffle or ribbed; 9 mm minimum thick; 50 durometer; maximum loading 350 kPa.
- .2 Type EP2 - rubber waffle or ribbed; 9 mm minimum thick; 30 durometer natural rubber; maximum loading 415 kPa.
- .3 Type EP3 - neoprene-steel-neoprene; 9 mm minimum thick neoprene bonded to 1.71 mm steel plate; 50 durometer neoprene, waffle or ribbed; holes sleeved with isolation washers; maximum loading 350 kPa.
- .4 Type EP4 - rubber-steel-rubber; 9 mm minimum thick rubber bonded to 1.71 mm steel plate; 30 durometer natural rubber, waffle or ribbed; holes sleeved with isolation washers; maximum loading 415 kPa.

2.6 ELASTOMERIC MOUNTS

- .1 Type M1 - colour coded; neoprene in shear; maximum durometer of 60; threaded insert and two bolt-down holes; ribbed top and bottom surfaces.

2.7 SPRINGS

- .1 Design stable springs: ratio of lateral to axial stiffness is equal to or greater than 1.2 times ratio of static deflection to working height. Select for 50% travel beyond rated load. Units complete with levelling devices.
- .2 Ratio of height when loaded to diameter of spring between 0.8 to 1.0.
- .3 Cadmium plate for outdoor 100% relative humidity installations.
- .4 Colour code springs.

2.8 SPRING MOUNT

- .1 Zinc or cadmium plated hardware; housings coated with rust resistant paint.
- .2 Type M2 - stable open spring: support on bonded 6 mm minimum thick ribbed neoprene or rubber friction and acoustic pad.

- .3 Type M3 - stable open spring: 6 mm minimum thick ribbed neoprene or rubber friction and acoustic pad, bonded under isolator and on isolator top plate; levelling bolt for rigidly mounting to equipment.
- .4 Type M4 - restrained stable open spring: supported on bonded 6 mm minimum thick ribbed neoprene or rubber friction and acoustic pad; built-in resilient limit stops, removable spacer plates.
- .5 Type M5 - enclosed spring mounts with snubbers for isolation up to 950 kg maximum.

2.9 HANGERS

- .1 Colour coded springs, rust resistant, painted box type hangers. Arrange to permit hanger box or rod to move through a 30 degrees arc without metal to metal contact.
- .2 Type H1 - neoprene - in-shear, moulded with rod isolation bushing which passes through hanger box.
- .3 Type H2 - stable spring, elastomeric washer, cup with moulded isolation bushing which passes through hanger box.
- .4 Type H3 - stable spring, elastomeric element, cup with moulded isolation bushing which passes through hanger box.
- .5 Type H4 - stable spring, elastomeric element with precompression washer and nut with deflection indicator.

2.10 ACOUSTIC BARRIERS FOR ANCHORS AND GUIDES

- .1 Acoustic barriers: between pipe and support, consisting of 25 mm minimum thick heavy duty duck and neoprene isolation material.

2.11 HORIZONTAL THRUST RESTRAINT

- .1 Spring and elastomeric element housed in box frame; assembly complete with rods and angle brackets for equipment and ductwork attachment; provision for adjustment to limit maximum start and stop movement to 9 mm.
- .2 Arrange restraints symmetrically on either side of unit and attach at centerline of thrust.

2.12 STRUCTURAL BASES

- .1 Type B1 - Prefabricated steel base: integrally welded on sizes up to 2400 mm on smallest dimension, split for field welding on sizes over 2400 mm on smallest dimension and reinforced for alignment of drive and driven equipment; without supplementary hold down devices; complete with isolation element attached to base brackets arranged to minimize height; pre-drilled holes to receive equipment anchor bolts; and complete with adjustable built-in motor slide rail where indicated.
- .2 Type B2 - Steel rail base: structural steel, positioned for alignment of drive and driven equipment; without supplementary hold down devices; complete with isolation element attached to base brackets arranged to minimize height; and pre-drilled holes to receive equipment anchor bolts.
- .3 Bases to clear housekeeping pads by 25 mm minimum.

2.13 INERTIA BASE

- .1 Type B3 - Full depth perimeter structural or formed channels, frames: welded in place reinforcing rods running in both directions; spring mounted, carried by gusseted height-saving brackets welded to frame; and clear housekeeping pads by 50 mm minimum.
 - .1 Pump bases: "T" shaped, where applicable, to provide support for elbows.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

3.2 INSTALLATION

- .1 Seismic control measures to meet requirements of Ontario Building Code.
- .2 Install vibration isolation equipment in accordance with manufacturer's instructions and adjust mounting to level equipment.
- .3 Unless indicated otherwise, support piping connected to isolated equipment with spring mounts or spring hangers with 25 mm minimum static deflection as follows:
 - .1 Up to NPS4: first 3 points of support. NPS5 to NPS8: first 4 points of support. NPS10 and Over: first 6 points of support.
 - .2 First point of support: static deflection of twice deflection of isolated equipment, but not more than 50 mm.
- .4 Where isolation is bolted to floor use vibration isolation rubber washers.
- .5 Block and shim level bases so that ductwork and piping connections can be made to rigid system at operating level, before isolator adjustment is made. Ensure that there is no physical contact between isolated equipment and building structure.
- .6 Slack Cable Systems (SCS):
 - .1 Connect to suspended equipment so that axial projection of wire passes through centre of gravity of equipment.
 - .2 Use appropriate grommets, shackles, other hardware to ensure alignment of restraints and to avoid bending of cables at connection points.
 - .3 Piping systems: provide transverse SCS at 10 m spacing maximum, longitudinal SCS at 20 m maximum or as limited by anchor/slack cable performance.
 - .4 Small pipes may be rigidly secured to larger pipes for restraint purposes, but not reverse.
 - .5 Orient restraint wires on ceiling hung equipment at approximately 90 degrees to each other (in plan), tie back to structure at maximum of 45 degrees to structure.
 - .6 Adjust restraint cables so that they are not visibly slack but permit vibration isolation system to function normally.
 - .7 Tighten cable to reduce slack to 40 mm under thumb pressure. Cable not to support weight during normal operation.

- .7 Install SRS at least 25 mm from equipment, systems, services.
- .8 Miscellaneous equipment not vibration-isolated:
 - .1 Bolt through house-keeping pad to structure.
- .9 Coordinate connections with other disciplines.
- .10 Vertical tanks:
 - .1 Anchor through house-keeping pad to structure.
 - .2 Provide steel bands above centre of gravity.
- .11 Horizontal tanks
- .12 Provide at least two straps with anchor bolts fastened to structure.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 01 33 00 - Submittal Procedures .

1.2 REFERENCES

- .1 Canadian Gas Association (CGA):
 - .1 CSA/CGA B149.1-10 (R2015), Natural Gas and Propane Installation Code.
- .2 Canadian General Standards Board (CGSB):
 - .1 CAN/CGSB-1.60-97 – Interior Alkyd Gloss Enamel.
 - .2 CAN/CGSB-24.3-92 – Identification of Piping Systems.
- .3 National Fire Protection Association (NFPA):
 - .1 NFPA-13, Standard for the Installation of Sprinkler Systems. 2013 Edition
 - .2 NFPA-14, Standard for the Installation of Standpipe and Hose Systems. 2013 Edition.

1.3 SUBMITTALS

- .1 Data sheets:
 - .1 Submit required data sheets in accordance with Section 01 33 00 – Submittal Procedures.
 - .2 Submit data sheets for the products specified in this section, including colour code.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Packaging, shipping, handling and receiving:
 - .1 Transport, store and handle materials in accordance Section 01 61 00 – Common Product Requirements.
 - .2 Transport, store and handle materials in accordance with the manufacturer's written instructions.
- .2 Waste management and disposal:
 - .1 Construction/demolition waste management and disposal: separate waste materials for recycling in accordance with Section 01 74 19 – Waste Management and Disposal.
 - .2 Divert unused paints and coating products from landfill to recognized hazardous material facility.

Part 2 Product

2.1 IDENTIFICATION AND REGISTRATION PLATES

- .1 The devices must be fitted with identification plates showing the dimensions, the equipment designation, and all the information normally provided: serial number, voltage, serial number, number of cycles, number of phases, motor power in HP, capacity, manufacturer name, etc.
- .2 The lettering stamped, printed, or engraved on the plates must be perfectly legible. Do not paint the identification plates. When units are insulated, provide openings in the insulation for these plates to be legible. The plates supplied by the manufacturer must not be modified in any way.
- .3 Provide registration plates for the devices under pressure and the approval plates from certification laboratories and the CSA on the equipment provided, in accordance with the different regulations. These plates must be perfectly legible.
- .4 Each unit or device, pump, fan, compressor, breaker, contactor, starter, transformer, and other control point must be clearly identified, according to the application or the specification's appellations, by a white ebonite plate with black engraved lettering, firmly fixed on or near the device. These plates are supplied and installed by the section providing the device.
- .5 Place the identification plates visibly.
- .6 The plates must have the following minimum dimensions: 90 mm x 40 mm x 2.5 mm minimum thickness.
- .7 The characters must be 25 mm high on important devices.
- .8 Have the list of plates checked before engraving them.

2.2 IDENTIFICATION OF ACCESSES

- .1 The identification of accesses applies to valves, manual dampers, motorized dampers, pressure reducing boxes, control points, electrical boxes, and any other device, instrument, or accessory.
- .2 Each concerned section must identify the access doors on their visible side with self-adhesive labels of 20 mm in diameter, from Avery, and in the colour shown below:
 - .1 Heating and cooling: yellow
 - .2 Plumbing: green
 - .3 Ventilation: black
 - .4 Sprinklers and fire protection: red
 - .5 Pressure conveying: blue
 - .6 Controls: brown
 - .7 Electricity: pink
 - .8 Communications: orange
 - .9 Medical gases: conforming to CSA standards

- .3 In ceilings with acoustic panels, each relevant mechanical and electrical section is required to identify the panels serving as accesses with coloured labels on the underside of the reversed tee according to the table above.
- .4 Include the legend in the operations and maintenance manuals.

2.3 VALVE IDENTIFICATION

- .1 Each relevant mechanical section must identify the valves that are part of their installation.
- .2 All valves must be equipped with a 50 mm x 50 mm coloured plastic tag with rounded corners, displaying the letters and the numbers engraved in a different colour and attached with a sturdy steel wire to the valve stem.
- .3 Use multi-stranded steel wire with lead cylinder to permanently seal the tag's wire.
- .4 The numbering must be alphanumeric. It must take into account the sector and the floor. It must be continuous for all the sections. Each section must collaborate with the other sections to determine the numbering.
- .5 Provide a numbering list for approval.

2.4 IDENTIFICATION OF PIPING, DUCTS, AND VENTILATION UNITS

- .1 Perform the identification of piping and ventilation ducts after the insulation work is completed.
- .2 Each relevant mechanical section must identify the pipes, the ventilation ducts, and the devices that are part of its installation.
- .3 Identify exposed plumbing, insulated or not. Identify the pipes installed in the suspended ceilings above the access doors. In suspended ceilings with removable panels, identify the pipes everywhere.
- .4 Identify all apparent ventilation ducts, insulated or not, in the mechanical rooms. Identify all ventilation units. In suspended ceilings, identify the ventilation ducts above the access doors. In suspended ceilings with removable panels and where the ducts are exposed, except in mechanical rooms, identify the ducts only in shafts accessible to the shaft's exit.
- .5 Identify the ducts at all fire dampers.
- .6 For identification purposes, the terms "exposed pipes and exposed ventilation ducts" apply to those located in mechanical rooms and those that are visible.
- .7 In trenches and/or in non-removable suspended ceilings, pipes and ventilation ducts are considered concealed.
- .8 Perform the identification using letters, numbers, and arrows indicating the direction of the flow of liquids, steam, gas, or air.
- .9 Print the numbers, letters, and arrows using rubber stamps and black ink.
- .10 Characters:
 - .1 For piping NPS 2 or smaller, including the insulation, letters and numbers are 25 mm x 6 mm, arrows are 25 mm in height by 150 mm in length.

- .2 For ducts and piping NPS 2 ½ or larger, including the insulation, letters and numbers are 50 mm x 10 mm, arrows are 25 mm in height by 150 mm in length.
- .11 Piping:
 - .1 On all non-insulated pipes where no base coat is provided, on the insulated pipes with aluminum exterior finish, apply two coats of white paint at the site of identification prior to the identification. This paint should form a perfect rectangle.
 - .2 As an alternative for uninsulated pipes, the identifying characters must be aluminum coloured if the pipe is black and not rusty. If the pipe is rusty, it must be painted with a coat of rustproof paint and a coat of black paint before proceeding to the identification with aluminum paint.
 - .3 As an alternative on insulated pipe with an aluminum exterior finish, apply a canvas with fire retardant coating on a surface forming a perfect rectangle, and identify the piping on this surface.
- .12 Ventilation ducts:
 - .1 On the exposed galvanized surfaces of the ventilation units and the ventilation ducts, apply a special primer on a surface forming a perfect rectangle allowing the adhesion of the finishing paint to the galvanized surface. Apply two coats of white paint, then proceed to the identification.
 - .2 Alternatively, stick a 0.22 kg canvas, 300 mm x 300 mm, with fire retardant adhesive and apply the identification.
 - .3 On ventilation ducts thermally insulated on the outside, before applying the two coats of white paint at the point of identification, install a rosin-sized paper, a glued 0.17 kg canvas, and a chemical adhesive ready to receive paint.
- .13 Approval and identification legend:
 - .1 Have the numbers, letters, and arrow characters and the stamps approved. Provide lettering specimens before proceeding to the identification work. It is understood that the characters for the numbers, the letters, and the arrows must be the same for all sections and for the entire project.
 - .2 The identification legend must be in English and French.
 - .3 Once the legend is established, each section must get approval for the legend of all its identifications before proceeding to its work.
- .14 Identification methods:
 - .1 The identifications are as follows:
 - .1 Identify the pipe at each shut-off valve so as to clearly identify its contents.
 - .2 At each identification, draw an arrow pointing in the direction of the flow.
 - .3 If the flow can be in two directions, draw an arrow with two heads or two parallel arrows with opposite heads.
 - .4 Every time a pipe or a duct goes through a wall, floor, or ceiling, identify the pipe or duct on each side with arrows.
 - .5 Identify every riser and tee with arrows.

- .6 On a continuous line, identify the pipe and the ducts with arrows every 16 m.
- .1 Safety colour designations: these functional colours attract attention to certain dangers but cannot substitute adequate accident prevention measures.
 - .2 Red: Reserved for fire protection equipment: fire extinguishers and their locations, fire alarms, emergency exits, emergency shut-off switches for dangerous devices.
 - .3 Orange: safeguarded for risks of cuts, crushing, or burning, reports the dangerous machine parts, sharp parts, press surfaces, particularly inside the guards.
 - .4 Yellow: indicates any danger of collision or falls: sharp or protruding angles, ledges, steps, low beams, hoists, hooks. The visibility of this colour can be accentuated by applying oblique stripes on a black background.
 - .5 Green: indicates emergency stations, pharmacies, and first aid stations.
 - .6 Blue: draws attention to all equipment that must not be in put into operation because they are defective or under repairs. Also indicates the distribution boxes and the electrical controls.
 - .7 Reference colours:

Services	Identification legend	Back colours	Secondary identification colours
Sanitary drain	SANITARY DRAIN	Green	None
Vent (plumbing)	PLUMBING VENT.	Green	None
Vent	VENT	Yellow	Black
Suction refrigerant (include refrigerant no.)	REFRIG. SUCTION. (NO ...)	Yellow	Black
Ventilation ducts:			
Cold air supply	(NO OF SYST.) COLD SUPPLY	White	None
Hot air supply	(NO OF SYST.) HOT AIR SUPPLY	White	None
Return	(NO DU SYST.) RETURN	White	None
Exhaust	(NO OF SYST.) EXHAUST	White	None
Fresh air	(NO OF SYST)	White	None

2.5 OPERATION AND MAINTENANCE MANUALS

- .1 Each section should include in its operation and maintenance manuals:
- .1 The identification legend for the accesses.
 - .2 The identification legend for the pipes, the ventilation ducts, the ventilation units, and fans must be separate.
 - .3 The identification legend for the valves.
 - .4 The identification legend for the devices.

- .2 Each relevant mechanical section must provide the identification tables of all valves, including: the valve number, the service, liquid, gas, or steam, the sector, the floor, the diameter, the model, the make, and the number of the valve located upstream.
- .3 Each mechanical section should provide a table showing the main valves of each service and for each sector and floor serviced.
- .4 The Division 23, section "HEATING – CHILLED WATER" must provide a table of the main valve(s) of each of service for the entire building and for all mechanical sections.
- .5 Photocopied table with black characters on a white background, glass framed. The table must be handed to the Departmental Representative. Provide ten additional copies of this table.
- .6 The tables mentioned above must be included in the operation and maintenance manuals and be printed in a sufficient number of copies.
- .7 All tables mentioned in previous articles must have the same format.

2.6 IDENTIFICATION ACCORDING TO THE EXISTING SYSTEM

- .1 Identify the added or renovated work according to the existing identification system.
- .2 When the existing identification system does not cover the identification of the new work installed, they must be identified in accordance with this section's requirements.
- .3 Before starting the work, obtain the Departmental Representative's written approval of the identification system.

Part 3 Execution

3.1 IDENTIFICATION PLATES

- .1 Location
 - .1 The plates must clearly identify the devices and/or piping networks and they must be installed in locations where they are highly visible and easy to read from the work floor.
- .2 Spacers
 - .1 On hot and/or heat-insulated surfaces, provide spacers under the identification plates.
- .3 Protection
 - .1 Do not apply paint, insulation, or any covering on the identification plates.

3.2 PLACEMENT OF THE PIPING AND AIR DUCT IDENTIFICATION ELEMENTS

- .1 On long piping in the open areas of the boiler rooms, equipment rooms, and service galleries: at intervals not exceeding 16 m, so that at least one is visible from any point of operating areas or walkways.
- .2 At changes in direction.

- .3 In each small room through which pipes or air ducts pass (at least one element).
- .4 On each side of visual obstacles or where it is difficult to follow the path of the networks.
- .5 On each side of separations, such as walls, floors, or partitions.
- .6 In places where the piping or air ducts are concealed in a shaft, a ceiling space, a sleeve, a service gallery, or any other confined space, at entry and exit points, and near access openings.
- .7 At the starting and ending points of each conduit or duct, and near all pieces of equipment.
- .8 Immediately upstream of the main automatic or manual control valves, otherwise, as close as possible, preferably upstream.
- .9 Such that the identification can be easily read from the normal operating areas and from all easily accessible points.
 - .1 Perpendicularly to the best line of vision possible, taking into consideration the area where the operating personnel usually are, the lighting conditions, the reduced visibility of the colours or legends caused by the accumulation of dust and dirt, and the risk of damage.

3.3 LOCATION OF THE VALVE IDENTIFICATION ELEMENTS

- .1 Attach the labels by means of chains or closed S hooks made of nonferrous metal on the valves, except for those related to medical devices or those connected to heating radiators, and unless they are near and in sight of the equipment to which they are connected.
- .2 Install a copy of the block diagram and the list of valves, framed in anti-reflective glass, at a location determined by the Departmental Representative. Also, insert a copy (in reduced size, if necessary) in each of the operation and maintenance manuals.
- .3 Number the valves of each network in order.

END OF SECTION

Part 1 General

1.1 QUALIFICATION OF TAB PERSONNEL

- .1 Submit names of personnel to perform TAB to the Departmental Representative within ninety (90) days of award of contract.
- .2 Submit documentation confirming staff's qualifications and experience.
- .3 The testing, adjusting, and balancing operations must be performed in accordance with the requirements of standard governing the qualifications of the company and the staff responsible for the work.
 - .1 Associated Air Balance Council (AABC) – National Standards for Total System Balance, MN-1-2016.
 - .2 National Environmental Balancing Bureau (NEBB) TABES, Procedural Standards for Testing, Adjusting, Balancing of Environmental Systems-2019.
 - .3 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA), HVAC TAB, HVAC Systems – Testing, Adjusting and Balancing of 2002.
- .4 Recommendations and suggested practices contained in the TAB Standard: mandatory.
- .5 Use TAB Standard provisions, including checklists, and report forms to satisfy Contract requirements.
- .6 Use TAB Standard for TAB, including qualifications for TAB Firm and Specialist and calibration of TAB instruments.
- .7 Where instrument manufacturer calibration recommendations are more stringent than those listed in TAB Standard, use manufacturer's recommendations.
- .8 TAB Standard quality assurance provisions such as performance guarantees form part of this contract.
 - .1 For systems or system components not covered in TAB Standard, use TAB procedures developed by TAB Specialist.
 - .2 Where new procedures, and requirements, are applicable to Contract requirements have been published or adopted by body responsible for TAB Standard used (AABC, NEBB, or TABB), requirements and recommendations contained in these procedures and requirements are mandatory.

1.2 PURPOSE OF TAB

- .1 Test to verify proper and safe operation, determine actual point of performance, evaluate qualitative and quantitative performance of equipment, systems and controls at design, average and low loads using actual or simulated loads.
- .2 Adjust and regulate equipment and systems to meet specified performance requirements and to achieve specified interaction with other related systems under normal and emergency loads and operating conditions.

- .3 Balance systems and equipment to regulate flow rates to match load requirements over full operating ranges.

1.3 COORDINATION

- .1 Schedule time required for TAB (including repairs, re-testing) into project construction and completion schedule to ensure completion before acceptance of project.
- .2 Do TAB of each system independently and subsequently, where interlocked with other systems, in unison with those systems.

1.4 PRE-DEMOLITION TESTING

- .1 Prior to demolition work commencing, Contractor to test and record airflows and operation data of the following:
 - .1 Return fan R-1.
 - .2 OA supply fan S-1.
 - .3 Air conditioner AC-5.
 - .4 All related diffusers and grilles.
- .2 Results in report form to be provided to Departmental Representative for review within five (5) days. New work diffuser balancing values to be provided for AC-5 supplied spaces after review of existing service.

1.5 START-UP

- .1 Notify the Departmental Representative seven (7) days prior to TAB.
- .2 Only undertake TAB when building is essentially completed, including:
 - .1 Installation of ceilings, doors, windows, and other components that may affect results are complete.
 - .2 Installation of sealants, caulking, and weather-stripping is complete.
 - .3 Pressure tests, seal tests, and other tests defined in other sections of Division 23 are completed.
 - .4 Equipment required for TAB are installed and in good working condition.
 - .5 Start-up and verification for proper, normal and safe operation of mechanical and associated electrical and control systems affecting TAB including but not limited to:
 - .1 Proper thermal overload protection in place for electrical equipment.
 - .2 Air systems:
 - .1 Clean filters in place.
 - .2 Duct systems clean.
 - .3 Ducts, duct shafts, and plenums including ceilings are airtight, within specified tolerances.
 - .4 Correct fan rotation.
 - .5 Balancing, fire, and smoke dampers are installed and open.
 - .6 Coil fins are combed and clean.
 - .7 Access doors and hatches, installed and closed.

- .8 Outlets installed, volume control dampers open.
- .3 Hydronic systems:
 - .1 Systems flushed, filled and vented.
 - .2 Correct pump rotation.
 - .3 Strainers in place, baskets clean.
 - .4 Isolating and balancing valves are installed and open.
 - .5 Balancing valves are installed and calibrated to factory settings.
 - .6 Chemical treatment system complete, operational.

1.6 INSTRUMENTS

- .1 Prior to starting TAB, submit to the Departmental Representative a list of instruments to be used, with their serial numbers.
- .2 Calibrate in accordance with requirements of the most stringent of referenced Standard for applicable system or HVAC system.

Part 2 Product

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 VENTILATION SYSTEMS

- .1 General:
 - .1 Perform tests, measurements and adjustments to:
 - .1 Demonstrate the ventilation systems are airtight.
 - .2 Adjust fans to obtain the specified airflows.
 - .3 Establish quantitative performance of all equipment installed under this section.
 - .4 Adjust quantity of air to terminal equipment.
 - .5 Check the adjustment of certain control components.
 - .2 Check installations for compliance with this section's requirements.
 - .3 For each system, establish, measure, and adjust the airflow required to meet the specified quantities.
 - .4 Record and present the results in the form of a report.
 - .5 Before starting TAB, TAB firm must be approved. The firm must be a certified member of the National Environmental Balancing Bureau Ontario Inc. (NEBB) or the Associated Air Balancing Council (AABC).
 - .6 Before starting TAB, submit an outline of the proposed procedures required to comply with this article and a list of equipment and instruments to be used.

- .7 The selected firm must, for the duration of the installation work, carry out regular site visits and submit a report indicating corrective measures required in order to adequately proceed with TAB (minimum one visit per month or more often depending on site conditions).
 - .8 Take corrective actions submitted by the retained specialized firm.
 - .9 Supply the equipment and work force required for leak tests.
 - .10 Perform the tests according to the methods recommended by the Associated Air Balance Council and SMACNA (HVAC Air Duct Leakage Test Manual, Third Edition, August 2002).
 - .11 Once ducts are installed, but before ceilings, walls, and insulation are installed, check the airtightness of all seals and the condition of all ducts.
 - .12 Hermetically seal each section undergoing a test and temporarily seal all openings. Run the tests, section by section, on each system, according to the convenience of the location and the established procedure.
- .2 Leak tests:
- .1 Water tests:
 - .1 Fill every horizontal duct susceptible of receiving water during standard operation with 25 mm of water and spray the inside vertical ducts subject to the same conditions, sufficiently to check the seals.
 - .2 This test applies to all sealed ducts requested in this specification, such as fresh air intakes and exhaust air outlets and their plenums, chilled water coil drain pans, heat recovery coils, kitchens hood exhaust, and dishwashers.
 - .3 Provide connections to drains and screwed drain caps at the low points of these ducts.
 - .2 Low pressure ducts:
 - .1 Conduct a 500 Pa static pressure test on the ducts.
 - .2 Maximum allowable loss:
 - .1 For each section tested: 0.48 L/s m² from duct walls.
 - .2 For overall system, the sum of the leakage must not exceed 3% of the fan(s) airflow.
- .3 Adjustment precision:
- .1 Do TAB to the following tolerances of the design values:
 - .1 Airflow adjustment:
 - .1 At terminal equipment: 10% ±
 - .2 In main ducts: 5% ±
 - .2 Differential pressure:
 - .1 Positive pressure zones:
 - .1 Supply: 0 to +10%
 - .2 Exhaust and return: 0 to -10%
 - .2 Negative pressure zones:
 - .1 Supply: 0 to -10%

.2 Exhaust and return: 0 to +10%

.4 General procedure:

.1 Equipment and system verification:

- .1 Once leak tests are performed and results are satisfactory, proceed with TAB of the equipment and systems as follows:
 - .1 Start up fans (supply, return, exhaust).
 - .2 Verify:
 - .1 Voltage and amperage of motors to avoid overload.
 - .2 Motor and fan rotation.
 - .3 Differential pressure switch (DPD) operation.
 - .4 Position of motorized dampers.
 - .5 Temperature control of chilled water, hot water or glycol with controls Contractor.
 - .6 Any obvious air leaks.
 - .2 Develop a ventilation system diagram which identifies all devices and equipment that will be used for testing, adjusting and/or balancing flow. Also, identify all locations where measurements will be taken to ensure that sufficient connections are provided on the ductwork. Use this identification as a reference in the balancing report. Ensure that there is no short-circuiting in the ductwork system.

.2 Airflow at main branches:

- .1 Using a Pitot tube, measure flow rate in the main branches.
- .2 If required, adjust fan speed to obtain design airflow.
- .3 Check motor power and fan speed to ensure that operation is within critical limits.
- .4 Adjust balancing dampers at main branches until design airflow has been reached.
- .5 Refer to each type of system described in this section.

.3 Minimum outside air:

- .1 Adjust static pressure in unit's mixing plenum to zero or slightly negative, following the requirements of the site conditions, when the return damper is open to its maximum position. Balancing dampers installed before the mixing plenum is used to set the static pressure in the plenum.
- .2 Adjust dampers to set the outside air to a maximum of 105% of design requirement.

.4 System adjustment for balancing work:

- .1 Adjust dampers for minimum outside air.
- .2 Dual-duct system and constant volume multizone, ensure the proper airflow through the cooling coils and maintain it throughout the adjustments.

- .5 Terminal equipment adjustments:
 - .1 Adjust airflow from terminal units up to the fan.
 - .2 Use balancing dampers at main branches for major adjustments and dampers at terminal units for precise adjustments.
 - .3 These adjustments may require multiple iterations.
 - .4 Note: the total airflow adjusted at the terminal units compared to the readings obtained in the ducts may provide an indication of leakage.
 - .5 When the system is set to the design airflow, at the branches and the outlets, perform the following readings:
 - .1 Motor amperage.
 - .2 Differential pressure at the fans (discharge minus inlet).
 - .3 Differential pressure at all secondary components (upstream minus downstream).
 - .4 Differential pressure at all system's primary components (air intake, air exhaust, filters, coils, air-mixing plenums, etc.).
- .5 Ventilation TAB report:
 - .1 For each balanced system, the balancing report shall include, as a minimum, the following information:
 - .1 Dated reports:
 - .1 On the report cover page, and on all pages of the report, clearly indicate dates when measurements and adjustments, at all stages (preliminary, corrections, and revisions) were taken.
 - .2 Design data:
 - .1 Airflows:
 - .1 Supply
 - .2 Return
 - .3 Exhaust
 - .2 Fan static pressure.
 - .3 Motor power (HP).
 - .4 Brake horsepower (BHP).
 - .5 Fan speed (rpm).
 - .6 Minimum percentage of outside air.
 - .3 Characteristics of installed equipment:
 - .1 Manufacturer (model and serial no.)
 - .2 Unit size and dimensions.
 - .3 Arrangement.
 - .4 Construction class.
 - .5 Motor nameplate:
 - .1 Power
 - .2 Voltage
 - .3 Number of phases

- .4 Frequency
 - .5 FLA
 - .6 Rotation speed
- .4 Tests at main:
 - .1 Fan speed.
 - .2 Power readings at the motor terminals (voltage and current on each phase).
 - .3 Differential pressure across each system component (coils, filters, etc.).
 - .4 Pressures at suction and discharge of the fan.
 - .5 Measured airflow.
 - .6 Fan curve indicating the operating point, based on measurements.
 - .7 Pressures measured with pressure sensors supplied and installed by the Division 23.
- .5 Test at the terminal devices:
 - .1 Identification of the terminal device by ID number and location.
 - .2 Type of terminal device:
 - .1 Manufacturer
 - .2 Model
 - .3 Dimensions
 - .4 Output factor
 - .3 Design airflow and air speed.
 - .4 Airflow and air speed results.
 - .5 Adjustment, where applicable, of airflow pattern diffuser.
- .6 Additional information:
 - .1 Fans:
 - .1 Dimensions and number of belts.
 - .2 Dimensions of pulleys.
 - .3 Position of adjustable pulleys.
 - .4 Full load motor speed.
 - .5 Overload protection adjustment.
 - .6 Filter type, initial pressure loss at full flow, final pressure loss for filter replacement.
 - .7 Air speed readings at coil faces, where possible.
 - .8 Airflow control device type.
 - .2 Air distribution system:
 - .1 Pressure reading at main branches.
 - .2 Pressure reading in ceiling spaces.

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- .3 Pressure difference between building interior and exterior when building is operating at minimum and maximum outside air.
 - .4 List of Pitot tube tests with their results.
 - .5 List of airflows measured at each grille and diffuser. Indicate the required airflows.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 23 31 13.01 – Metal Air Ducts – Low Pressure to 500 Pa.

1.2 REFERENCES

- .1 Definitions:
 - .1 For the purposes of this section, the following definitions apply:
 - .1 In this section, the term "insulation" and "thermal insulation" will be considered synonymous.
 - .2 The acronym "CGSB" stands for the Canadian General Standards Board.
 - .3 "Concealed" elements: insulated mechanical services and equipment located above suspended ceilings or in inaccessible chases and furred-in spaces.
 - .4 "Exposed" elements: elements that are not concealed (as previously defined).
 - .5 Insulation system: systems consisting in particular of the insulation itself, the fasteners, jackets and other accessories.
 - .2 TIAC acronyms:
 - .1 CRD: Code Round Ductwork.
 - .2 CRF: Code Rectangular Finish.
 - .3 References:
 - .1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE):
 - .1 ANSI/ASHRAE 90.1-2019-SI Edition – Energy Standard for Buildings Except Low-Rise Residential Buildings.
 - .2 ASTM International Inc.:
 - .1 ASTM B209M-14, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric).
 - .2 ASTM C335-17, Standard Test Method for Steady State Heat Transfer Properties of Pipe Insulation.
 - .3 ASTM C411-11, Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.
 - .4 ASTM C449/C449M-07(2019), Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.
 - .5 ASTM C547-19, Standard Specification for Mineral Fiber Pipe Insulation.
 - .6 ASTM C553-13(2019), Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
 - .7 ASTM C612-14(2019), Standard Specification for Mineral Fiber Block and Board Thermal Insulation.

- .8 ASTM C795-08(2018), Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.
- .9 ASTM C921-10(2015), Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.
- .3 Canadian General Standards Board (CGSB):
 - .1 Preformed mineral fiber insulation: ONGC 51-GP-9M.
 - .2 Thermal Insulation, Flexible, Elastomeric, Unicellular, Sheet and Pipe Covering: ONGC 51-GP-40.
 - .3 Mineral fiber flexible blanket: ONGC 51-GP-11M.
 - .4 Mineral fiber rigid and semi-rigid boards: ONGC 51-GP-10M.
 - .5 Hydrated calcium silicate insulation: ONGC 51.2-M88 or 51-GP-2M.
 - .6 Vapor barrier covering: ONGC 51-GP-52Ma.
 - .7 PVC jacketing: ONGC 51.53-95.
- .4 "k" thermal conductivity factors:
 - .1 ASTM C-335 for precast or rigid insulation.
 - .2 ASTM C-177 or C-518 for the other types.
- .5 Green Seal Environmental Standards (GSES):
 - .1 Standard GS-36-13, Commercial Adhesives.
- .6 South Coast Air Quality Management District (SCAQMD), California State:
 - .1 SCAQMD Rule 1168-A2017 – Adhesive and Sealant Applications.
- .7 Thermal Insulation Association of Canada (TIAC), National Insulation Standards (2005).
- .8 Underwriters' Laboratories of Canada (ULC):
 - .1 CAN/ULC-S102-10, Method of test for surface burning characteristics of building materials and assemblies.
 - .2 CAN/ULC-S701-11, Standard for Thermal Insulation, Polystyrene, Boards and Pipe Covering.

1.3 SUBMITTALS

- .1 Submit the documents and samples required in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Data sheets:
 - .1 Submit required data sheets, including the manufacturer's documentation for the insulation. Data sheets must include product characteristics, performance criteria, dimensions, limits and finish.
 - .1 A description of the devices and materials, including the manufacturer name, type, model, year of fabrication, the strength or the flow.
 - .2 Details relevant to the operation, usage, and maintenance of the devices and materials.
 - .3 A list of recommend spare parts.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Transport, store and handle materials in accordance with Section 01 61 00 – Common Product Requirements.
- .2 Deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Packing waste management: collect packing waste for reuse/recycling in accordance with Section 01 74 19 – Waste Management and Disposal.

1.5 MANUFACTURER'S INSTRUCTIONS

- .1 Submit the manufacturers' instructions for the installation of the insulating materials.
- .2 The instructions must specify the methods to be used, as well as the required execution quality, particularly in regards to the joints and the overlaps.

1.6 QUALIFICATIONS

- .1 The installer must be an expert in the field, with at least three years of proven and successful experience in the installation of work in this size, type and scope of work, and possess the qualifications required by the TIAC.

Part 2 Product

2.1 FIRE AND SMOKE RATING

- .1 To CAN/ULC-S102.
 - .1 Maximum flame spread rating : 25
 - .2 Maximum smoke developed rating : 50

2.2 TYPE B INSULATION

- .1 Elastomeric cellular thermal insulation in tubular, flexible sheet, or roll form, according to the application.
- .2 Maximum thermal conductivity "k": 0.039 W/m.°C at 32°C.

2.3 TYPE C INSULATION

- .1 Flexible wrap made of mineral fiber bonded with thermosetting resin with vapor barrier and reinforced aluminum, with a density of 36 kg/m³, maximum service temperature of 121°C.
- .2 Maximum thermal conductivity "k": 0.042 W/m.°C at 24°C.

2.4 TYPE D INSULATION

- .1 Rigid mineral fiber board bonded by a thermosetting resin with integrated FSK vapor barrier, with a density of 36 kg/m³, maximum service temperature of 232°C.
- .2 Maximum thermal conductivity "k": 0.035 W/m.°C at 24°C.

2.5 ADHESIVES

- .1 Compliant with the standards ASTM-E-84-76 and CAN/ULC-S102.
- .2 Use to secure the canvas, the tabs and all-service jackets, seal the joints, and secure the insulation to the metal surfaces.

2.6 JACKETS

- .1 PVC jackets:
 - .1 Preformed one piece molded jacketing compliant with CGSB 51.53-95, similar to the Proto Corp. PVC type or equivalent.
 - .2 Operating temperatures:
 - .1 Minimum : -20°C
 - .2 Maximum : 65°C
 - .3 Permeability: 0.02 perm.
 - .4 Thickness:
 - .1 Internal: 20 mils minimum.
External: 30 mils minimum; 40 mils minimum on piping 380 mm and larger.
 - .5 Adhesive and sealant: follow the manufacturer's recommendations.
- .2 Canvas jackets:
 - .1 Cotton canvas having a density of 220 g/m² and when exposed and 120 g/m² when concealed, coated with a diluted insulating fire retardant adhesive, compliant with the standards ASTM C921 and ASTM E84.
- .3 Aluminum jackets:
 - .1 Aluminum jacketing compliant with the standards ASTM B209 and CSA HA.4-1980, to be used on exposed elements located outdoors and in mechanical rooms, when specified.
 - .2 Corrugated or embossed aluminum alloy jacketing, 0.4 mm thick, with longitudinal S joints with 50 mm wide overlapping ends, factory installed internal protective covering, and also featuring an aluminum alloy joint cover with mechanical fasteners. Vapor barrier membrane.
 - .3 Jackets for connecting to matrix elements made of 0.4 mm thick aluminum alloy with factory installed internal protective covering.

2.7 RIGID SUPPORT MATERIAL

- .1 Characteristics:
 - .1 Permeability: 0.00 perm/cm.
 - .2 Non-combustible.
 - .3 Compressive strength: 7.0 kg/cm²
 - .4 Average density: 128 kg/m³
 - .5 Coefficient of linear thermal expansion: 8.6 x 10⁻⁸/°C
 - .6 Maximum Operating Temperature: 482°C
 - .7 Thermal conductivity: 0.48 W/m.°C.

Part 3 Execution

3.1 PREPARATORY WORK

- .1 Only install the insulation once the system has been tested and the results have been certified by the responsible authority who has witnessed the test.
- .2 Ensure surfaces to be covered with insulation or with a finish coating are clean, dry, and free of foreign matter.

3.2 INSTALLATION METHOD

- .1 The insulation work is considered as:
 - .1 Concealed: pipes and ducts are installed in suspended ceilings, walls, shafts, and floors.
 - .2 Exposed: exposed pipes and ducts must be insulated on all sides, even on non-visible sides against walls or ceilings.
 - .3 Ducts and pipes in mechanical rooms, tunnels, and service spaces are considered exposed.
- .2 Install insulation once all tests are complete and accepted, and air inside the building is dry enough and in conditions conforming to the manufacturers standards. Install insulation continuously, without interruption.
- .3 All equipment, piping, and ducts must be clean and dry before installing the insulation.
- .4 Consult the other mechanical sections to determine the type of ducts, piping, fittings, valves, and other accessories installed by other contractors. The insulation contractor must consider that contractors from divisions 21, 22, and 23 will use the Victaulic type fittings where allowed, and will tender accordingly.
- .5 This section is responsible for the proper installation of insulation in the locations specified.
- .6 When insulation is likely to be damaged by impact or crushing near the access doors, doors, access panels, corridors, etc., protect with a 1.3 mm galvanized steel sleeve (18 gauge).
- .7 Notify applicable sections and properly adjust the supports and saddles to ensure that saddles remain in place.

3.3 APPLICATION

- .1 See section "DUCTWORK INSULATION SCHEDULE" for thicknesses.
- .2 Mixed temperature, cold ducts and plenums (13-65°C):
 - .1 Rigid insulation:
 - .1 Preparation:
 - .1 Secure the mechanical fasteners to horizontal and vertical surfaces at approximately 300 mm centre to centre in each direction.

- .2 Application:
 - .1 Cut insulation with integral vapor barrier to the right size and apply to the exterior of duct and/or plenum, with the vapor barrier towards the exterior and its horizontal surfaces overlapping its vertical surfaces. Tighten the edges firmly. Secure the insulation to mechanical fasteners. Install retaining washers.
 - .2 In places where mechanical fasteners go through the vapor barrier and at each corner and joint, apply adhesive vapor barrier tape or vapor barrier tape applied with vapor barrier adhesive. If there are raised joints, cover them with an overlapping strip or a flexible insulating material with integral vapor barrier to ensure a complete vapor barrier.
 - .3 Cover all joints and duct reinforcements with an overlapped strip of flexible insulation material with integrated vapor retarder of the same thickness as the thermal insulation used for the duct. Glue this overlapping strip with a vapor barrier adhesive to ensure integral protection.
- .2 Flexible insulation:
 - .1 Preparation:
 - .1 On round and rectangular ducts 740 mm or less in width, no preparation is necessary. On rectangular ducts 762 mm or more in width, either secure mechanical fasteners to the lower surface at approximately 450 mm centre to centre, or apply 100 mm wide bands of the insulating adhesive at approximately 300 mm centre to centre.
 - .2 Application:
 - .1 Cut insulation with integral vapor barrier to the right size and apply to exterior of duct with the vapor barrier on the outside. In places where the mechanical fasteners go through the vapor barrier and at all joints, apply an adhesive vapor barrier tape or vapor barrier tape applied with vapor barrier adhesive. All joints must overlap by at least 50 mm and be stapled at approximately 100 mm centre to centre. Attach insulation with either string or wire at approximately 300 mm centre to centre.
 - .2 Cover all joints and duct reinforcements with an overlapped strip of flexible insulation material with integrated vapor retarder of the same thickness as the thermal insulation used for the duct. Glue this overlapping strip with a vapor barrier adhesive to ensure integral protection.
 - .3 Note: PVC jackets and fittings used outdoors or exposed to fluorescent light must be resistant to ultraviolet rays.
- .3 Exceptions:
 - .1 Unless otherwise stated, when an internal duct liner is specified, external insulation is not required.

- .2 For external applications of rigid insulation, where mechanical fasteners are not suitable because of a lack of space, it is possible to substitute them for string or wire, insulation adhesive, or other suitable fastening methods.
- .3 Finishes:
 - .1 Indoor:
 - .1 Rectangular ductwork with rigid insulation:
 - .1 Install a continuous metal corner bead at all corners. Apply vapor barrier tape on all vapor barrier joints and breaks and on every corner.
 - .2 Where exposed, install fire retardant canvas jacket over insulation using fabric adhesive and finish with second layer of adhesive coating.
 - .2 Round ductwork with rigid or flexible insulation:
 - .1 Apply vapor barrier tape on all joints and breaks.
 - .2 Where exposed, install fire retardant canvas jacket over insulation using fabric adhesive and finish with second layer of adhesive coating.
 - .3 Rectangular ductwork with flexible insulation:
 - .1 Flexible insulation is not acceptable where ductwork is exposed.
- .4 Refrigerant piping:
 - .1 Application:
 - .1 Use methods recommended by the manufacturer. Seal all longitudinal and transverse joints with adhesives specified in this section. Where exposed, insulation is covered with a layer of vapor barrier paint specifically recommended for this type of insulation.

3.4 DUCTWORK INSULATION SCHEDULE

- .1 General:
 - .1 No insulation is required for:
 - .1 Ducts fitted with acoustic insulation serving as thermal insulation, unless otherwise indicated.
 - .2 Acoustic plenums (boxes).
- .2 Systems No. AC-3/4/5:
 - .1 All supply ducts from the system's plenum boxes in the mechanical room and in shafts:
 - .1 In the mechanical room:
 - .1 Insulation: type D
 - .2 Thickness: 50 mm
 - .2 In shafts:
 - .1 Insulation: type C
 - .2 Thickness: 25 mm on hot ducts, 50 mm on cold ducts.

- .3 Up to the grilles and diffusers (only if there is no acoustic insulation)
 - .1 Insulation: type C (type D when exposed)
 - .2 Thickness: 25 mm

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 23 05 15 - Common Installation Requirements for HVAC Pipework.
- .2 Section 23 05 29 – Hangers and Supports for HVAC Piping and Equipment.

1.2 REFERENCES

- .1 Definitions:
 - .1 For the purposes of this section, the following definitions apply:
 - .1 In this section, the term "insulation" and "thermal insulation" will be considered synonymous.
 - .2 The acronym "CGSB" stands for the Canadian General Standards Board.
 - .3 "Concealed" elements: insulated mechanical services and equipment located above suspended ceilings or in inaccessible chases and furred-in spaces.
 - .4 "Exposed" elements: elements that are not concealed (as previously defined).
 - .5 Insulation system: systems consisting in particular of the insulation itself, the fasteners, jackets and other accessories.
 - .2 TIAC acronyms:
 - .1 CRD: Code Round Ductwork.
 - .2 CRF: Code Rectangular Finish.
- .2 References:
 - .1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE):
 - .1 ASHRAE Standard 90.1-2019, Energy Standard for Buildings Except Low-Rise Residential Buildings (IESNA co-sponsored; ANSI approved; Continuous Maintenance Standard).
 - .2 American Society for Testing and Materials International (ASTM).
 - .1 ASTM-B209M-14, Standard Specification for Aluminum and Aluminum Alloy Sheet and Plate Metric.
 - .2 ASTM-C335-17, Standard Test Method for Steady State Heat Transfer Properties of Horizontal Pipe Insulation.
 - .3 ASTM-C411-11, Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.
 - .4 ASTM-C449/C449M-07(2019), Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.
 - .5 ASTM-C533-2017, Calcium Silicate Block and Pipe Thermal Insulation.
 - .6 ASTM-C547-2019, Mineral Fiber Pipe Insulation.
 - .7 ASTM-C795-08(2018), Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.

- .8 ASTM-C921-10(2015), Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.
- .3 Canadian General Standards Board (CGSB):
 - .1 Preformed mineral fiber insulation: ONGC 51-GP-9M.
 - .2 Thermal Insulation, Flexible, Elastomeric, Unicellular, Sheet and Pipe Covering: ONGC 51-GP-40.
 - .3 Mineral fiber flexible blanket: ONGC 51-GP-11M.
 - .4 Mineral fiber rigid and semi-rigid boards: ONGC 51-GP-10M.
 - .5 Hydrated calcium silicate insulation: ONGC 51.2-M88 or 51 GP 2M.
 - .6 Vapor barrier covering: ONGC 51-GP-52Ma.
 - .7 PVC jacketing: ONGC 51.53-95.
- .4 "k" thermal conductivity factors:
 - .1 ASTM-C-335 for precast or rigid insulation.
 - .2 ASTM-C-177 or C-518 for the other types.
- .5 Department of Justice Canada (JUS):
 - .1 Canadian Environmental Assessment Act (CEAA), c. 19, s. 52, 2012.
 - .2 Canadian Environmental Protection Act (CEPA), c. 33, 1999.
 - .3 Transportation of Dangerous Goods Act (TDGA), c. 34, 1992.
- .6 Health Canada/Workplace Hazardous Materials Information System (WHMIS):
 - .1 Material Safety Data Sheet (MSDS).
- .7 Manufacturers' associations:
 - .1 Thermal Insulation Association of Canada (TIAC), National Insulation Standards.
- .8 Underwriters' Laboratories of Canada (ULC):
 - .1 CAN/ULC-S102-10, Method of test for surface burning characteristics of building materials and assemblies.
 - .2 CAN/ULC-S701-11, Standard for Thermal Insulation, Polystyrene, Boards and Pipe Covering.
 - .3 CAN/ULC-S702-09, Standard for Mineral Fibre Thermal Insulation for Buildings.
 - .4 CAN/ULC-S702.2-15, Mineral Fibre Thermal Insulation for Buildings, Part 2: Application Guidelines.

1.3 SUBMITTALS

- .1 Submit the documents and samples required in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Data sheets:
 - .1 Submit required data sheets, including the manufacturer's documentation for the piping insulation. Data sheets must include product characteristics, performance criteria, dimensions, limits and finish.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Transport, store and handle materials in accordance with Section 01 61 00 – Common Product Requirements.
- .2 Deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Packing waste management: collect packing waste for reuse/recycling in accordance with Section 01 74 19 – Waste Management and Disposal.

1.5 MANUFACTURER'S INSTRUCTIONS

- .1 Submit the manufacturers' instructions for the installation of the insulating materials.
- .2 The instructions must specify the methods to be used, as well as the required execution quality, particularly in regards to the joints and the overlaps.

Part 2 Product

2.1 FIRE AND SMOKE RATING

- .1 To CAN/ULC-S102.
 - .1 Maximum flame spread rating: 25
 - .2 Maximum smoke developed rating: 50

2.2 TYPE A INSULATION

- .1 Preformed wrap made of mineral fiber bonded with thermosetting resin, maximum service temperature of 454°C.
- .2 Reinforced vapor barrier: factory applied all service jacket, paintable finish. Jacketing permeability: 0.02 perm. maximum.
- .3 Maximum thermal conductivity "k": 0.035 W/m.°C at 24°C.

2.3 TYPE B INSULATION

- .1 Elastomeric cellular thermal insulation in tubular, flexible sheet, or roll form, according to the application.
- .2 Maximum thermal conductivity "k": 0.039 W/m.°C at 32°C.

2.4 TYPE C INSULATION

- .1 Flexible wrap made of mineral fiber bonded with thermosetting resin with vapor barrier and reinforced aluminum, with a density of 36 kg/m³, maximum service temperature of 121°C.
- .2 Maximum thermal conductivity "k": 0.042 W/m.°C at 24°C.

2.5 ADHESIVES

- .1 Compliant with ASTM-E-84-76 and CAN/ULC-S102.
- .2 Use to adhere the canvas, tabs and all service jackets, seal joints, and secure the insulation to metal surfaces.

2.6 JACKETS

- .1 PVC jackets:
 - .1 Preformed one piece molded jacket compliant with CGSB 51.53-95, similar to the Proto Corp. PVC type or equivalent.
 - .2 Operating temperatures:
 - .1 Minimum: -20°C
 - .2 Maximum: 65°C
 - .3 Permeability: 0.02 perm.
 - .4 Thickness:
 - .1 Internal: 20 mils minimum.
External: 30 mils minimum; 40 mils minimum on piping 380 mm and larger.
 - .5 Adhesive and sealant: follow manufacturer's recommendations.
- .2 Canvas jackets:
 - .1 Cotton canvas having a density of 220 g/m² where exposed and 120 g/m² where concealed, coated with a diluted insulating fire retardant adhesive, compliant with the standards ASTM-C921 and ASTM-E84.

Part 3 Execution

3.1 PREPARATORY WORK

- .1 Only install the insulation once the system has been tested and the results have been certified by the responsible authority who has witnessed the test.
- .2 Ensure surfaces to be covered with insulation or with a finish coating are clean, dry, and free of foreign matter.

3.2 INSTALLATION METHOD

- .1 The insulation work is considered as:
 - .1 Concealed: pipes and ducts are installed in suspended ceilings, walls, shafts, and floors.
 - .2 Exposed: exposed pipes and ducts must be insulated on all sides, even on non-visible sides against walls or ceilings.
 - .3 Ducts and pipes in mechanical rooms, tunnels, and service spaces are considered exposed.
- .2 Install insulation once all tests are complete and accepted, and air inside the building is dry enough and in conditions conforming to the manufacturers standards. Install insulation continuously, without interruption.
- .3 All equipment, piping, and ducts must be clean and dry before installing the insulation.
- .4 This section is responsible for the proper installation of insulation, where specified.

- .5 When insulation is likely to be damaged by impact or crushing near the access doors, doors, access panels, corridors, etc., protect with a 1.3 mm galvanized steel sleeve (18 gauge).
- .6 For all insulated piping exposed to water, steam, or oil, and all insulated piping passing through the mechanical room floor: cover the insulation with a 0.75 kg copper sheet with blind welded 50/50 joints or with a corrugated aluminum sheet with two stainless steel straps of 225 mm in minimum height.
- .7 Install all piping supports for chilled water, cold glycol water, and domestic cold water completely outside the insulation. For this piping, use a rigid material at each support. Install a steel saddle of appropriate length and width to distribute the weight. This material must be supplied and installed by this section. Steel supports and saddles are supplied and installed by each relevant mechanical section to this section's satisfaction.
- .8 Notify applicable sections and properly adjust the supports and saddles to ensure that saddles remain in place.
- .9 Leave access to strainers uncovered. However, for domestic cold water and chilled water piping, insulate them with a removable cover shaped piece of insulation to allow removal of the strainer for cleaning purposes. Have a sample of this cover approved.

3.3 APPLICATION

- .1 See the articles "PIPING INSULATION SCHEDULE" for thicknesses.
- .2 Cold piping (5 to 15°C):
 - .1 Piping:
 - .1 Apply pipe insulation with an integral vapor barrier jacket to the piping and hold it in place by securing the jacket flap. Seal all flaps and butt strips with vapor barrier adhesive, or alternatively, secure them with staples every 75 mm and cover them with vapor barrier tape. Pipe insulation with integral self-sealing vapor barrier jacketing does not require additional fastening.
 - .2 Fittings:
 - .1 Insulate fittings with sections of pipe insulation mitered to fit tightly or with tightly fit flexible insulation then apply reinforcing membrane embedded in vapour barrier coating. Alternatively, insulate fittings with tightly fit flexible insulation then apply reinforcing membrane embedded in vapour barrier coating and apply PVC fitting cover.
 - .3 Valves and strainers:
 - .1 Insulate valve bodies, flanges, and strainers with insulating cement, fitted pipe insulation segments, or mitred blocks, all of the same thickness as the adjacent insulation and then apply a vapor barrier coated reinforcing membrane. Alternatively, insulate with tightly fitted flexible insulation, then apply a vapor barrier coated reinforcing membrane. Drains, drain plugs and caps to be left uncovered. Alternatively, insulate with tightly fit flexible insulation, then apply a vapor barrier coated reinforcing membrane and apply PVC cover.

- .4 Flanges:
 - .1 Insulate flanges with oversized pipe covering or mitred blocks of the same thickness as the adjacent pipe covering, then cover with a vapor barrier coated reinforcing membrane. Alternatively, insulate with flexible insulation covered with a vapor barrier coated reinforcing membrane and apply PVC cover.
- .3 Finishes:
 - .1 See article "JACKETS" of Part 2.
 - .2 Indoor (exposed areas):
 - .1 Factory applied all service jacket must be properly applied to receive the fire retardant canvas jacket. Install the jacket with an adhesive coating.
 - .2 Fittings (valves and strainers, if specified) not finished with a PVC cover must be covered with a layer of hard cement and finished with a fire retardant canvas applied with an adhesive coating.
 - .3 Finish the lining with a layer of adhesive coating.
 - .3 Indoor (concealed areas):
 - .1 Apply pipe insulation with factory applied all service jacket. Secure the jacket with appropriate fasteners at approximately 100 mm centre to centre. Cover longitudinal and circumferential joints with a tight fitted jacket finishing tape. Alternatively, secure the jacket using the integral self-sealing overlap joints and self-sealing circumferential joint bands.
 - .2 Fittings (valves and strainers, if specified) not finished with a PVC cover must be covered with a layer of hard cement and finished with a fire retardant canvas applied with an adhesive coating.

3.4 PIPING INSULATION SCHEDULE – PLUMBING

- .1 On all drainage plumbing for condensate pans of chilled water and glycol cooling coils, refrigerant, fan coil units, as well as on the drainage piping for the funnels serving these systems to the connections to the sanitary risers:
 - .1 Insulation: type B tubular form for copper pipes, type C for cast iron pipes.
 - .2 Thickness: 10 mm for type B and 15 mm for the type C.

3.5 PIPING INSULATION SCHEDULE – REFRIGERANT PIPING

- .1 Refrigerant from 4 to 13°C:
 - .1 Insulation: type B, with tubular elements
 - .2 Thickness: 25 mm everywhere
- .2 Refrigerants under 4°C:
 - .1 Piping up to NPS 1:
 - .1 Insulation: type B, with tubular elements
 - .2 Thickness: 25 mm

- .2 Piping up NPS 1¼ and more:
 - .1 Insulation: type B, with tubular elements
 - .2 Thickness: 38 mm

END OF SECTION

Part 1 General**1.1 RELATED REQUIREMENTS**

- .1 Section 23 81 40 – Air Source Unitary Heat Pump.
- .2 Section 23 84 13 – Humidifiers.
- .3 Section 26 05 00 – Common Work Results for Electrical

1.2 SYSTEM DESCRIPTION

- .1 Supply, install, and commission all controls systems shown on the drawings and described in these specifications.
- .2 Provide all labour, material and equipment that may or may not be specifically referred to herein or on the drawings, that are required to meet the functional intent of these specifications.
- .3 Controls work includes, but is not limited to, the following:
 - .1 All electrical and DDC type controls required for HVAC systems, electrical heating and electro-mechanical equipment, unless specified as part of another section.
 - .2 Control and monitoring panels and local cabinets.
 - .3 Replacement of the existing controls for AC-05, as indicated.
 - .4 Removal of the winter/summer switches, installed in rooms 126 and 120, associated with AC-05 and AC-04, and patching of these with a stainless steel cover plate.
 - .5 To prevent fighting between the existing perimeter electric heaters and the AC units, a lockdown strategy is implemented, as indicated on drawing M-603. Provide a programmable digital thermostat and the require relay logic for the electric heaters outdoor air temperature lockdown.
 - .6 Complete electrical installation including conduits, cables, junction boxes, etc. required for control systems, as shown on drawings and described in these specifications, as well as all electrical connections required to motor control centers and starters, interlocks for fans, pumps or other controls (e.g. device, panels).
 - .7 Electric power at 120V/1/60 and 24 V feeding control panels.
 - .8 All controls required for ventilation – air conditioning, and one humidifier.
 - .9 The decommissioning work and the selective demolition of all controls equipment and wiring not reused in the new installation.
 - .10 Provide support during the calibration and balancing of the ventilation systems.
 - .11 Provide Departmental Representative supervision, adjustments, and calibrations for the DDC control system, for new and existing controllers.
 - .12 Provide documentation for system start-up, initial commissioning, training, operating and maintenance for all systems.

- .13 Close-out documentation to include:
 - .1 Equipment: descriptive data, installation sheet, service manuals, operation/maintenance manuals and recommended spare parts lists.
 - .2 Instrumentation and control schematics and point-to-point wiring diagrams.

1.3 SUBMITTALS

- .1 Submit shop drawings as per Section 01 33 00 – Submittal Procedures and include following:
 - .1 Complete bill of materials indicating quantity, manufacturer and model number of equipment to be used and the associated equipment ID.
 - .2 Detailed layouts of each control panel including a bill of materials and system schematics.
 - .3 Specification sheets for each item. To include manufacturer's descriptive literature, manufacturer's installation recommendations, specifications, drawings, diagrams, performance and characteristic curves, catalogue cuts, manufacturer's name, trade name, catalogue or model number, nameplate data, size, layout, dimensions, capacity, other data to establish compliance.
 - .4 Wiring schematics for each controlled system. Label control elements and terminals. Where a control element is also shown on control schematic use the same name.
 - .5 Controller locations and auxiliary control cabinet locations.
 - .6 Sequences of operation for each system in descriptive format

1.4 CODES AND STANDARDS

- .1 All wiring and conduit systems for instrumentation and controls systems to comply with CSA C22.1-21, Canadian Electrical Code, Part 1 (25th Edition), Safety Standard for Electrical Installations.

1.5 WIRING AND ACCESSORIES INSIDE PANELS

- .1 Wiring systems with different voltage levels or types shall be suitably segregated within panels, according to relevant electrical codes.

1.6 EXISTING CONDITIONS - CONTROL COMPONENTS

- .1 Submit to the Departmental Representative a written request for permission to disconnect controls and to obtain equipment downtime before proceeding with Work.

1.7 ELECTRICAL INSTALLATION

- .1 The General Contractor is responsible for the hiring of a qualified and licensed electrical contractor for the following work:
 - .1 Complete electrical installation including material and labor for all conduits, cables, junction box, etc. required for control and automation systems.

- .2 120V single phase power source for controls, local monitoring panels, cabinets and transformers provided by this Division.
- .3 All controls related connections to motor control centers or starters, interlocks for fans, pumps and other control components.
- .4 Grounding systems required for all systems and devices provided under Division 23, in accordance with manufacturer's instructions and requirements of Division 26.
- .2 Quality Assurance:
 - .1 Electrical contractor to hold a valid Master Electrical contractor license as issued by the Province of Ontario.

1.8 MISCELLANEOUS WORK

- .1 Are included in control work:
 - .1 Supply and installation of field control devices, conduits, wiring and system connections for controls of all sections, unless specified as being part of another section.
 - .2 Split unit AC-03/C-03, AC-04/C-04 and AC-05/C-05:
 - .1 Provide and install all wiring, equipment and electrical conduits required for controls in this contract.
 - .2 The interlock between the standalone unit and the condenser.
 - .3 Coordinate required signal types between all equipment suppliers for all sections.

Part 2 Products

2.1 GENERAL

- .1 Control devices of each category to be of same type and manufacturer.
- .2 Operating conditions: 0 – 40 degrees C with 10 – 90 % RH (non-condensing) unless otherwise specified.
- .3 Terminations: use standard conduit box with slot screwdriver compression connector block unless otherwise specified.
- .4 Account for hysteresis, relaxation time, maximum and minimum limits in applications of sensors and controls.
- .5 Outdoor installations: use weatherproof construction in NEMA 4 enclosures.
- .6 Range: including temperature, humidity, and pressure, as indicated in system Sequences of Operation, part 3 of this section.
- .7 Control devices to satisfy the following requirements:
 - .1 Controls must react to changing conditions.
 - .2 Linearity: relationship between control device measurement (temperature, humidity, pressure, etc.) and output signal to be linear type.

2.2 ELECTROMECHANICAL RELAY - R

- .1 4PDT or DPDT, plug-in type with termination base and LED status indicators.
- .2 Coils: rated for 120V AC or 24V DC.
- .3 Contacts: rated at 10 amps at 120 V AC.
- .4 In applications where relay is subject to vibration, provide hold-on clips.

2.3 TIMER RELAY – TR

- .1 Multifunction electronic relay, plug in type with termination base.
- .2 Multi-voltage rating: 100 to 240 V A.C., 24 to 48 V A.C./D.C.
- .3 Field selectable time range from .05 second to 300 hours (site adjustable).
- .4 In applications where relay is subject to vibration, provide hold-on clip.
- .5 Select the time range based on application.

2.4 PROGRAMMABLE DIGITAL THERMOSTAT

- .1 For outdoor air temperature lockout:
 - .1 Stand-alone digital controller, for panel mounting complete with graphical user-interface, lockable keypad, real-time internal clock and non-volatile memory.
 - .2 Supply for use as a thermostat, complete with remote outdoor temperature sensor and NEMA-4X housing.
 - .3 The controller allows the configuration of inputs, outputs, integral and derivative time constants, value of reset setpoints and the calibration of sensors connected.
 - .4 Power requirements: 120 VAC, 60Hz.
- .2 I/O requirements:
 - .1 (1) Analog Input accepting 1,097 ohms PTC type thermistor.
 - .2 (1) Universal Input, configurable for 0-5 Vdc, 0-10 Vdc or 4-20 mA.
 - .3 (2) Universal Outputs, configurable for 2-10 Vdc, 0-10 Vdc or 4-20 mA.
 - .4 (1) Digital Output.
 - .5 Relay Contact Outputs.

2.5 LOCAL CONTROL PANEL

- .1 Cabinet type, complete with key-lockable front door mounted on concealed hinges, easily removable to provide interior access. Installed on rigid support for mounting on wall or pipe stand. Enclosure rating to NEMA-4X.
- .2 Locate to provide a minimum clearance of 1000 mm in front of panel.

- .3 Accessories:
 - .1 All controls equipment including relays, switches, fuses, terminal blocks, etc., to be installed inside the panel.
 - .2 Push buttons, pilot lights, selector switches, to be surface mounted on the panel's front door and NEMA rated.
 - .3 All wiring shall be inside raceways of adequate size with 40% of free space.
- .4 Identification:
 - .1 Identify each device installed within the control panel using pre-printed electronically generated self-adhesive vinyl labels.
 - .2 Label all wiring and terminals inside the control panel. Identification to match wiring diagrams.
- .5 Terminal blocks:
 - .1 All joints and connections inside the panel must be done on screw-type terminal blocks.
 - .2 Industrial grade modular type terminal blocks, DIN-rail mounted with vibration proof screw connections and color coded labelled terminals and voltage and current separators.
 - .3 Allow 15% (minimum 10 terminals) spare capacity per panel.
- .6 Provide a manual switch inside the panel for the 120V power supply.
- .7 Supply and install on the interior of the panel's front door, a detailed schematic diagram of the system's arrangement, including all wiring and devices identification. Schematic drawing to be sealed in a transparent plastic case.

2.6 TRANSFORMER – TR

- .1 Single phase transformer, enclosed type complete with fuse holder and fuse. Transformer capacity in VA to be at least 20% greater than the rated charge to be connected. As per MC series from Marcus or approved equivalent from Hammond. Use of transformers with integrated thermal protection or with intrinsic limitation as an alternative to fuses is prohibited.

Part 3 Execution

3.1 INSTALLATION

- .1 Install equipment, components so that manufacturer's and CSA labels are visible and legible after commissioning is complete.
- .2 Install field control devices in accordance with manufacturers recommended methods, procedures and instructions.
- .3 All controls components must be easily accessible for maintenance.
- .4 Fire stopping: provide space for fire stopping and maintain fire rating integrity.

- .5 Locate control panels to provide a minimum clearance of 1000 mm in front of panel.

3.2 ELECTRICAL INSTALLATION

- .1 Complete installation in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Terminate wires with screw terminal type connectors suitable for wire size, and number of terminations.
- .3 Provide grounding for controls systems and instrumentation in accordance with Division 26 and manufacturer's recommendations.
- .4 Wiring:
 - .1 Wiring must be continuous without joints.
 - .2 All wiring shall be run in EMT conduit.
 - .3 Maximum conduit fill not to exceed 50%.
 - .4 Wiring sizes:
 - .1 120 V: #12AWG minimum.
 - .2 24 V: #18AWG minimum.
 - .3 Power loss through conductor shall not exceed 5%.

3.3 TEMPERATURE AND HUMIDITY SENSORS

- .1 Stabilize to ensure minimum field adjustments or calibrations.
- .2 Readily accessible and adaptable to each type of application to allow for quick easy replacement and servicing without special tools or skills.
- .3 Room installations:
 - .1 Locations of room thermostat/humidistat shown on drawings are approximate and given as reference only.
 - .2 Room thermostat shall not be affected by the sun or any other heat, cold or draft sources. When it is necessary to install a thermostat on a hot or cold wall, provide a ventilated and insulated base.
 - .3 Install room thermostat/humidistat 1500 mm above finished floor.
 - .4 Never install thermostat above switches, rheostats or other heat-generating devices.

3.4 COMMISSIONING

- .1 Carry out commissioning in compliance with Section 01 91 13 – General Commissioning Requirements and additional requirements of this section.
- .2 Inform, and obtain approval from, Departmental Representative in writing at least 7 days prior to commissioning or each test. Indicate:
 - .1 Location and part of system to be tested or commissioned.
 - .2 Testing/commissioning procedures, anticipated results.

- .3 Names of testing/commissioning personnel.
- .3 Correct deficiencies, re-test in presence of Commissioning Authority until satisfactory performance is obtained.
- .4 Acceptance of tests will not relieve Contractor from responsibility for ensuring that complete systems meet every requirement of project.
- .5 Load system with project software.
- .6 Perform tests as required.

3.5 COMPLETION OF COMMISSIONING

- .1 Commissioning to be considered as satisfactorily completed when objectives of commissioning have been achieved and reviewed by Departmental Representative.

3.6 IDENTIFICATION

- .1 Power wiring:
 - .1 Power wiring: identify circuit breaker number and panel ID inside each control panel.
 - .2 Supply and install numbered tape markings on wiring at panels, junction boxes, splitters, cabinets and outlet boxes.
 - .3 Distribution panels: Identify breaker for controls and EMCS.
- .2 Control wiring:
 - .1 Identify field device and network wiring end-to-end with plastic rings printed with indelible number markings. Alternatively, use pre-printed labels specifically designed for wiring identification.
 - .2 Inside control panels, label terminals of terminal blocks with the same identification used on wiring schematics.
 - .3 Use distinctive colour coded wiring for communications cables, matched throughout system. Color to be coordinated with the Departmental Representative.
- .3 Nameplates:
 - .1 Panels:
 - .1 Identify by Plastic laminate, 3 mm thick black core, square corners, lettering accurately aligned and engraved into core.
 - .2 Sizes: 25 x 67 mm minimum.
 - .3 Lettering: minimum 7 mm high, black.
 - .4 Inscriptions: machine engraved to identify function.
 - .2 Room thermostat:
 - .1 Identify each device with pre-printed electronically generated self-adhesive vinyl labels.

3.7 SEQUENCES OF OPERATION

- .1 Sequences and procedures described in this part of the current section represent minimum operation criteria, omitting small details required for system fine tuning.
- .2 AC-03/C-03
(Ref.: Drawing M-601)
 - .1 At shutdown:
 - .1 AC-03 is disabled at the thermostat:
 - .1 The fan is stopped;
 - .2 The outdoor unit is stopped;
 - .3 By interlock the electric heaters are disabled.
 - .2 At start-up:
 - .1 AC-03 is enabled at the thermostat:
 - .1 The fan starts;
 - .2 Controls are operational.
 - .3 Normal operation:
 - .1 The system operates according to an occupied time schedule configured at AC-03 thermostat.
 - .2 The thermostat controls the compressor, reversing valve and enables the electric baseboards as a second heating stage to maintain the room temperature between the heating and cooling setpoints (21°C and 23°C, respectively – adjustable at the thermostat).
 - .3 When enabled, the electric baseboard are controlled by an existing electric thermostat to maintain the room at the temperature adjusted at the existing electric thermostat.
 - .4 Operation during off-hours:
 - .1 The thermostat restarts the system to maintain heating and cooling night setbacks (18°C and 26°C, respectively – adjustable at AC-03 thermostat).
 - .5 Power loss:
 - .1 System stops.
 - .6 Fire detection:
 - .1 Not applicable.
 - .7 Protections:
 - .1 Not used.

.3 AC-04/C-04

(Ref.: Drawing M-602)

.1 At shutdown:

- .1 AC-04 is disabled at the thermostat:
 - .1 The fan is stopped;
 - .2 The outdoor unit is stopped;
 - .3 By interlock, the electric heaters are disabled.

.2 At start-up:

- .1 AC-04 is enabled at the thermostat:
 - .1 The fan starts;
 - .2 Controls are operational.

.3 Normal operation:

- .1 The system operates according to an occupied time schedule configured at AC-04 thermostat.
- .2 The thermostat controls the compressor, reversing valve and enables the electric baseboards as a second heating stage to maintain the room temperature between the heating and cooling setpoints (21°C and 23°C, respectively – adjustable at the thermostat).
- .3 When enabled, the electric baseboard are controlled by an existing electric thermostat to maintain the room at the temperature adjusted at the existing electric thermostat.

.4 Operation during off-hours:

- .1 The thermostat restarts the system to maintain heating and cooling night setbacks (18°C and 26°C, respectively – adjustable at AC-04 thermostat).

.5 Power loss:

- .1 System stops.

.6 Fire detection:

- .1 Not applicable.

.7 Protections:

- .1 Not used.

.4 AC-05/C-05

(Ref.: Drawing M-602)

.1 At shutdown:

- .1 AC-05 is disabled at the thermostat:
 - .1 The fan is stopped;

- .2 The outdoor unit is stopped;
 - .3 By interlock, the electric heaters are enabled.
 - .2 At start-up:
 - .1 AC-05 is enabled at the thermostat:
 - .1 The fan starts;
 - .2 Controls are operational.
 - .3 Normal operation:
 - .1 The system operates according to an occupied time schedule configured at AC-05 thermostat.
 - .2 The thermostat controls the compressor to maintain the room temperature at the cooling setpoints (23°C – adjustable at the thermostat).
 - .3 On a call for cooling from the thermostat, the electric baseboards are disabled by a hardwire interlock.
 - .4 When enabled, the electric baseboard are controlled by an existing electric thermostat to maintain the room at the temperature adjusted at the existing electric thermostat.
 - .4 Operation during off-hours:
 - .1 The electric baseboards operates to maintain the room temperature at the setpoint set at existing electric thermostat.
 - .2 AC-05 thermostat restarts the system to maintain the room temperature at the cooling unoccupied setpoint (26°C, respectively – adjustable at the thermostat).
 - .5 Power loss:
 - .1 System stops.
 - .6 Fire detection:
 - .1 Not applicable.
 - .7 Protections:
 - .1 Not used.
- .5 AC-06/C-06
(Ref.: Drawing M-602)
 - .1 At shutdown:
 - .1 AC-06 is stopped at the unit interface.
 - .2 The condenser is stopped.
 - .2 At start-up:
 - .1 AC-06 is enabled at the unit interface:
 - .1 The fan starts;

- .2 Controls are operational.
 - .3 Normal operation:
 - .1 The system operates as a supplementary cooling system in room 111.
 - .2 The thermostat starts the mini-split when room temperature reaches the setpoint (25°C).
 - .3 The thermostat stops the mini-split when the room temperature reaches setpoint -1°C (24°C).
 - .4 Operation during off-hours:
 - .1 As per normal operation.
 - .5 Power loss:
 - .1 System stops.
 - .6 Fire detection:
 - .1 Not used.
 - .7 Protections:
 - .1 Not used.
- .6 SUMMER GENERAL LOCKOUT
(Ref.: Drawing M-602)
- .1 The programmable digital thermostat disables the electric heaters when the outdoor air temperature rises above 16°C (adjustable at the thermostat).

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 23 05 15 – Common Installation Requirements for HVAC Pipework.
- .2 Section 23 07 19 – HVAC Piping Insulation.
- .3 Section 23 81 40 – Air and Water Source Unitary Heat Pumps.

1.2 REFERENCES

- .1 ASME:
 - .1 ASME B16.22-13, Wrought Copper and Copper Alloy Solder - Joint Pressure Fittings.
 - .2 ASME B16.24-16, Cast Copper Pipe Flanges and Flanged Fittings: Class 150, 300, 600, 900, 1500 and 2500.
 - .3 ASME B16.26-13, Cast Copper Alloy Fittings for Flared Copper Tubes.
 - .4 ASME B31.5-19, Refrigeration Piping and Heat Transfer Components.
- .2 ASTM International:
 - .1 ASTM-A307-21, Standard Specification for Carbon Steel Bolts and Studs, and Threaded Rod 60,000 psi Tensile Strength.
 - .2 ASTM-B280-20 – Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service.
- .3 CSA Group:
 - .1 CSA B52-13, Mechanical Refrigeration Code.
- .4 Environment Canada (EC):
 - EPS 1/RA/1-2015 (R2021) – Environmental Code of Practice for Elimination of Fluorocarbon Emissions from Refrigeration and Air Conditioning Systems.

1.3 SUBMITTALS

- .1 Submit the documents and samples required in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Product data:
 - .1 Submit manufacturer's printed product literature, specifications and data sheet for the refrigerant piping, joints, and material. Data sheets must include product characteristics, performance criteria, dimensions, limits and finish.

1.4 CLOSEOUT SUBMITTALS

- .1 Supply all operation and maintenance documents along with manual as per Section 01 78 00 – Closeout Submittals.
- .2 Operation and maintenance data (O&M): provide instructions with respect to the operation and maintenance of the refrigerant fluid circuit, to be incorporated into the O&M manual.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Transport, store and handle materials in accordance with Section 01 61 00 – Common Product Requirements.
- .2 Shipping and receiving: deliver material to site in the original packaging, which must bear the name and address of the manufacturer.
- .3 Waste management and disposal:
 - .1 Separate waste materials for reuse/recycling in accordance with Section 01 74 19 – Waste Management and Disposal.
 - .2 Remove from site and dispose of packaging materials at appropriate recycling facilities.
 - .3 Collect and separate for disposal paper, plastic, polystyrene and corrugated cardboard packaging material for recycling in accordance with the waste management plan.
 - .4 Separate steel, metal and plastic materials in designated containers for recycling in accordance with the waste management plan.
 - .5 Divert unused metal materials from landfill to metal recycling facility.

Part 2 Product

2.1 PIPING

- .1 Treated, deoxidized, dehydrated, and sealed copper piping, designed for refrigeration installations.
 - .1 Hard drawn copper pipe: ASTM-B280, ACR type.
 - .2 Annealed copper pipe: ASTM-B280, at a minimum wall thickness according to the standards CSA B52 and ASME B31.5.

2.2 FITTINGS

- .1 Operating conditions: calculation pressure and temperature of 2070 kPa and 121°C respectively.
- .2 Brazing fittings:
 - .1 Connectors: wrought copper, B16.22 ASME.
 - .2 Brazing: silver (silfos) solder, with non-corrosive flux.
- .3 Flanged fittings:
 - .1 Connecting elements: bronze or brass, designed for refrigeration networks, ASME B16.26.

2.3 SLEEVES

- .1 Hard drawn copper or steel sleeves, with a diameter suitable for the passage of insulated or non-insulated tubes, for both cases, annular clearance of 6 mm in width.

2.4 VALVES

- .1 Valve of diameter equal to or smaller than 22 mm: globe valves, straight or angled, class 500, 3.5 MPa category, with membrane, non-directional, without gland gasket, forged brass body and bonnet, waterproof joint suitable for temperatures lying below the freezing point, and welding ends.
- .2 Valve of diameter equal to or larger than 22 mm: globe valves, straight or angled, class 375, 2.5 MPa category, with membrane, without gland gasket, with sealing device behind the plug, sealing cap, cast bronze body and bonnet, waterproof joint suitable for temperatures lying below the freezing point, and welding ends.

Part 3 Execution

3.1 INSTALLATION

- .1 Install piping in accordance with the standards CSA B52 and ASME B31.5, the document 1/RA/1 issued by EPS and section 23 05 15– Common Installation Requirements for HVAC Pipework.
- .2 Perform refrigeration work according to the codes in effect and the diagrams outlined in the drawings. The work must be performed by accredited refrigeration Contractors.
- .3 Welding:
 - .1 During welding, maintain a nitrogen flow in the piping, provided by a cylinder with a regulator.

3.2 SUPPORTS

- .1 Firmly support piping every 3 m, primarily on the exterior using a wood frame treated with a fungicide product meeting the environmental standards.

3.3 TESTING AND FILLING

- .1 Testing pressurized piping:
 - .1 Close the valves to isolate the factory-loaded devices and all devices that are not to be tested to prevent their deterioration.
 - .2 Raise the pressure, high/low pressure sides, with nitrogen, according to the standard CSA B52 and the applicable provincial code.
 - .3 After twenty-four (24) hours, check for leaks using a soap solution or dye based indicator. Repair leaking joints and resume testing.
- .2 Testing piping under vacuum:
 - .1 By means of a vacuum pump specifically designed for this purpose, perform the first vacuum test at a pressure of at least 500 μm Hg (absolute pressure) and maintain this vacuum for at least four (4) hours.
 - .2 Break the vacuum by introducing nitrogen.
 - .3 Perform a second vacuum test at a pressure of 300 μm Hg.
 - .4 If after twelve hours the pressure goes back to over 500 μm Hg, retest.
 - .5 Isolate the network pump and note the values under vacuum and the time until the vacuum stabilizes.

.6 These tests must be carried out when the ambient temperature is at least 4°C.

3.4 THERMAL INSULATION

- .1 All relevant clauses from section 23 07 19 – HVAC Piping Insulation that apply to this section's work.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 23 05 15 – Common Installation Requirements for HVAC Pipework
- .2 Section 23 05 29 – Hangers and Supports for HVAC Piping and Equipment.
- .3 Section 23 33 00 – Air Duct Accessories.

1.2 REFERENCES

- .1 American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE).
- .2 ASTM International:
 - .1 ASTM A480/A480M-20a, Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet and Strip.
 - .2 ASTM A635/A635M-15, Standard Specification for Steel, Sheet and Strip, Heavy-Thickness Coils, Hot-Rolled, Alloy, Carbon, Structural, High-Strength Low-Alloy, and High-Strength Low-Alloy with Improved Formability, General Requirements.
 - .3 ASTM A653/A653M-13. Standard Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process.
- .3 Green Seal Environmental Standards (GS):
 - .1 GS-36-13, Standard for Adhesives for Commercial Use.
- .4 National Fire Protection Agency Association (NFPA):
 - .1 NFPA 90A, Standard for the Installation of Air-Conditioning and Ventilating Systems. 2018 Edition.
 - .2 NFPA 90B, Standard for the Installation of Warm Air Heating and Air-Conditioning Systems. 2018 Edition.
 - .3 NFPA 96, Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations. 2014 Edition.
- .5 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA):
 - .1 SMACNA HVAC – Duct Construction Standards - Metal and Flexible, 2006.
 - .2 SMACNA HVAC – Air Duct Leakage Test Manual, 2012.
 - .3 IAQ – Guideline for Occupied Buildings Under Construction 2008.
- .6 South Coast Air Quality Management District (SCAQMD), California State, Regulation XI. Source Specific Standards:
 - .1 SCAQMD Rule 1168-A2017 – Adhesives and Sealants Applications.

1.3 SUBMITTALS

- .1 Submit documents in accordance with Section 01 33 00 – Submittal Procedures.

- .2 Product data:
 - .1 Submit manufacturer's printed product literature, specifications and data sheet for fixtures and equipment.
- .3 Certificates:
 - .1 Submit certificates signed by the manufacturer certifying that the products and materials comply with the specified performance and physical requirements.

1.4 CLOSEOUT SUBMITTALS

- .1 Submit all document/elements required, in accordance with Section 01 78 00 – Closeout Submittals.
- .2 Operation and maintenance data (O&M): provide instructions with respect to the operation and maintenance, to be incorporated into the O&M manual.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Transport, store and handle hazardous materials in accordance with Section 01 61 00 – Common Product Requirements.
- .2 Shipping and receiving: deliver material to site in the original packaging, which must bear the name and address of the manufacturer.
- .3 Waste management and disposal:
 - .1 Separate waste materials for recycling in accordance with Section 01 74 19 – Waste Management and Disposal.
 - .2 Remove from site and dispose of packaging materials at appropriate recycling facilities.
 - .3 Collect and separate for disposal paper, plastic, polystyrene and corrugated cardboard packaging material for recycling in accordance with the waste management plan.
 - .4 Separate steel, metal and plastic materials in designated containers for recycling in accordance with the waste management plan.
 - .5 Divert unused metal materials from landfill to metal recycling facility.

Part 2 Product

2.1 GENERAL

- .1 Unless otherwise specified, manufacture the ducts in galvanized steel. If the ducts are made of aluminum, use aluminum sheets with a thickness corresponding to the following table:

Galvanized steel:						
– CAL US	26	24	22	20	18	16
– mm	0.551	0.701	0.853	1.006	1.311	1.613
Aluminum:						
– CAL B & S	24	22	20	18	16	14
– mm	0.508	0.635	0.813	1.016	1.295	1.626

- .2 For all cases, the faces of each duct section will have the same thickness. The thickness of the sheet and the dimensions of the transverse seals and the reinforcements are determined by the dimensions of the largest side. Visibly mark the caliber of the sheet on the outer face of the duct for inspection purposes.
- .3 To ensure the rigidity to the ducts, the sheet will be marked with transverse ribs (stop beads) when manufacturing the pipes. The spacing between the ribs is 300 mm at most. The method of marking two diagonal plies (cross breaking) on all flat surfaces 200 mm and more in width is also acceptable. For either method, the sheet gauge required will be the same.
- .4 For energy saving needs, seal the joints of ducts conveying treated air.
- .5 At the locations shown in the drawings, block the ends of the ducts for future connections. Use galvanized steel sheet metal of the same gauge as the duct. These caps must be airtight and withstand the static pressures of the relevant systems.
- .6 Ducts exiting service shafts: installed inside the shaft with a collar securely fastened to the duct and to the shaft wall. Seal the joints.
- .7 Definitions:
 - .1 Low pressure ducts:
 - .1 Ducts with a static pressure less than 500 Pa and an air velocity below 610 m/min.
 - .2 Treated air ducts:
 - .1 Ductwork supplying heated or cooled air.
- .8 Before starting the installation of any ducts, demonstrate with tested samples that the specification requirements are met.

2.2 LOW PRESSURE DUCTS

- .1 Ducts:
 - .1 For the sheet thickness, the types of joints, and the reinforcements for rectangular, round, and oval ducts, see the details in the drawings.
- .2 Connections:
 - .1 All branch connections must have 45° angle lateral outlets, 150 mm in length.
 - .2 For any branch connections serving a supply grille placed within 600 mm of the main duct and any other branch connected at right angles without adaptors, install "extractor" type guide blades with adjustment rod and lock screw inside or outside the duct, depending on the ceiling type. The extractor must be able to completely close off the branch. If the air speeds are greater than 365 m/min., it must be manufactured to withstand these speeds.
 - .3 For the air supply terminal units and the diffusers, when connected by a flexible duct with adjustable damper, as well as for connecting a duct to a plenum, see the details in the drawings.

- .3 Joints:
 - .1 Rectangular ducts:
 - .1 All corners of tee joints will be sealed using butyl tape placed over the joint and held in place by the cover flap of the two metal strips. See details in the drawings.
- .4 Access doors:
 - .1 See details on the drawings.

2.3 PROTECTIVE PAINT

- .1 When a steel sheet's galvanization is damaged by electric welding or some other act, apply two layers of cold galvanizing compound containing a maximum of 221 g/L of VOCs and leaving a dry film of 92% zinc. This compound will also be applied to protect any metal surface (galvanized steel, carbon steel, cast iron, and aluminum, when required). Matte grey finish.
- .2 Use two coats of paint (such as epoxy-based) for the protection of galvanized steel sheet for certain special systems described in paragraph "Locations" above. Apply these paint layers after degreasing.

Part 3 Execution

3.1 SUPPORTS AND ANCHORS

- .1 General:
 - .1 Comply with Section 23 05 29 – Hangers and Supports for HVAC Piping and Equipment, and with the tables included in the drawings.
 - .2 Adequately support all ducts, equipment, and devices to the structure. These supports include the entire steel structure, the steel beams, the structural irons, the angle irons, the steel rods, the steel plates, the supports from specialized manufacturers and other accessories necessary for the work, and all drilling, anchoring, and welding work required.
 - .3 Prior to the manufacturing and the installation, provide shop drawings of all types of supports.
- .2 Support rods:
 - .1 Mild steel rods, diameter according to the table on drawings.
- .3 Horizontal ducts:
 - .1 General:
 - .1 Securely support the ducts to the structural frame by means of rods and angles.
 - .2 Firmly affix the steel rods used to secure the supports to the concrete slabs or the steel frame.
 - .3 Coat all support elements with a layer of aluminium-based paint.

- .4 Install additional hangers at every bend, every change of direction, the connections fittings, and any additional steel required to support the pipes in the shafts.

3.2 ELBOWS

- .1 Rectangular ducts:
 - .1 Wherever pipes change direction with an average radius smaller than 1.5 times the dimension of the pipe, install directional vents arranged proportionately to ensure a pressure loss that is not greater than that caused by a change in direction respecting the ratio $R/D = 1.5$. For square elbows, install double-walled vents, with low-loss blades. Submit manufacturing details, performance details, and samples.

3.3 LEAK TIGHTNESS OF THE JOINTS BETWEEN PIPES, DUCTS, ETC.

- .1 Make watertight and airtight the joints between the ventilation ducts and the pipes passing through these ducts, as well as the openings required for all control devices, humidifiers, and electrical conduits going through the ducts.

3.4 LEAK TIGHTNESS OF OPENINGS

- .1 Perform the sealing work for the openings required through the slabs and the walls for the passage of ducts and pipes supplying the diffusers or others. See the article "SEALING OF OPENINGS" from Section 23 05 15. Common Installation Requirements for HVAC Pipework.

3.5 ACCESS AND INSPECTION DOORS

- .1 Provide access doors at the locations indicated on the drawings and where required.
- .2 Provide inspection doors of 450 mm x 450 mm or of equivalent dimensions, depending on the dimensions of the duct (unless otherwise indicated), close to each motorized or manual damper, control instrument, fire damper, combustion product analyzer, humidifier, intake or exhaust motor, upstream and downstream of each coil and other equipment.
- .3 Place the doors for easy access.
- .4 Reinforce the opening and align the doors. Seal the doors using a permanently installed flexible rubber seal (foam rubber not accepted).
- .5 In insulated walls construct doors out of a double panel with mineral fibre filler between the two panels of a thickness equivalent to the wall insulation

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 23 31 13.01 – Metal Ducts – Low Pressure to 500 Pa.

1.2 REFERENCES

- .1 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA):
 - .1 SMACNA – HVAC Duct Construction Standards – Metal and Flexible, 2006.

1.3 SUBMITTALS

- .1 Submit documents in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Product data:
 - .1 Submit manufacturer's printed product literature, specifications and data sheet for fixtures and equipment.
Indicate:
 - .1 Flexible connections.
 - .2 Duct access doors.
 - .3 Turning vanes.

1.4 CLOSEOUT SUBMITTALS

- .1 Submit all document/elements required, in accordance with Section 01 78 00 – Closeout Submittals. Operation and maintenance data (O&M): provide instructions with respect to the operation and maintenance, to be incorporated into the O&M manual.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Transport, store and handle hazardous materials in accordance with Section 01 61 00 – Common Product Requirements.
- .2 Shipping and receiving: deliver material to site in the original packaging, which must bear the name and address of the manufacturer.
- .3 Waste management and disposal:
 - .1 Separate waste materials for recycling in accordance with Section 01 74 19 – Waste Management and Disposal.
 - .2 Remove from site and dispose of packaging materials at appropriate recycling facilities.
 - .3 Collect and separate for disposal paper, plastic, polystyrene and corrugated cardboard packaging material for recycling in accordance with the waste management plan.
 - .4 Separate steel, metal and plastic materials in designated containers for recycling in accordance with the waste management plan.
 - .5 Divert unused metal materials from landfill to metal recycling facility.

Part 2	Product
2.1	GENERAL
.1	The accessories must be manufactured according to the SMACNA HVAC Duct Construction Standard.
2.2	FLEXIBLE CONNECTIONS
.1	Frame:
.1	Galvanized sheet metal frame 1.5 mm thick with fabric secured by means of double locked seams.
.2	Material:
.1	Fire resistant, self-extinguishing, neoprene coated glass fabric, temperature rated at -40 degrees C to 90 degrees C, density of 1.3 kg/m ² .
2.3	ACCESS DOORS
.1	Non-insulated ducts: double-walled doors (sandwich panels), the same material as used for the ducts, but of the next largest thickness (not be thinner than 0.6 mm), with angle iron frame.
.2	Insulated ducts: double-walled doors (sandwich panels), the same material as used for the ducts, but of the next largest thickness (not be thinner than 0.6 mm), with angle iron frame and rigid insulation, fiberglass, 25 mm thick.
.3	Seals: neoprene.
.4	Hardware parts:
.1	Doors measuring up to 300 mm wide: two (2) latches for the frame.
.2	Doors measuring between 301 mm and 450 mm wide: four (4) latches for the frame.
.3	Doors measuring between 451 mm and 1000 mm wide: a piano hinge and at least two (2) latches for the frame.
.4	Doors measuring over 1000 mm side: a piano hinge and two (2) handles operable from the inside and from the outside.
.5	Device to hold the open position.
2.4	TURNING VANES
.1	Factory or shop fabricated double thickness to recommendations of SMACNA and as indicated.
2.5	INSTRUMENT TEST
.1	1.6 mm thick steel zinc plated after manufacture.
.2	Cam lock handles with neoprene expansion plug and handle chain.
.3	28 mm minimum inside diameter. Length to suit insulation thickness.
.4	Neoprene mounting gasket.
2.6	SPIN-IN COLLARS
.1	Conical galvanized sheet metal spin-in collars with lockable butterfly damper.

- .2 Sheet metal thickness to co-responding round duct standards.

2.7 BALANCING DAMPERS - SINGLE BLADE

- .1 Only permitted on round ducts and rectangular ducts up to 100 mm in height:
 - .1 Fabricate from same material as duct, but one sheet metal thickness heavier. V-groove stiffened.
 - .2 Locking quadrant with shaft extension to accommodate insulation thickness.
 - .3 Inside and outside bronze end bearings.
 - .4 Channel frame of same material as adjacent duct, complete with angle stop.

2.8 BALANCING DAMPERS - MULTI-BLADED

- .1 Factory manufactured of material compatible with duct.
- .2 Opposed blade: configuration, metal thickness and construction to recommendations of SMACNA.
- .3 Maximum blade height: 100 mm.
- .4 Bearings: bronze bushings.
- .5 Linkage: shaft extension with locking quadrant.
- .6 Channel frame of same material as adjacent duct, complete with angle stop.

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 air duct accessories installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of the Departmental Representative.
 - .2 Inform the Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from the Departmental Representative.

3.2 INSTALLATION

- .1 Flexible Connections:
 - .1 Install in following locations:
 - .1 Inlets and outlets to supply air units, fan-coils, and fans.
 - .2 Inlets and outlets of exhaust and return air fans.
 - .3 As indicated.
 - .2 Length of connection: 100 mm.
 - .3 Minimum distance between metal parts when system in operation: 75 mm.
 - .4 Install in accordance with recommendations of SMACNA.

- .5 When fan is running:
 - .1 Ducting on sides of flexible connection to be in alignment.
 - .2 Ensure slack material in flexible connection.
- .2 Access doors:
 - .1 Locations:
 - .1 At locations required to allow access to airflow control dampers.
 - .2 Where required to allow access to devices requiring periodic maintenance.
 - .3 Where required by code.
- .3 Instrument Test Ports:
 - .1 General:
 - .1 Install in accordance with recommendations of SMACNA and in accordance with manufacturer's instructions.
 - .2 Locate to permit easy manipulation of instruments.
 - .3 Install insulation port extensions as required.
 - .4 Locations:
 - .1 For traverse readings:
 - .1 Ducted inlets to roof and wall exhausters.
 - .2 Inlets and outlets of other fan systems.
 - .3 Main and sub-main ducts.
 - .4 And as indicated.
 - .2 For temperature readings:
 - .1 At outside air intakes.
 - .2 In mixed air applications in locations as approved by Departmental Representative
 - .3 At inlet and outlet of coils.
 - .4 Downstream of junctions of two converging air streams of different temperatures.
 - .5 And as indicated.
- .4 Balancing Dampers:
 - .1 Install the dampers according to the SMACNA recommendations and the manufacturer's instructions.
 - .2 Seal the multi-damper module joints with a silicone sealant.
 - .3 Install an access door near each damper.
 - .1 Ensure that all dampers are easily visible and accessible.
- .5 Turning Vanes:
 - .1 Install in accordance with recommendations of SMACNA and as indicated.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 23 31 13.01 – Metal Ducts – Low Pressure to 500 PA.

1.2 REFERENCES

- .1 American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE).
- .2 National Fire Protection Association (NFPA):
 - .1 NFPA 90A, Standard for the Installation of Air-Conditioning and Ventilating Systems. 2018 Edition.
 - .2 NFPA 90B, Standard for Installation of Warm Air Heating and Air-Conditioning Systems. 2018 Edition.
- .3 Sheet Metal and Air-Conditioning Contractors' National Association (SMACNA):
 - .1 SMACNA HVAC – Duct Construction Standards - Metal and Flexible, 2006.
 - .2 SMACNA IAQ – Guideline for Occupied Buildings under Construction, 2008.
- .4 Underwriters' Laboratories (UL):
 - .1 UL 181-2013, Factory-Made Air Ducts and Air Connectors.
- .5 Underwriters' Laboratories of Canada (ULC):
 - .1 CAN/ULC-S110-2013, Standard Methods of Test for Air Ducts.

1.3 SUBMITTALS

- .1 Submit documents in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Product data:
 - .1 Submit manufacturer's printed product literature, specifications and data sheet for fixtures and equipment.
- .3 Shop drawings:
 - .1 Shop drawings must include the seal and signature of a professional Engineer recognized in Canada, in the province of Ontario.
- .4 Certificates:
 - .1 Submit certificates signed by the manufacturer certifying that the products and

1.4 CLOSEOUT SUBMITTALS

- .1 Submit all document/elements required, in accordance with Section 01 78 00 – Closeout Submittals.
- .2 Operation and maintenance data (O&M): provide instructions with respect to the operation and maintenance, to be incorporated into the O&M manual.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Transport, store and handle hazardous materials in accordance with Section 01 61 00 – Common Product Requirements.
- .2 Shipping and receiving: deliver material to site in the original packaging, which must bear the name and address of the manufacturer.
- .3 Waste management and disposal:
 - .1 Separate waste materials for recycling in accordance with Section 01 74 19 – Waste Management and Disposal.
 - .2 Remove from site and dispose of packaging materials at appropriate recycling facilities.
 - .3 Collect and separate for disposal paper, plastic, polystyrene and corrugated cardboard packaging material for recycling in accordance with the waste management plan.
 - .4 Separate steel, metal and plastic materials in designated containers for recycling in accordance with the waste management plan.
 - .5 Divert unused metal materials from landfill to metal recycling facility.

Part 2 Product

2.1 FLEXIBLE DUCTS

- .1 General:
 - .1 Flexible ducts according to the standards NFPA-90A, NFPA-90B, and ULC.
 - .2 The pressure loss coefficients listed below are based on a reference coefficient of 1.00 established for metal ducts.
 - .3 The flame spread index must not exceed 25 and the smoke development index must not exceed 50.
 - .4 Submit a sample of each type.
 - .5 When required, use the proper tool to give the end of the flexible duct an oblong shape.
 - .6 Install a maximum length of 1500 mm.
- .2 Joints between rigid and flexible ducts:
 - .1 Attach the flexible ducts to the rigid ducts, air supply terminal units, and diffusers using metal screws or metal clamping bands, make airtight with a sealant, and cover everything with tape. The sealant must have a VOC content below 250 g/L.

Part 3 Execution

3.1 INSPECTION

- .1 Conditions verification: prior to proceeding to the installation of flexible air ducts, ensure that the state of the surfaces/supports previously implemented under the constraints of other sections or contracts is acceptable and permits the execution of the work in accordance with manufacturer's written instructions.
- .2 Make a visual inspection of surfaces/supports in the presence of the Departmental Representative.

3.2 FLEXIBLE DUCT INSTALLATION

- .1 Install flexible air ducts in accordance with CAN/ULC-S110, NFPA-90A and NFPA-90B.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 21 05 01 – Common Work Requirements for Mechanical
- .2 Section 23 23 00 – Refrigerant Piping

1.2 REFERENCES

- .1 American National Standards Institute/Air-Conditioning and Refrigeration Institute (ANSI/ARI)
 - .1 ANSI/ARI 210/240-2008, Unitary Air Conditioning and Air-Source Heat Pump Equipment.
- .2 American National Standards Institute/American Society of Heating, Refrigeration and Air-Conditioning Engineers (ANSI/ASHRAE)
 - .1 ANSI/ASHRAE Standard 15-2019, Safety Standard for Refrigeration Systems.
- .3 CSA International
 - .1 CAN/CSA-C656-14 (R2019), Performance Standard for Split-System and Single Package Central Air Conditioners and Heat Pumps.
- .4 Environment Canada, (EC)/Environmental Protection Services (EPS)
 - .1 Environmental Code of Practice for Elimination of Fluorocarbons Emissions from Refrigeration and Air Conditioning Systems SOR/2003-289.
 - .2 Federal Halocarbon Regulations, 2003 (FHR 2003).

1.3 SUBMITTALS

- .1 Submit the documents and samples required in accordance with Section 01 33 00 – Submittal Procedures .
- .2 Shop drawings:
 - .1 Submit shop drawings including identification of specification section, and include data per Section 21 05 01 – Common Work Requirements for Mechanical.
- .3 Data sheets:
 - .1 Submit required data sheets, including the manufacturer's documentation for the heat pumps and air conditioners. Data sheets must include product characteristics, performance criteria, dimensions, limits and finish.
 - .1 A description of the devices and materials, including the manufacturer name, type, model, year of fabrication, the strength or the flow.
 - .2 Details relevant to the operation, usage, and maintenance of the devices and materials.
 - .3 A list of recommend spare parts.

1.4 CLOSEOUT SUBMITTALS

- .1 Submit required documents in accordance with section 01 78 00 – Documents/éléments à remettre à l'achèvement des travaux.
- .2 Operation and Maintenance Data: submit operation and maintenance data for heat pumps and air conditioners for incorporation into manual.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Transport, store and handle materials in accordance with section 01 61 00 – Exigences générales concernant les produits.
- .2 Shipping and receiving:
 - .1 Deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

1.6 WARRANTY

- .1 Contractor hereby warrants that air conditioning and heat pump equipment will not spall or show visible evidence of cracking, except for normal hairline shrinkage cracks for 1 year.

Part 2 Products

2.1 DESCRIPTION

- .1 Heat pumps: to EPS 1/RA/2, CSA approved and with ARI or CSA certification seal.

2.2 REFRIGERANTS

- .1 Type of Refrigerant: R410A.

2.3 COMPLIANCE

- .1 Perform work in accordance with article 1.2.4 of this Section:
 - .1 Fill and submit to the Departmental Representative the form attached to this Section in appendix in conformance with this article.

2.4 DRAIN PANS

- .1 Design and construct condensate drain pans under indoor coils so that no water can accumulate and install to allow for easy cleaning. A galvanized or stainless steel pitched drain pan shall be provided.

2.5 AIR SOURCE HEAT PUMP – AC-3 AND AC-4

- .1 General:
 - .1 Three component unit consisting of refrigerant compressor section, outdoor unit and indoor coil for use with R410A. Vertical draw through style, front return, ducted top discharge. Maintenance and filter access from the front.

- .2 Indoor unit
 - .1 Direct expansion evaporator coil
 - .1 The coil shall have copper tube and aluminum fins complete with thermal expansion valve. The coil capacities shall be as shown in the schedule.
 - .2 Cabinet
 - .1 The unit cabinet shall be 20 ga corrosion resistant steel, braced and reinforced for rigidity with 16-guage framing. The finish shall be textured powder coat, color as per the Departmental Representative's choice. The cabinet shall be fully lined with 25 mm coated glass fiber insulation. The return air grille shall be heavy duty steel.
 - .2 The unit shall include no mixing section or motorized dampers. Dampers if provided shall be factory locked at 100% return with no damper actuators.
 - .3 Supply air fan/motor
 - .1 The fan shall be a direct centrifugal type with ECM motor mounted on rubber isolation grommets. The motor voltage shall be 208V/3/60Hz.
 - .2 ECM motor shall be equipped with a local potentiometer for on-site adjustment of fan-speed. Remote speed command input is optional.
 - .4 Filters
 - .1 The filters shall be of the manufacturer's standard disposable type, 25mm thick, MERV 8.
 - .5 Electrical
 - .1 All internal line voltage wiring shall be by the unit manufacturer. See Section 26 28 16.02 - Moulded Case Circuit Breakers for suitably rated remote circuit breaker to be provided and installed.
 - .2 Each unit shall be supplied with a line voltage service disconnect and a door switch for control voltage interrupt to disable the mechanical components when the service panel is removed. The disconnect switch is lockable in off position.
 - .6 Controls:
 - .1 A fully programmable, direct digital controller shall be supplied loose by the supplier. The controller shall be programmed by the factory to operate the ventilator, start-and stop the ECM motor at constant speed, command the condenser and be site ready to function standalone.
 - .2 The controller must be able to run standalone with occupancy determined by an internal weekly and annual schedule, and room temperature set-points configurable for occupied and unoccupied modes.
 - .3 The controller must feature an integral temperature sensor.
 - .4 The controller must feature on, off, cooling, and heating modes, with two stages of heating and cooling, and be capable of automatic changeover from heating to cooling and vice-versa.

- .3 Outdoor unit
 - .1 General
 - .1 The Outdoor Units are fully charged from the factory for up to 4.6 m of piping. Unit is designed to operate at outdoor ambient temperatures as high as 46 C. The unit is certified to UL 1995.
 - .2 Casing
 - .1 Unit casing is constructed of heavy gauge, galvanized steel and painted with a weather-resistant powder paint finish on all louvered panels and the fan top panel. The corner panels are prepainted. All panels are subjected to 1,000 hour salt spray test. The base is made of weatherproof material to resist corrosion.
 - .3 Refrigerant Controls
 - .1 Refrigeration system controls include condenser fan, compressor contactor and high pressure switch. High and low pressure controls are inherent to the compressor. A factory supplied liquid line drier is standard.
 - .4 Compressor
 - .1 The compressor features internal over temperature, pressure protection and total dipped hermetic motor. Other features include: Centrifugal oil pump and low vibration and noise.
 - .5 Condenser Coil
 - .1 The outdoor coil provides low airflow resistance and efficient heat transfer. The coil is protected on all four sides by louvered panels.

2.6 VERTICAL AIR CONDITIONER – AC-5

- .1 General:
 - .1 Three component unit consisting of refrigerant compressor section, outdoor unit and indoor coil for use with R410A. Arrangement vertical, draw through, top duct discharge, bottom rear return,
- .2 Indoor unit
 - .1 General
 - .1 Completely factory assembled convertible for horizontal or vertical configuration. Convertible for cooling only or heat pump application, convertible for left or right external connections (Refrigerant and/or Electrical). Convertible for front or bottom air return.
 - .2 Nitrogen holding charge certified and rated in accordance with AHRI and DOE standards, Certified to UL 1995 for indoor blower coil units
 - .2 Casing
 - .1 Zinc Coated, heavy gauge, galvanized steel weather resistant baked enamel finish. Access panels with captive screws. Completely insulated with foil faced, cleanable, fire retardant, permanent, odorless glass fiber material, sealed insulation edges
 - .2 Electrical Connection: bushings
 - .3 Refrigerant Connection: plugs

- .3 Refrigeration System
 - .1 Dual circuit distributor(s) Thermal Expansion Valves (TXVs).
- .4 Evaporator Coil
 - .1 Internally enhanced copper tube mechanically bonded to lanced aluminum plate fins factory pressure and leak tested to 3096 kpa.
 - .2 Draw-through airflow dual circuits are interlaced/intertwined double sloped, removable, cleanable, composite drain pan four drain pan positions
- .5 Indoor Fan
 - .1 DWDI, centrifugal type dual fans
 - .2 Adjustable Belt Drive
 - .3 Permanently Lubricated Bearings
- .6 Indoor Motor
 - .1 Adjustable motor sheaves
 - .2 Thermal overload protection
 - .3 Permanently lubricated bearings
- .7 Controls
 - .1 Completely internally wired, numbered and colored wires, magnetic indoor fan contactor, low voltage terminal strip, single point power entry, evaporator defrost control.
 - .2 Thermostat:
 - .1 A fully programmable, direct digital controller shall be supplied and installed by the factory. The controller shall be programmed to operate the ventilator, and be site ready to function standalone.
 - .2 The controller must be able to run standalone with occupancy determined by an internal weekly and annual schedule, and room temperature set-points configurable for occupied and unoccupied modes.
 - .3 The controller must feature an integral temperature sensor.
 - .4 The controller must feature on, off, cooling, and heating modes, two stages of heating and cooling. and be capable of automatic changeover from heating to cooling and vice-versa.
- .8 Filters
 - .1 Access from side coil panels filters slide on rack, 50mm throw-away filters.
- .9 Electric Heaters
 - .1 Heavy duty nickel chromium elements, cETL approved, installed directly on fan discharge, two stage control, single point for power.
 - .2 Automatic reset of high limit controls through pilot duty with secondary backup fuse links.
- .10 Electrical:
 - .1 Single connection point, 575V/3phase/60 Hz.
 - .2 Factory mounted disconnect, all internal wiring installed in factory.

- .11 Performance data:
 - .1 as indicated.
- .3 Outdoor unit:
 - .1 General
 - .1 Weatherproofed steel mounting/lifting rails, hermetic scroll compressors, microchannel condenser coils, plate fin condenser coils, fans and motors.
 - .2 Standard operating range 10-51 °C (min. -18 C°F with low ambient accessory). Nitrogen holding charge certified and rated in accordance with AHRI and DOE standards certified to UL 1995
 - .2 Casing
 - .1 Zinc coated, heavy gauge, galvanized steel Weather resistant baked enamel finish Meets ASTM B117, 672 hour salt spray test.
 - .2 Removable single side maintenance access panels
 - .3 Lifting handles in maintenance access panels
 - .4 Unit base provisions for forklift and/or crane lifting
 - .3 Refrigeration System - Dual Compressor
 - .1 Two (2) separate and independent refrigerant circuits. Each refrigeration circuit equipped with integral subcooling circuit. Front or rear refrigerant line connections.
 - .2 Two (2) direct drive hermetic scroll compressor. Suction gas-cooled motors w/ $\pm 10\%$ voltage utilization range of unit nameplate voltage. Crankcase heaters. Internal temperature and current sensitive motor overloads. Factory installed liquid line filter driers. Phase loss/reverse rotation monitor. Liquid line service valves (with gauge port). Suction line service valves (with gauge port). No compressor suction and/or discharge valves (reduced vibration/sound). External high pressure cutout devices.
 - .3 At least one compressor must be equipped with hot gas bypass for capacity modulation at low load.
 - .4 Condenser Coil (Microchannel)
 - .1 Microchannel coils burst tested by the manufacturer. Coils shall be leak tested to ensure the pressure integrity Factory pressure and leak tested to 4550 kPa
 - .2 Perforated steel hail guards, factory installed.
 - .5 Condenser Fan
 - .1 Direct drive, statically and dynamically balanced propeller fan 711 mm dia.
 - .6 Condenser Motor(s)
 - .1 Permanently lubricated bearings, totally enclosed construction, built-in current and thermal overloads.
 - .7 Controls
 - .1 Microprocessor controlled. Completely internally wired with umbered and colored wires. Contactor. Terminal block. Unit external mounting location for disconnect device. Single point power entry.

- .8 Microprocessor
 - .1 Centralized processor, indoor and outdoor temperature sensors drive algorithms, making decisions for all heating, cooling, and ventilation. Integrated anti-short cycle timer. Integrated time delay between compressors.

2.7 DUCTLESS MINI-SPLIT AIR CONDITIONER – AC-6

- .1 Indoor Unit, General:
 - .1 Wall-mounted indoor unit
 - .2 Fan speeds: Very Low, Low, Medium, High, and Very High
 - .3 Auto fan speed control feature
 - .4 Indoor unit powered from outdoor unit
 - .5 Auto restart following a power outage
 - .6 Prefilter and anti-allergy filter
 - .7 Refrigerant type: R410A.
 - .8 Cooling Capacity: 3.52 kW (12,000 Btu/h)
 - .1 Rating Conditions Cooling:
 - .1 Indoor: 27°C (80°F) DB, 19°C (67°F) WB;
 - .2 Outdoor: 35°C (95°F) DB, 24°C (75°F) WB.
 - .2 Local control at console (not via hand-held remote) for:
 - .1 Start-stop;
 - .2 Cooling mode temperature setpoint.
 - .9 Power Supply :
 - .1 115V, 1-Phase, 60 Hz
 - .2 MCA: 16 A
 - .3 Breaker Size: 20 A
 - .10 Provide complete with:
 - .1 Condensate pump
- .2 Outdoor Unit:
 - .1 Compressor: DC Inverter-driven single rotary
 - .1 Voltage: 115V, 1-Phase, 60 Hz
 - .2 MCA: 1.2 A
 - .2 Fan Motor: 0.93 F.L.A.
 - .3 Sound Pressure Level:
 - .1 Cooling : 54 dB(A)
 - .2 W: 849 mm
 - .3 D: 291 mm
 - .4 H: 605 mm
 - .4 Max weight: 44 kg
 - .5 Refrigerant Type: R410A

- .6 Refrigerant Pipe Size O.D.:
 - .1 Gas Side: :12.7 mm
 - .2 Liquid Side: 6.35 mm
- .7 Max. Refrigerant Pipe Length: 30 m
- .8 Max. Refrigerant Pipe Height Difference: 11 m
- .9 Connection Method: Flared
- .10 Provide complete with:
 - .1 Low ambient head pressure controller

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 heat pumps installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied.

3.2 INSTALLATION

- .1 Install indoor unit where indicated and in accordance with manufacturer's instructions:
 - .1 For ducted units:
 - .1 Route condensate drain to adjacent existing funnel floor drain.
 - .2 Connect gas and suction lines in accordance with manufacturer's instructions.
 - .3 Install thermostat.
 - .4 Route cabling from thermostat through roof penetration to condenser for control.
 - .5 Route cabling from thermostat to interlock panel located in room 119.
 - .6 Hire and pay for a licensed electrician for all conduit, cable runs, and terminations associated with these controls as indicated.
 - .2 For ductless unit:
 - .1 Install condensate pump and route drain as indicated.
 - .2 Connect gas and suction lines in accordance with manufacturer's instructions.
 - .3 Route cabling from indoor unit through roof penetration to condenser for control.
 - .4 Hire and pay for a licensed electrician for all conduit, cable runs, and terminations associated with these controls.
- .2 Install outdoor units on roof with vibration isolation providing 95% isolation efficiency. Coordinate with Division 7 contractor for placement.

- .3 Secure with hold-down bolts in accordance with manufacturer's recommendations.
- .4 Make duct connections through flexible connections.
- .5 Level unit with fans running. Align duct work. flexible connections. .

3.3 DRAIN PANS

- .1 Install so that no water can accumulate. Arrange easy access for cleaning.
- .2 Include internal or external trap for proper draining.

3.4 START-UP AND COMMISSIONING

- .1 Have manufacturer certify installation and attend during start-up and testing to certify performance.
- .2 Submit written start-up and commissioning reports to Departmental Representative.

3.5 CLOSEOUT ACTIVITIES

- .1 Manufacturer to deliver verbal, and written instructions to operating personnel.

3.6 CLEANING

- .1 Clean regularly during installation as per Section 01 74 00 – Cleaning.
 - .1 Leave the workplace neat and clean at the end of every working shift.

3.7 PROTECTION

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by heat pumps and air conditioning equipment installation.

END OF SECTION

APPENDIX – FORM 67 –

**SERVICE LOG FOR A REFRIGERATION, AIR
CONDITIONING OR FIRE EXTINGUISHING
SYSTEM**



SERVICE LOG FOR A REFRIGERATION, AIR CONDITIONING OR FIRE EXTINGUISHING SYSTEM
REGISTRE D'ENTRETIEN D'UN SYSTÈME DE RÉFRIGÉRATION, DE CLIMATISATION OU D'EXTINCTION D'INCENDIE

A. GENERAL INFORMATION - INFORMATION GÉNÉRALE

DFRP No. - N° du RBIF	Name and Address of System Owner Nom et adresse du propriétaire du système	Facility Name and Civic Address Nom et adresse municipale de l'immeuble	Location of System (floor & room no.) Emplacement du système (étage et n° de pièce)
Building No. - N° de l'immeuble			Operator Name - Nom de l'opérateur

B. DESCRIPTION OF SYSTEM - DESCRIPTION DU SYSTÈME

Type of System - Type de système	Manufacturer - Fabricant	Model No. - N° du modèle	Serial No. - N° de série
<input type="checkbox"/> Air Conditioning Climatisation	<input type="checkbox"/> Refrigeration Réfrigération	<input type="checkbox"/> Fire-extinguishing Extinction d'incendie	
Type of Halocarbon - Type d'halocarbure	Charging/design capacity of system - Capacité de charge/conception du système	Refrigeration Capacity - Capacité de réfrigération	
	<input type="checkbox"/> kg <input type="checkbox"/> lbs livres	<input type="checkbox"/> kW <input type="checkbox"/> Ton Tonnes <input type="checkbox"/> BTU/h	

C. SERVICE INFORMATION - INFORMATION SUR L'ENTRETIEN

Service Date Date d'entretien	Leak test performed Essai de détection des fuites effectué	Leak detected Fuite détectée	Leak repaired Fuite réparée	Type of halocarbon charged Type d'halocarbure chargé	Quantity charged Quantité chargée (kg, lbs-livres)	Quantity recovered Quantité récupérée (kg, lbs-livres)	Technician name and name of employer Nom du technicien et nom de l'employeur	Trade qualification certificate no. N° du certificat de qualification professionnelle	Environmental awareness certificate no. N° de certificat du cours de sensibilisation à l'environnement	Contractor service report no. N° du rapport d'entretien de l'entrepreneur	Description of activity Description de l'activité
(Y-A-MM-D-J)	Y/N - O/N	Y/N - O/N	Y/N - O/N								
	<input type="checkbox"/> Yes Oui	<input type="checkbox"/> Yes Oui	<input type="checkbox"/> Yes Oui								
	<input type="checkbox"/> No Non	<input type="checkbox"/> No Non	<input type="checkbox"/> No Non								
	<input type="checkbox"/> Yes Oui	<input type="checkbox"/> Yes Oui	<input type="checkbox"/> Yes Oui								
	<input type="checkbox"/> No Non	<input type="checkbox"/> No Non	<input type="checkbox"/> No Non								
	<input type="checkbox"/> Yes Oui	<input type="checkbox"/> Yes Oui	<input type="checkbox"/> Yes Oui								
	<input type="checkbox"/> No Non	<input type="checkbox"/> No Non	<input type="checkbox"/> No Non								
	<input type="checkbox"/> Yes Oui	<input type="checkbox"/> Yes Oui	<input type="checkbox"/> Yes Oui								
	<input type="checkbox"/> No Non	<input type="checkbox"/> No Non	<input type="checkbox"/> No Non								
	<input type="checkbox"/> Yes Oui	<input type="checkbox"/> Yes Oui	<input type="checkbox"/> Yes Oui								
	<input type="checkbox"/> No Non	<input type="checkbox"/> No Non	<input type="checkbox"/> No Non								

C. SERVICE INFORMATION (Cont'd) - INFORMATION SUR L'ENTRETIEN (suite)

Service Date Date d'entretien	Leak test performed Essai de détection des fuites effectué	Leak detected Fuite détectée	Leak repaired Fuite réparée	Type of halocarbon charged Type d'halocarbure chargé	Quantity charged Quantité chargée (kg, lbs-livres)	Quantity recovered Quantité récupérée (kg, lbs-livres)	Technician name and name of employer Nom du technicien et nom de l'employeur	Trade qualification certificate no. N° du certificat de qualification professionnelle	Environmental awareness certificate no. N° de certificat du cours de sensibilisation à l'environnement	Contractor service report no. N° du rapport d'entretien de l'entrepreneur	Description of activity Description de l'activité
(Y-A-MM-D-J)	Y/N - O/N	Y/N - O/N	Y/N - O/N								
	<input type="checkbox"/> Yes Oui <input type="checkbox"/> No Non	<input type="checkbox"/> Yes Oui <input type="checkbox"/> No Non	<input type="checkbox"/> Yes Oui <input type="checkbox"/> No Non								
	<input type="checkbox"/> Yes Oui <input type="checkbox"/> No Non	<input type="checkbox"/> Yes Oui <input type="checkbox"/> No Non	<input type="checkbox"/> Yes Oui <input type="checkbox"/> No Non								
	<input type="checkbox"/> Yes Oui <input type="checkbox"/> No Non	<input type="checkbox"/> Yes Oui <input type="checkbox"/> No Non	<input type="checkbox"/> Yes Oui <input type="checkbox"/> No Non								
	<input type="checkbox"/> Yes Oui <input type="checkbox"/> No Non	<input type="checkbox"/> Yes Oui <input type="checkbox"/> No Non	<input type="checkbox"/> Yes Oui <input type="checkbox"/> No Non								
	<input type="checkbox"/> Yes Oui <input type="checkbox"/> No Non	<input type="checkbox"/> Yes Oui <input type="checkbox"/> No Non	<input type="checkbox"/> Yes Oui <input type="checkbox"/> No Non								
	<input type="checkbox"/> Yes Oui <input type="checkbox"/> No Non	<input type="checkbox"/> Yes Oui <input type="checkbox"/> No Non	<input type="checkbox"/> Yes Oui <input type="checkbox"/> No Non								
	<input type="checkbox"/> Yes Oui <input type="checkbox"/> No Non	<input type="checkbox"/> Yes Oui <input type="checkbox"/> No Non	<input type="checkbox"/> Yes Oui <input type="checkbox"/> No Non								
	<input type="checkbox"/> Yes Oui <input type="checkbox"/> No Non	<input type="checkbox"/> Yes Oui <input type="checkbox"/> No Non	<input type="checkbox"/> Yes Oui <input type="checkbox"/> No Non								

1 ton/tonne Refrigeration = 12,000 BTU/h = 3.5 kW
19 kW = 5.4 ton/tonnes
1 lb = 0.454 kg
1 oz. = 0.02835 kg

INSTRUCTIONS

Purpose

In accordance with FHR 2003 section 31(1), the *Service Log for a Refrigeration, Air Conditioning or Fire Extinguishing System* is used to maintain a written record whenever a system is installed, serviced, leak-tested or charged or if any other work is done on it that may result in the release of a halocarbon.

Objectif

En conformément à l'article 31(1) du RFH 2003, le *Registre d'entretien d'un système de réfrigération, climatisation ou d'extinction d'incendie* est utilisé pour maintenir un dossier papier des renseignements au moment de l'installation d'un système et chaque fois qu'il est entretenu ou chargé ou qui sont effectués sur lui des essais de détection des fuites ou tout autre travail pouvant entraîner le rejet d'un halocarbure.

Section - Partie	Field - Champ	Information	
A. General Information Information générale	DFRP No. N° de RBIF	Enter the Directory of Federal Real Property (DFRP) number which may be accessed at http://www.tbs-sct.gc.ca/dfrp-rbif/home-accueil-eng.aspx	
		Entrez le numéro du Répertoire des biens immobiliers fédéraux (RBIF) qui peut être consulté à http://www.tbs-sct.gc.ca/dfrp-rbif/home-accueil-fra.aspx	
	Building No. N° du bâtiment	Where a DFRP number refers to multiple buildings, indicate the building number which is found on the DFRP website (link above)	
		Où un numéro du RBIF réfère à plusieurs bâtiments, indiquez le numéro de bâtiment qui se trouve sur le site-web du RBIF (lien ci-dessus)	
	Name and address of system owner Nom et adresse du propriétaire du système	Asset Ownership and Management Type	Name and Address
		Public Services and Procurement Canada (PSPC) owned and PSPC managed	Name: PSPC Address: civic address where the system is located
		PSPC owned and Real Property Contractor (RPC) managed	This form does not apply as the RPC is required to use their own form
		OGD owned and PSPC managed	Name: OGD Address: civic address where the system is located
		OGD owned and RPC managed	This form does not apply as the RPC is required to use their own form
		PSPC leased	Name: Building owner Address: civic address where the system is located
		Type de propriété et de gestion du bien	Nom et adresse
		Appartenant à Service publics et Approvisionnement Canada (SPAC) et géré par celui-ci	Nom : SPAC Adresse : adresse civique où le système est situé
		Appartenant à SPAC et géré par l'entrepreneur des Biens immobiliers	Ce formulaire ne s'applique pas car l'entrepreneur des Biens immobiliers utilise son propre formulaire
		Appartenant à un autre ministère et géré par SPAC	Nom : nom de l'autre ministère Adresse : adresse civique où le système est situé
		Appartenant à un autre ministère et géré par l'entrepreneur des Biens immobiliers	Ce formulaire ne s'applique pas car l'entrepreneur des Biens immobiliers utilise son propre formulaire
		Loué par SPAC	Nom : Propriétaire du bâtiment Adresse : adresse civique où le système est situé
	Name of Operator Nom de l'opérateur	For SPAC managed, enter SPAC For RPC managed, this form does not apply	
		Pour les sites gérés par SPAC, entrez SPAC Pour les sites gérés par un entrepreneur des Biens immobiliers, ce formulaire ne s'applique pas	

Section - Partie	Field - Champ	Information
B. Description of System Description du système	Charging/design cap. of syst. Cap. de charge/conception du syst.	Refers to the maximum capacity that the system was designed for. Charging capacity is also known as design capacity
		Réfère à la capacité maximale pour laquelle le système a été conçu. La capacité de charge est également connue comme la capacité de conception
	Refrigeration capacity Capacité de réfrigération	Refrigeration capacity is also known as cooling capacity
		La capacité de refroidissement est également connue comme la capacité de réfrigération
C. Service Information Information de service	Environmental awareness certificate No. N° de certificat de sensibilisation à l'environnement	Training that is required to be considered as a certified person under the Federal Halocarbon Regulations, 2003. An environmental awareness training program is available in all provinces. This training complements, but does not replace trade qualifications.
		Formation qui est nécessaire pour être considéré comme une personne certifiée en vertu du <i>Règlement fédéral sur les halocarbures, 2003</i> . Un programme de formation de sensibilisation environnementale est disponible dans toutes les provinces. Cette formation vient compléter, mais ne remplace pas, les qualifications professionnelles
	Trade qualification certificate No. N° d'accréditation professionnelle	Refers to the provincial trade certification received by a technician for successfully completing an Ozone Depleting Substances (ODS) course in all provinces except Ontario or an Ozone Depleting Prevention (ODP) course in Ontario
		Fait référence à la certification de qualification provinciale reçue par un technicien pour avoir complété avec succès un cours sur les substances appauvrissant la couche d'ozone (dans tous les provinces sauf Ontario) ou un cours pour la prévention d'un appauvrissement de la couche d'ozone (en Ontario)
	Service Report Number N° du rapport de service	A number that references the Service Technician's Service Report
		Un numéro qui fait référence au rapport du technicien de service

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 23 09 33 – Electric and Electronic Control System for HVAC.

1.2 SUBMITTALS

- .1 Submit documents in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Product data:
 - .1 Submit manufacturer's printed product literature, specifications and data sheet for fixtures and equipment.
- .3 Shop drawings:
 - .1 Shop drawings must be submitted in accordance with Section 21 05 01 – Common Work Requirements for Mechanical.
- .4 Certificates:
 - .1 Submit certificates signed by the manufacturer certifying that the products and materials comply with the specified performance and physical requirements.

1.3 CLOSEOUT SUBMITTALS

- .1 Submit all document/elements required, in accordance with Section 01 78 00 – Closeout Submittals.
- .2 Operation and maintenance data (O&M): provide instructions with respect to the operation and maintenance, to be incorporated into the O&M manual.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Transport, store and handle hazardous materials in accordance Section 01 61 00 – Common Product Requirements.
- .2 Shipping and receiving: deliver material to site in the original packaging, which must bear the name and address of the manufacturer.
- .3 Waste management and disposal:
 - .1 Separate waste materials for recycling in accordance Section 01 74 19 – Waste Management and Disposal.
 - .2 Remove from site and dispose of packaging materials at appropriate recycling facilities.
 - .3 Collect and separate for disposal paper, plastic, polystyrene and corrugated cardboard packaging material for recycling in accordance with the waste management plan.
 - .4 Separate steel, metal and plastic materials in designated containers for recycling in accordance with the waste management plan.
 - .5 Divert unused metal materials from landfill to metal recycling facility.

Part 2 Product

2.1 ELECTRIC HEATING ELEMENT HUMIDIFIERS

- .1 General:
 - .1 This type of humidifier must produce clean vapor free of chemicals.
 - .2 CSA and ULC certification.
 - .3 Two year limited warranty.
 - .4 The steam is generated by electrical heating elements covered in self-cleaning Inconel (or equivalent) generating steam using domestic or softened water.
 - .5 The humidifier must be able to operate at a positive static pressure of 1245 Pa in the duct (without modification to the filling system). It may also overcome the pressure of a copper steam line over 15m long when required.
- .2 Components:
 - .1 The enclosure will be the full access type (without hinged door). The bottom of the enclosure will be in stainless steel, will serve as a drain pan, and will be fitted with connections for drainage and water supply piping.
 - .2 The evaporation chamber is made of stainless steel 304, 14-gauge, arc welded joints. It is mounted on guide rails.
 - .3 The high-voltage electrical wiring in the basin compartment is protected by a high temperature resistant plastic alloy and the electrical connections of the heating elements are protected by a stainless steel cover, all for a safe environment when opening the enclosure. All electrical connections between the two compartments will be the plug-in and unidirectional type.
 - .4 The enclosure will be provided with support for wall mounting.
 - .5 The unit is fully pre-wired in factory.
 - .6 Cover with easily removable screws for maintenance. The gasket is held in place by the flanges that are an integral part of the cover and of the evaporation chamber. These flanges will fit into each other to fix the seal between them.
 - .7 Resistance type heating elements for immersed operation with Incoloy covering, maximum density of 13.95 W/cm² (90 W/in²). The magnetic contactors of a model approved by the CSA, the electrical connections terminals are identified, control circuit protection fuses, required protections, all installed and pre-wired in factory.
 - .8 The automatic controller for the water level in the evaporation chamber allows automatic filling, low level shut-off, and surface skimming. This controller includes:
 - .1 A set of three stainless steel water level sensors screwed on a ceramic base, all protected within the basin by a wave reducing tube.
 - .2 A stainless steel removable solenoid valve for water filling mounted on the unit.
 - .3 An automatic motorized drain valve, factory pre-wired and mounted on the unit.
 - .4 The filling system will be provided with an adjustable surface skimmer, which removes minerals on the surface of the water.

- .5 Note: indirect filling through a funnel is prohibited and will not be considered. Filling and/or drain valves made of sealed plastic will not be considered.
- .9 Microprocessor type controller, ensuring the proper operation and management of the generator:
 - .1 Self-diagnosis program at every start and during operation.
 - .2 Control of the fill valve and low water level protection.
 - .3 Drainage and automatic purge sequence by accumulation of operating time or specific day.
 - .4 Automatic adjustable drainage at the end of the season.
 - .5 Internal clock that logs the dates and the times in case of failure or malfunction.
 - .6 Detailed explanation of the errors with their logged error date.
 - .7 Service operation duration.
 - .8 Detailed alarms.
 - .9 Numbered terminals for the connection of centralized controls.
 - .10 Terminal for dry contact type alarm (normally open or closed) to signal the centralization when an alarm is triggered on the unit.
- .10 Skimmer adjusted in factory so as to remove minerals with a minimum of water drained to the sewer.
- .11 The control compartment must contain all the required accessories, such as:
 - .1 Display keypad mounted directly on the front panel.
 - .2 Control transformer with integrated circuit breaker.
 - .3 Magnetic contactor.
 - .4 SSR with heatsink.
 - .5 Identified terminals.
 - .6 Controls diagram.
- .12 Temperature sensor ensuring that a specific temperature is maintained for a rapid response or protection against freezing, and the rapid preheating function for a cold start.
- .13 High temperature protection sensor. This protection is redundant with the protection of the main temperature sensor.
- .14 A flexible joint at the generator output.
- .15 Modulating control of the elements:
 - .1 The elements are modulated by SSR type electronic relays with fin heat sink.
 - .2 Note: electronic relays without heat sinks are prohibited and will not be considered.
- .16 Modulation control of the humidifier by room humidity sensor. Provide room humidity sensor compatible with humidifier.
- .17 Controls (high limit switch, and air flow switch) must be provided by Division 23, and must be by the same manufacturer as the humidifier.

- .18 Drainage water cooler and including:
 - .1 Self-starting control valve (not electric).
 - .2 Integrated temperature sensor adjusted to 140°F.
 - .3 Integrated vacuum breaker.
- .19 Vapor dispersion tubes, including a stainless steel condensate return of the length indicated with holes, mounting plates, and adjustable fittings, calibrated thermoplastic hoses, hoses reinforced for connecting steam, stainless steel pipe clamps, washers for passing tubes through the duct.
- .20 Calculations of steam dissipation, location, and distribution should be checked with the manufacturer.
- .3 Capacity: as scheduled.

Part 3 Execution

3.1 INSTALLATION

- .1 Install in accordance with manufacturer's instructions.
- .2 Humidifier and evaporator media to be new and clean when project is accepted.
- .3 Install humidistat as indicated.
- .4 Water service overflow drain: as indicated to manufacturers' recommendation.
- .5 Install access doors or panels in adjacent ducting.

3.2 CONTROLS INSTALLATION

- .1 Provide the services of a licensed electrician to install, wire, and connect the high limit and air proving controls.

3.3 FIELD QUALITY CONTROL

- .1 Performance Verification (PV):
 - .1 General: in accordance with Section 01 91 13 - General Commissioning (Cx) Requirements: General Requirements, supplemented as specified.
 - .2 Application tolerances: $\pm 2\%$.
 - .3 Timing:
 - .1 After TAB of ducted air systems.
 - .2 At same time as PV of related air handling units.
 - .4 PV procedures:
 - .1 Packaged Resistive Steam Generating type.
- .2 Start-up:
 - .1 General: in accordance with Section 01 91 13 - General Commissioning (Cx) Requirements: General Requirements, supplemented as specified.
 - .2 Verify:
 - .1 Steam lines are sloped to ensure steam condensate is drained away from the humidifier.

- .2 Vapour lines and manifolds are sloped to ensure condensate is drained away from the duct system.
 - .3 Visually check distribution manifold to ensure:
 - .1 Even distribution of vapour.
 - .2 Freedom from water deposits.
 - .3 Commissioning Reports:
 - .1 General: in accordance with Section 01 91 13 - General Commissioning (Cx)
Requirements: reports, supplemented as specified. Include:
 - .1 PV results on approved PV Report Forms.
 - .2 Product Information Report Forms.

END OF SECTION

Part 1 General**1.1 RELATED REQUIREMENTS**

- .1 Section 26 05 21 - Wires and Cables (0-1000 V).
- .2 Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.
- .3 Section 23 09 33 - Electric and Electronic Controls System For HVAC.
- .4 All contractual documents.
- .5 Obtain a copy of all documents, read them carefully and consider the requirements during the execution of work.

1.2 REFERENCES

- .1 Canadian Standards Association (CSA)/CSA International
 - .1 CSA C22.1-21, Canadian Electrical Code, Part I, Safety Standard for Electrical Installations (25th Edition).
 - .2 CSA Z462 –18, Workplace electrical safety.
 - .3 CAN3-C235-20, Preferred Voltage Levels for AC Systems, 0 to 50 000 V.
- .2 Electrical Equipment Manufacturers Association of Canada (EEMAC)
 - .1 EEMAC 2Y-1-1958, Light Gray Colour for Indoor Switch Gear.
- .3 Institute of Electrical and Electronics (IEEE)/National Electrical Safety Code Product Line (NESC)
 - .1 IEEE 100-2000, The Authoritative Dictionary of IEEE Standards Terms, 7th Edition, Institute of Electrical and Electronics Engineers.
 - .2 IEEE 1122-1998, IEEE Standard for Digital Recorders for Measurements in High Voltage Impulse Tests.

1.3 SCOPE OF WORK

- .1 Work Includes:
 - .1 In general, work consists of the supply of all required materials, workforce, equipment and tools required to complete the electrical installations as described in writing, plans, and specifications. Most notably, work is comprised of:
 - .1 Addition of new 120 V circuits.
 - .2 Grounding and bonding for power systems.
 - .3 Disconnection and removal of electrical equipment as indicated on drawings.
 - .4 Modification including additions and removal to heating controls at 347, 120 and 24 V.
 - .5 Modifications including additions of receptacles and connection of electrified workstations.
 - .6 All steel structural supports for conductors, cables, devices, and equipment.

- .7 All electrical work related to Section 23 09 33, and drawings M601 through M603.
- .8 All specified tests.
- .9 Relocation of existing equipment.
- .10 Disconnection and removal of equipment deemed obsolete.
- .11 Installation of temporary equipment to ensure continuity of service.

1.4 MATERIALS

- .1 Unless stated to the contrary use new materials, without defect, and of the quality required, bearing the appropriate approval labels by CSA, ULC, FM, according to the specifications.

1.5 ACTION AND INFORMATIONAL SUBMITTAL

- .1 Submit the documents and samples required in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Shop Drawings:
 - .1 Wiring diagrams and device installation details must indicate proposed location, proposed layout, control panels, accessories, piping, ducts, and all other elements which must be shown in order to ensure a coordinated construction installation.
 - .2 Wiring diagrams must indicate the terminal ends, internal wiring of each device and in addition interconnections between the different devices.
 - .3 Drawings must indicate clearances for operation, maintenance and replacement of operating equipment devices.
- .3 Reports:
 - .1 Submit reports for balancing test and control systems as required by the manufacturer (See items 3.10.3 and 3.10.5.1)

Part 2 Products

2.1 DESIGN REQUIREMENTS

- .1 Operating voltages to CAN3-C235.
- .2 Motors, electric heating, control and distribution devices and equipment to operate satisfactorily at 60 Hz within normal operating limits established by above standard.
 - .1 Equipment to operate in extreme operating conditions established in above standard without damage to equipment.
- .3 Language operating requirements: provide identification nameplates and/or labels in French and English.
- .4 Use one nameplate or label for both languages.

2.2 MATERIALS AND EQUIPMENT

- .1 Unless otherwise noted, use new materials, without defect, and of the quality required, bearing the appropriate approval labels by CSA, ULC, FM, according to the specifications.

2.3 WIRING TERMINATIONS

- .1 Ensure lugs, terminals, screws used for termination of wiring are suitable for either copper or aluminum conductors.

2.4 EQUIPMENT IDENTIFICATION

- .1 Identify electrical equipment with nameplates as follows:
 - .1 Lamicoid 3 mm thick plastic engraving sheet, matt white finish face with black core, and matt red finish face with white core for emergency with lettering accurately aligned and engraved into core mechanically attached with self-tapping screws on covers, doors or on frame of equipment.
 - .2 Sizes as follows:

NAMEPLATE SIZES			
Size 1	10 mm x 50 mm	One line	3 mm high letters
Size 2	12 mm x 70 mm	One line	5 mm high letters
Size 3	12 mm x 70 mm	Two lines	3 mm high letters
Size 4	20 mm x 90 mm	One line	8 mm high letters
Size 5	20 mm x 90 mm	Two lines	5 mm high letters
Size 6	25 mm x 100 mm	One line	12 mm high letters
Size 7	25 mm x 100 mm	Two lines	6 mm high letters

- .3 Wording on nameplates to be approved by Departmental Representative prior to manufacture.
- .4 Allow for minimum of twenty-five (25) letters per nameplate or label.
- .5 Nameplates for terminal cabinets and junction boxes to indicate system and/or voltage characteristics.
- .6 Identify equipment with Size 3 labels engraved "ASSET INVENTORY NO. []" as directed by Department Representative.
- .7 List of equipment to be identified:
 - .1 Nameplates for terminal cabinets and junction boxes to indicate system and/or voltage characteristics.
 - .2 Nameplates for disconnect switches, starters and contactors relays, bus duct, cabinets and transfer switches shall indicate equipment being controlled, amperage and voltage.
 - .3 Nameplates for pull boxes to indicate system and voltage.
 - .4 Nameplates for breakers and/or fused-disconnects of low voltage switchboard, distribution panel and motor control center shall indicate the fuse size and equipment being controlled.
 - .5 All specific elements identified in plans or in each section of the specifications.

- .8 Identify wiring devices with labels as follows:
 - .1 Use clear self-adhesive labels with 3 mm high black letters for circuit ID on cover plates of receptacles.
 - .2 Also identify computer dedicated receptacle (receptacle located beside a data outlet and/or orange receptacles), receptacles dedicated to photocopiers, printers, fridges, microwaves and other equipment of such (receptacle affected by a "D").
- .9 Identify each lighting fixture connected on emergency with a visible 12mm Ø red dot self adhesive label.

2.5 WIRING IDENTIFICATION

- .1 Identify wiring with permanent indelible identifying markings, coloured plastic tapes, on both ends of phase conductors of feeders and branch circuit wiring.
- .2 Maintain phase sequence and colour coding throughout.
- .3 Use colour coded wires in communication cables, matched throughout system.
- .4 Phases:
 - .1 Identify with letters of size 5 cm in height, each phase A, B, C, N, on the inside of each transformer entry point, each low-voltage switchboard, and each motor control centre on all live components.
 - .2 Identify components and assigned phases using the colour codes outlined below:

Identification	120/208 V	120/240 V	347/600 V
Phase A	Red	Red	Red with stripe
Phase B	Black	Black	Black with stripe
Phase C	Blue	---	Blue with stripe
Neutral	White	White	White
Grounding or bonding	Green	Green	Green

- .3 Use yellow conductors for light switches return conductors and use orange conductors for tie conductors of three way and 4 way switches.
- .4 When colored jacket is not available, code each end of phase conductors with 150mm wide coloured tape. Use coloured tape on each end of the conductors inside junction and pull boxes.
- .5 Code both ends of neutral, grounding and bonding conductors with a colored heat shrinkable jacket or appropriate type of paint when colored jacket is not available.
- .5 Wires:
 - .1 Identify in each panel, in each pull and junction box each wire with the use of identification tags.
 - .2 Indicate on the tag: the circuit number, zone number, and function, in a way that each wire can be easily identified.

2.6 CONDUIT AND CABLE IDENTIFICATION

- .1 Colour code conduits, boxes and metallic sheathed cables according to existing building requirements. Use the following for information as a minimum for tender pricing.
- .2 Code with plastic tape or paint at points where conduit or cable enters wall, ceiling, or floor, and at 5 m intervals.
- .3 Code covers of junction and pull boxes with plastic tape or paint.
- .4 Colours: 25 mm wide prime colour and 20 mm wide auxiliary colour.

Description	Prime	Auxiliary
Up to 250 V	Yellow	
Up to 600 V	Orange	
Telecommunication	Blue	
Other communication systems	Green	Blue
Fire alarm	Red	
Security – Access control	Green	
Other security systems	Purple	Yellow
Lighting	White	
Emergency	Black	
Receptacles	Gray	

- .5 Conduits:
 - .1 Colour code conduits, boxes and metallic sheathed cables.
 - .2 Paint all junction and pull boxes.

2.7 CIRCUIT IDENTIFICATION

- .1 Secondary panels at 120/208 V and 347/600 V:
 - .1 Identify in type each of the circuits in the secondary panel on a protected plastic tab inserted in the panel box door. Use the same circuit number that appears in the plans. Be sure to describe succinctly the load.
- .2 Distribution panel at 120/208 V, 347/600 V and 600 V:
 - .1 Identify each circuits with a nameplate mechanically attached with screws on face of panel near each disconnect or breaker.

2.8 FINISHES

- .1 Shop finish metal enclosure surfaces by application of rust resistant primer inside and outside, and at least two coats of finish enamel.
 - .1 Paint indoor switchgear and distribution enclosures light gray.

2.9 ELECTRIC MOTORS, EQUIPMENT AND CONTROLS

- .1 Verify installation and co-ordination responsibilities related to motors, equipment and controls, as indicated.

- .2 Control wiring and conduit: in accordance with Division 23 and other relevant mechanical sections except for conduit, wiring and connections below 50 V which are related to control systems specified under division 23.

2.10 EQUIPMENT PROTECTED BY SPRINKLERS

- .1 Any electrical equipment enclosed in a perforated housing and installed in a sprinkler-protected area must be protected by a hood or non-combustible cover installed in such a way that it does not impede the proper operation of the sprinkler system.

Part 3 Execution

3.1 EXAMINATION

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

3.2 INSTALLATION

- .1 Do complete installation in accordance with CSA C22.1 except where specified otherwise.

3.3 NAMEPLATES AND LABELS

- .1 Ensure manufacturer's nameplates, CSA labels and identification nameplates are visible and legible after equipment is installed.

3.4 CONDUIT AND CABLE INSTALLATION

- .1 If plastic sleeves are used in fire rated walls or floors, remove before conduit installation.
- .2 Install cables, conduits and fittings embedded or plastered over, close to building structure so furring can be kept to minimum.

3.5 FIRESTOP AND SMOKE SEAL SYSTEMS

- .1 Do firestop and smoke seal in accordance with CAN-ULC-S115 – Standard Method of Fire Test of Firestop Systems. Install around pipe, ductwork, cables, and other objects penetrating fire separations to provide fire resistance not less than the fire resistance rating of surrounding floor, ceiling, and wall assembly.
- .2 Firestop system rating: 2-hour minimum.

3.6 LOCATION OF OUTLETS

- .1 Locate outlets as indicated on plans and align outlets in symmetrical fashion.

- .2 Do not install outlets back-to-back in wall; allow minimum 300 mm horizontal clearance between boxes.
- .3 Change location of outlets at no extra cost or credit, providing distance does not exceed 3000 mm, and information is given before installation.
- .4 Place lighting outlets and outlets above suspended ceiling in horizontal lines in both directions. Do not interfere with ceiling suspensions. Ensure the outlets are easily accessible
- .5 Make necessary adjustments when the interior finish is complete.
- .6 The exact location of outlets should be coordinated using the architectural drawings prior to installation.

3.7 MOUNTING HEIGHTS

- .1 Mounting height of equipment is from finished floor to centreline of equipment unless specified or indicated otherwise. In rooms with a raised floor, measure with respect to the top of the finished raised floor.
- .2 If mounting height of equipment is not specified or indicated, verify before proceeding with installation.
- .3 Install electrical equipment at following heights unless indicated otherwise.
 - .1 Local switches: 1200 mm.
 - .2 Wall receptacles:
 - .1 General: 400 mm.
 - .2 Above top of continuous baseboard heater: 200 mm.
 - .3 Above work plane or its backing: 1065 mm.
 - .4 In mechanical rooms: 1065 mm.
 - .3 Panel boards: as required by Code or as indicated.

3.8 WORK IN EXISTING BUILDING

- .1 Coordinate with the Departmental Representative work to be executed in areas as indicated on drawings. In general, work cannot be executed in more than one floor area at a time.
- .2 Partial or complete shutdown required on existing systems to make connections or changes shall be executed only with prior written authorisation during silent hours determined by Departmental Representative.
- .3 Submit shutdown request to each stakeholder at least one week before shutdown.
- .4 Submit a schedule of work to the Departmental Representative and other divisions for coordination of service interruption.
- .5 Coordinate receipt and handling of materials with the Departmental Representative.
- .6 Reduce noise and dust inconveniences to a minimum.
- .7 Comply at all times to Departmental Representative health and safety requirements, rules and regulations.
- .8 While on site, all personnel, including sub-trades, shall wear an identification card.

3.9 COORDINATION OF PROTECTIVE DEVICES

- .1 Ensure circuit protective devices such as overcurrent trips, relays and fuses are installed to required values and settings.

3.10 FIELD QUALITY CONTROL

- .1 Load Balance:
 - .1 Measure phase current to panel boards with normal loads operating at time of acceptance; adjust branch circuit connections as required to obtain best balance of current between phases and record changes.
 - .2 Measure phase voltages at loads and adjust transformer taps to within 2% of rated voltage of equipment.
 - .3 Provide upon completion of work, load balance report as directed in part 1 "ACTION AND INFORMATIONAL SUBMITTALS", phase and neutral currents on panel boards and dry-type transformers, operating under normal load, as well as hour and date on which each load was measured, and voltage at time of test.
- .2 Conduct following tests.
 - .1 Power distribution system including phasing, voltage, grounding and load balancing.
 - .2 Circuits originating from branch distribution panels.
 - .3 Motors, heaters and associated control equipment including sequenced operation of systems where applicable.
 - .4 Insulation resistance testing:
 - .1 Megger circuits, feeders and equipment up to 350 V with a 500 V instrument.
 - .2 Megger 350 and 600 V circuits, feeders and equipment with a 1 000 V instrument.
 - .3 Check resistance to ground before energizing.
- .3 Carry out tests in presence of Departmental Representative.
- .4 Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project.
- .5 Manufacturer`s Field Services:
 - .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".
 - .2 Manufacturer recommendations shall be adhered to. Manufacturers shall conduct periodic site visits to verify the implementation of products has been carried out in accordance with its recommendations.

3.11 PERFORMANCE

- .1 Electrical contractor to collaborate with other trades in such a way that the performance of equipment can be tested in a timely fashion.

- .2 Once testing of equipment is complete, devices can be adjusted in such a way to obtain maximum efficiency.
- .3 General Requirements:
 - .1 All testing must be completed in the presence of the Departmental Representative and to their satisfaction.
 - .2 The Departmental Representative may require their own testing prior to accepting the results.
 - .3 For temporary testing, obtain written permission to perform the tests.
 - .4 A written warning giving a notice of 48 hours to the Departmental Representative is required prior to testing.
 - .5 Provide the necessary devices, equipment, meters, materials, and personnel required for the execution of testing throughout the project until such a time as the Departmental Representative accepts the performance.
 - .6 If a piece of equipment or a device does not operate as per the manufacturer's guarantee or the results of a test do not yield the desired results, the faulty piece of equipment must be replaced without delay and payment shall be deferred until the new piece of equipment is installed and desired operating results are obtained. Contractor shall pay all costs associated with replacing defective equipment at no extra cost to the client.
 - .7 Prevent dust, dirt, and other foreign materials from penetrating the openings in installations and devices during the testing phase.
 - .8 Provide the Departmental Representative with a certificate or a manufacturer's letter confirming that the power supply to the device has been installed to their satisfaction.
 - .9 Provide written confirmation of the results obtained from testing.
 - .10 Testing trials must be completed and accepted prior to the installation of thermal insulation.
 - .11 Do not hide or recess any outlets, accessories, or devices until testing is complete and results have been accepted.
- .4 Special Requirements:
 - .1 The presence of the electrical contractor may be required for a test conducted by another trade.
- .5 Factory Tests
 - .1 The Departmental Representative reserve the right to inspect equipment at the factory and to attend factory tests as specified.
 - .2 Notify Departmental Representative at least one week in advance of date, time and location of factory tests.
 - .3 Submit to Departmental Representative two certified copies of Factory Test Reports.

3.12 SYSTEM STARTUP

- .1 Instruct operating personnel in operation, care and maintenance of systems, system equipment and components.

- .2 Arrange and pay for services of manufacturer's factory service engineer to supervise start-up of installation, check, adjust, balance and calibrate components and instruct operating personnel.
- .3 Provide these services for such period, and for as many visits as necessary to put equipment in operation, and ensure that operating personnel are conversant with aspects of its care and operation.

3.13 DEMOLITION

- .1 This section complements Section 02 41 99 – Demolition for Minor Works.
- .2 Remove and transport off-site all demolished equipment including the following: conduits, boxes, outlets, switches, power distribution devices, auxiliary systems, and all accessories.
- .3 Remove wiring and conduits back to the panel, or to the last remaining box.
- .4 Seal all openings left in accordance with the requirements contained in article 3.5 "FIREPROOFING".
- .5 Repair any power circuits, control wiring or communications wiring that may have been damaged during demolition work.

3.14 REMOVAL AND RE-INSTALLATION OF EXISTING EQUIPMENT

- .1 Remove and install all electrical devices, conduits and required conductors to allow for the completion of architectural, mechanical, and structural work as outlined in the drawings and specifications. Consult the drawings and specifications of other disciplines as required.

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 This Section includes requirements for selective demolition and removal of electrical installation, security and telecommunication components including removal of conduit, junction boxes, and feeders and incidentals required to complete work described in this Section.

1.2 RELATED REQUIREMENTS

- .1 Section 26 05 00 – Common Work Results for Electrical

1.3 REFERENCES

- .1 Canadian Standards Association (CSA)
 - .1 CSA S350 M1980 (R2003), Code of Practice for Safety in Demolition of Structures.

1.4 DEFINITIONS

- .1 Demolish: Detach items from existing construction and legally dispose of items off site, unless indicated as removed and salvaged, or removed and reinstalled.
- .2 Remove: Planned deconstruction and disassembly of electrical items from existing construction including removal of conduit, junction boxes , cabling and wiring from electrical component to panel taking care not to damage adjacent assemblies designated to remain; legally dispose of items off site, unless indicated as removed and salvaged, or removed and reinstalled.
- .3 Remove and Salvage: Detach items from existing construction and deliver them to Landlord's Property Manager ready for reuse.
- .4 Remove and Reinstall: Detach items from existing construction, prepare them for reuse, and reinstall them where indicated.
- .5 Existing to Remain: Existing items of construction that are not removed and that are not otherwise indicated as being removed and salvaged, or removed and reinstalled.
- .6 Hazardous Substances: Dangerous substances, dangerous goods, hazardous commodities and hazardous products may include asbestos, mercury and lead, PCB's, poisons, corrosive agents, flammable substances, radioactive substances, or other material that can endanger human health or wellbeing or environment if handled improperly as defined by Federal Hazardous Products Act (RSC 1985) including latest amendments.

1.5 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Action Submittals: Provide in accordance with Section 01 33 00 – Submittal Procedures before starting work of this Section:
 - .1 Construction Waste Management Plan (CWM Plan): Submit plan addressing opportunities for reduction, reuse, or recycling of materials prepared in accordance with Section 01 74 19 – Waste Management and Disposal.

- .2 Landfill Records: Indicate receipt and acceptance of selective demolition waste and hazardous wastes by a landfill facility licensed to accept hazardous waste.

1.6 ADMINISTRATIVE REQUIREMENTS

- .1 Coordination: Coordinate work of this Section to avoid interference with work by other Sections.
- .2 Scheduling: Account for continued building occupancy during selective demolition.

1.7 QUALITY ASSURANCE

- .1 Regulatory Requirements: Perform work of this Section in accordance with:
 - .1 Provincial Workers' Compensation Boards/Commissions.
 - .2 Government of Canada Work Program: Occupational Safety, Provincial and Territorial Standards and Programs for Occupational Health and Safety

1.8 SITE CONDITIONS

- .1 Existing Conditions: Condition of materials identified as being salvaged or demolished are based on observed conditions at time of site examination before tendering.
- .2 Discovery of Hazardous Substances: Immediately notify Landlord Building Operator if materials suspected of containing hazardous substances are encountered, and perform following activities:
 - .1 Hazardous substances will be as defined in Hazardous Products Act.
 - .2 Stop work in area of suspected hazardous substances.
 - .3 Take preventative measures to limit users' and workers' exposure, provide barriers and other safety devices and do not disturb.
 - .4 Hazardous substances will be removed by Landlord's Property Manager under a separate contract or as a change to Work.
 - .5 Proceed only after written instructions have been received by Landlord's Property Manager.

Part 2 Products

2.1 NOT USED REPAIR MATERIALS

- .1 General Patching and Repair Materials: Refer to architect's documents for listing of patching and repair materials incidental to removal or demolition of components associated with work of this Section.
- .2 Electrical Repair Materials: Use only new materials, CSA or ULC labelled as appropriate and matching components remaining after work associated with components identified for removal or demolition are completed.
- .3 Firestopping Repair Materials: Use firestopping materials compatible with existing firestopping systems where removal or demolition work affects rated assemblies, restore to match existing fire rated performance.

2.2 SALVAGE AND DEBRIS MATERIALS

- .1 Material Ownership: Demolished materials become Contractor's property and will be removed from Project site; except for items indicated as being reused, salvaged, reinstalled, or otherwise indicated to remain Owner's property.
- .2 Salvaged Materials: Carefully remove materials designated for salvage and store in a manner to prevent damage or devaluation of materials. Observe the following guidelines:
 - .1 Leave main electrical distribution panel in place; panel can be used for temporary construction power for this and subsequent contracts; coordinate temporary power connections with Owner.
 - .2 Leave main telephone terminal backboard in place; panel can be used for temporary construction telephone system for this and subsequent contracts; coordinate temporary telephone connections with Owner.

2.3 REMOVAL OF EXISTING EQUIPMENT DEEMED UNNECESSARY

- .1 In general, unless otherwise noted, remove all existing electrical equipment as indicated on drawings or deemed obsolete and/or not reused and maintain continuity of systems and services from end to end. Verify every equipment to be removed and remove them following work procedures and the established steps of construction.
- .2 Coordinate the removal of existing equipment deemed obsolete.
- .3 Disconnect and remove conduit and conductors up to electrical panelboard or to the last junction box of the network that is to remain.

2.4 CONTINUITY OF SERVICES

- .1 The following services shall not be interrupted without prior approval from the Landlord's Property Manager: telephone system, electrical service, fire alarm system and security systems.
- .2 Before the start of demolition work, properly identify all electrical circuits, the fire alarm circuits and security systems serving the surrounding areas around the demolition area that could potentially be affected by the demolition work.
- .3 Complete the temporary installation required to maintain in operation the electrical services of the surrounding area for the duration of work.

2.5 TEMPORARY SERVICES

- .1 Complete the temporary installation required to maintain fire alarm system in operation for the duration of construction.
- .2 Provide temporary lighting for a minimum light level of 200 lux in the areas where the lighting will be removed.

2.6 INTERRUPTIONS OF SERVICES

- .1 For any interruption of services to building services, provide a written request to the Landlord's Property Manager indicating the nature of work, the required length of time for its execution and date at which this work will be executed. Wait for authorisation before proceeding.

- .2 Unless otherwise noted in specific sections, provide to the Landlord's Property Manager with a written request at least five (5) days in advance each time a service, a power, a fire alarm or telecommunication interruption is required.
- .3 All shutdowns of any base building systems shall be performed by the Landlord Building Operations staff.
- .4 Even after authorisation from the Landlord's Property Manager, in the event of a stop all-ongoing work and re-establish the service immediately.
- .5 The operation and padlocking of breakers or disconnect switches supplying existing loads is the combine responsibility of the Electrical Contractor and the General Contractor. Coordinate with the Landlord's Property Manager the operation of these devices required for the execution of work.

2.7 EXISTING EQUIPMENT TO REMAIN

- .1 Provide all the services, electrical installation and temporary installations required to maintain and ensure operation of existing equipment according to established steps of construction.

2.8 SALVAGED OR REUSED EQUIPMENT

- .1 Before removal of equipment, the salvaged equipment shall be properly examined by the Contractor and the Client to ensure it is free of defect.
- .2 Where indicated on drawings, carefully remove materials designated for salvage, manipulate and store the existing equipment that are retained in a place determined by the General Contractor to prevent damage and depreciation.
- .3 Refeed all reused equipment and devices as indicated on drawings.

2.9 REMOVAL AND RE-INSTALLATION OF EXISTING EQUIPMENT

- .1 Remove and install all electrical devices, conduits and required conductors to allow for the completion of architectural, mechanical, and structural work as outlined in the drawings and specifications. Consult the drawings and specifications of other disciplines as required.

2.10 DEMOLITION

- .1 Remove and dispose off site of all equipment identified to be removed on drawings on that become obsolete, including wiring, conduits, boxes, receptacles, switches, light fixtures, distribution material, auxiliary system, signalling or communication devices, all accessories part of the electrical installation to be removed.
- .2 Remove wiring and conduits up to electrical panel or up to last junction box that is to remain.
- .3 Fill openings left behind in accordance with article on firestopping.
- .4 Restore power supply, control circuits, signalling or communication circuits, when a continuity failure happens because of the demolition of existing installation.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Existing Conditions: Visit site, thoroughly examine and become familiar with conditions that may affect work of this Section before tendering Bid; Departmental Representative will not consider claims for extras for work or materials necessary for proper execution and completion of contract that could have been determined by a site visit.

3.2 PREPARATION

- .1 Protection of Existing Systems to Remain: Protect systems and components indicated to remain in place during selective demolition operations and as follows:
 - .1 Prevent movement and install bracing to prevent settlement or damage of adjacent services and parts of existing buildings scheduled to remain.
 - .2 Notify General Contactor and cease operations where safety of buildings being demolished, adjacent structures or services appears to be endangered and await additional instructions before resuming demolition work specified in this Section.
 - .3 Prevent debris from blocking drainage inlets.
 - .4 Protect mechanical systems that will remain in operation.
- .2 Protection of Building Occupants: Sequence demolition work so that interference with use of the building by Landlord's Property Manager and users is minimized and as follows:
 - .1 Prevent debris from endangering safe access to and egress from occupied buildings.
 - .2 Notify General Contractor and cease operations where safety of occupants appears to be endangered and await additional instructions before resuming demolition work specified in this Section.

3.3 EXECUTION

- .1 Disconnect electrical circuits and panel feeders; maintain electrical service and main distribution panel as is, ready for subsequent Work.
- .2 Remove existing luminaires, electrical devices and equipment including associated conduits, boxes, wiring, and similar items as indicated on drawings.
- .3 Maintain fire alarm system operational during work.
- .4 Disconnect and remove telecommunication systems including associated conduits, boxes, cabling, and similar items unless specifically noted otherwise on drawings.
- .5 Disconnect and remove Voice/Data telecommunication outlets, associated conduit, cabling up to connection panel.
- .6 Perform demolition work in a neat and workmanlike manner:
 - .1 Remove tools or equipment after completion of work, and leave site clean and ready for subsequent renovation work.
 - .2 Repair and restore damages caused as a result of work of this Section to match existing materials and finishes.

- .7 Disconnect panel feeders back to main distribution panel and re label respective circuit breaker as "SPARE".
- .8 Remove existing conduits, boxes, cabling and wiring associated with removed luminaires, electrical devices and equipment.
- .9 Grind off conduits and make flush with surface of concrete where conduits are cast into concrete; seal open ends of conduit with silicone sealant and leave in place.
- .10 Seal open ends of conduit with silicone sealant and leave in place where they are inaccessible or cannot be removed without damaging adjacent construction.

3.4 CLOSEOUT ACTIVITIES

- .1 Demolition Waste Disposal: Arrange for legal disposal and remove demolished materials to accredited provincial landfill site or alternative disposal site (recycle centre).
- .2 Hazardous Substances Disposal: Arrange for disposal of hazardous substances.

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 This section includes:
 - .1 Equipment and accessories for cable and box connectors.

1.2 REFERENCE STANDARDS

- .1 CSA Group (CSA)
 - .1 CAN/CSA-C22.2 No.18.1-13(R2018), Metallic Outlet Boxes
 - .2 CAN/CSA-C22.2 No.18.2-06(R2016), Non-Metallic Outlet Boxes
 - .3 CAN/CSA-C22.2 No.65-18, Wire Connectors.
- .2 Electrical and Electronic Manufacturers' Association of Canada (EEMAC)
 - .1 EEMAC 1Y-2-1961, Bushing Stud Connectors and Aluminum Adapters (1200 Ampere Maximum Rating).
- .3 National Electrical Manufacturers Association (NEMA)

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Submit Shop Drawings for the following:
 - .1 Multi-port wire connectors for parallel conductor joints.
 - .2 Terminal blocks.
- .3 Interference Drawings:
 - .1 Interference drawings showing proposed locations and dimensions of junction boxes for distribution conductors (i.e. conductors between distribution equipment, not branch wiring).
- .4 Installation Sheet:
 - .1 Information required for Multi-port wire connectors for parallel conductor joints:
 - .1 Identification of junction box.
 - .2 Quantity and size of conductors.
 - .3 Model number of the connector used.
 - .4 Tightening torque used.
 - .5 Tightening marked.
 - .6 Dielectric test results.
 - .7 Infrared photo of the joint.

1.4 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 – Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for wire and box connectors for incorporation into manual.

Part 2 Products

2.1 MATERIALS

- .1 Pressure type wire connectors to: CAN/CSA-C22.2 No.65 , with current carrying parts of copper or aluminum alloy sized to fit aluminum or copper conductors as indicated.
- .2 Fixture type splicing connectors to: CAN/CSA-C22.2 No.65 , with current carrying parts of copper sized to fit copper conductors 10 AWG or less.
- .3 Bushing stud connectors to: EEMAC 1Y-2 and pertinent NEMA standards to consist of:
 - .1 Connector body and stud clamp for copper conductors.
 - .2 Clamp for copper conductors.
 - .3 Stud clamp bolts.
 - .4 Bolts for copper conductors.
 - .5 Sized for conductors as indicated.

2.2 WIRE CONNECTORS

- .1 Mechanical connectors for conductor size 8 AWG or less.
- .2 Mechanical connection for copper-to-copper conductors of size 6 AWG or larger.
- .3 Mechanical connection for copper-to-Nual conductors of size 6 AWG or larger.
- .4 Mechanical connection for Nual-to-Nual conductors of size 6 AWG or larger.

2.3 MULTI-PORT WIRE CONNECTORS

- .1 Insulated mechanical connector for wire termination:
 - .1 Multi port connection block with clamping screw.
 - .2 Insulation rated to 600 V, 90 deg C.
 - .3 Removable port and screw plugs.
 - .4 Dual rated for copper or aluminum conductors.
 - .5 Pre-filled with oxide inhibitor.

2.4 WIRE TERMINATIONS

- .1 The contractor is responsible for coordinating the size of the equipment connection lugs with the conductor sized indicated on drawings. Where it is not possible to connect the conductors, the Contractor may use insulated compression reducing connectors.
- .2 Insulated Compression Reducer Connector:
 - .1 Offset connecting stem.
 - .2 Insulation rated to 600 V, 90 deg C.
 - .3 Dual rated for copper or aluminum conductors.
 - .4 Pre-filled with oxide inhibitor.

2.5 TERMINAL BLOCKS

- .1 All wire connection in junction boxes and panels for low-voltage systems, etc., shall be made on terminal blocks in sufficient quantities for each wire connection.

- .2 Terminal blocks shall be complete with DIN rail, end plates, identification, extremity flanges and jumpers.

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 wire and box connectors installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied.

3.2 TIGHTENING OF MECHANICAL CONNECTIONS

- .1 Use a torque wrench adjusted to the manufacturer's recommended torque value for all torque lug connections.
- .2 Mark terminals with a yellow paint marker after clamping.

3.3 INSTALLATION

- .1 Remove insulation carefully from ends of conductors and cables and, as appropriate, proceed as follows:
 - .1 Apply coat of zinc joint compound on aluminum conductors prior to installation of connectors.
 - .2 Install mechanical pressure type connectors and tighten screws with appropriate compression tool recommended by manufacturer. Installation shall meet secureness tests in accordance with CAN/CSA-C22.2 No.65.
 - .3 Install fixture type connectors and tighten to CAN/CSA-C22.2 No.65. Replace insulating cap.
 - .4 Install bushing stud connectors in accordance with EEMAC 1Y-2 and applicable NEMA standards.

3.4 CONDUCTOR JOINTS

- .1 Wrap connectors not having their own insulation with at least two (2) rows of tape.
- .2 The dielectric characteristics of the joint wrapping shall not be less than that of the conductor insulation.
- .3 Gaskets and connectors that do not have a smooth surface must be wrapped prior to being wrapped.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 26 05 00 - Common Work Results for Electrical.
- .2 Section 26 05 20 - Wire and Box Connectors 0-1000 V
- .3 Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.

1.2 REFERENCES

- .1 Canadian Standards Association (CSA)/CSA International:
 - .1 CSA C22.2 No 38-18, Thermoset-Insulated Wires and Cables (Tri-national standard, with UL 44 and ANCE NMX-J-451-2014).
 - .2 CSA C22.2 No 51-20, Armoured Cables.
 - .3 CSA C22.2 No 131-17, Type Teck 90 Cable.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Product Data:
 - .1 Provide manufacturer's printed product literature and datasheets for insulation and adhesives, and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

1.4 CLOSEOUT SUBMITTALS

- .1 Provide operation, maintenance and engineering data for incorporation into manual specified in Section 01 78 00 – Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for incorporation into manual.

Part 2 Products

2.1 BUILDING WIRES

- .1 Conductors: stranded for 8 AWG and larger. Minimum size: 12 AWG.
- .2 Unless otherwise indicated, copper conductors: size as indicated, with 1000 V insulation of cross-linked thermosetting polyethylene material rated RW90 XLPE, without jacket.
- .3 Conductors and cables must bear the manufacturer's label, insulation type, size and voltage rating at regular intervals on the outer conductor or cable with permanent markings.

2.2 ARMOURED CABLES

- .1 Conductors: insulated, unless otherwise indicated: copper, size as indicated, RW-90.
- .2 Armour: interlocking type fabricated from galvanized steel strip.
- .3 Connectors: anti short connectors.
- .4 Type AC90 (BX) for connection:
 - .1 Lighting equipment recessed in suspended ceilings for a maximum length permitted not to exceed 3% voltage drop.
 - .2 Receptacles installed in suspended ceilings or gypsum board wall.
 - .3 Light switches installed in gypsum board.
 - .4 Suspended devices such as motorized dampers, valves, and other similar devices (approximate length of \pm 900 mm between the ductwork and the suspended device).
- .5 Type ACWU90 cable c/w fire retardant PVC cover over armor in accordance with Building Code requirements for the building class of this project. For applications in damp locations.

2.3 CONTROL CABLES

- .1 Type: LVT: 2 soft annealed copper conductors, sized as indicated:
 - .1 Insulation : thermoplastic.
 - .2 Sheath : cotton braid and armour of closely wound aluminum wire.
- .2 Type: low energy 300 V control cable: stranded annealed copper conductors sized as indicated.
 - .1 Insulation: PVC.
 - .2 Shielding: Metallic wires, braids or ribbons on each pair of conductors.
 - .3 Overall covering: PVC jackets.

Part 3 Execution

3.1 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Perform all tests using method appropriate to site conditions and to approval of Departmental Representative and local authority having jurisdiction over installation.
- .3 Perform tests before energizing electrical system.

3.2 GENERAL CABLE INSTALLATION

- .1 Terminate cables in accordance with Section 26 05 20 - Wire and Box Connectors (0-1000 V).
- .2 Cable Colour Coding: to Section 26 05 00 - Common Work Results for Electrical.
- .3 Conductor length for parallel feeders to be identical.

- .4 Lace or clip groups of feeder cables at distribution centres, pull boxes, and termination points.
- .5 Wiring in walls: typically drop or loop vertically from above to better facilitate future renovations. Unless indicated otherwise, wiring from below and horizontal wiring in walls are to be avoided.
- .6 Branch circuit wiring for surge suppression receptacles and permanently wired computer and electronic equipment to be 2-wire circuits only, i.e. common neutrals not permitted.
- .7 Provide numbered wire collars for control wiring. Numbers to correspond to control wiring identified in shop drawing legend. Obtain wiring diagram for control wiring.
- .8 Supply and install all wires and cables required for the connection of all electrical equipment and devices a complete and operational installation even if the wires or cables are not specifically shown on the drawings.
- .9 Provide numbered wire collars for control wiring. Numbers to correspond to control shop drawing legend.
- .10 Install a separate neutral conductor for each 120 V branch circuit.
- .11 Only use manufacturer approved pulling lubricant to pull cables.
- .12 Install cables or conductor in a continuous run, without splices, from source to device. Make junctions in pull boxes only if necessary.
- .13 Support vertically mounted armored cables or type Teck such as AC90, ACU90, RP90, RC90, according to the requirements outlined in Table 21, of the Canadian Electrical Code, Part I, Safety Standard for Electrical Installations or:
 - .1 Incorporate 90° bends in the vertical conduit at intervals not exceeding the distances outlined in Table 21, of the Canadian Electrical Code, Part I, Safety Standard for Electrical Installations.
 - .2 Use a cable specifically designed for vertical installation.
- .14 Refer to table 1 at the end of this section to determine the maximum number of conductors/conduits.

3.3 INSTALLATION OF BUILDING WIRES

- .1 Install wiring as follows:
 - .1 In conduit systems in accordance with Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.

3.4 TESTING RESISTANCE IN INSULATION

- .1 Measure the di-electric value of circuits, power cables, and equipment with a maximum voltage of 350 V and a 500 V megger.
- .2 Measure the di-electric value of circuits, power cables, and equipment with a maximum voltage of 350 V and 600 using a meg-ohmmeter of 1 000 V.
- .3 In either case, ensure that the value of the resistance to ground, before power is applied, is not less than the requirement as set forth by the manufacturer.
- .4 Provide certification that all drivers have been checked and that any defective conductors have been replaced.

- .1 Group cables wherever possible on channels.
- .2 Secure cables directly to the frame at a distance of 300 mm from outlet boxes and at every 1500 mm maximum on all runs.
- .3 Cut the metal casing of the cables with a suitable tool and provide insulating anti short sleeves at the ends.
- .4 The installation of armoured cables in walls and partitions is only permitted for vertical installations.

- .1 Install control cables in conduit.
- .2 Connect to ground the control cable shield.

MAXIMUM NUMBER OF RW-90 CONDUCTORS PER CONDUIT

MAXIMUM NUMBER OF RW-90 CONDUCTORS PER CONDUIT						
Conductor Size AWG	Size of Conduit in mm					
	16	21	27	35	41	53
14	7	14	22	40	55	90
12	4	10	16	30	40	66
10	4	6	12	20	30	50
8	---	3	6	10	16	26
6	---	---	3	8	9	18
4	---	---	---	3	6	12
3	---	---	---	3	6	12
2	---	---	---	---	6	9
1	---	---	---	---	4	6
1/0	---	---	---	---	---	6

Note :
For dimensions not listed, refer to Canadian Electrical Code, Part I, Safety Standard for Electrical Installations.

TABLE 2

MAXIMUM LENGTH (IN METERS) OF A BRANCH CIRCUIT AT 120 V VERSUS VOLTAGE DROP			
Conductor Size AWG	Rating in Amps (A)		
	15	20	30
12	20	15	---
10	30	25	15
8	50	40	25
6	90	65	40
Notes : <ul style="list-style-type: none"> – For non-specified loads, refer to Canadian Electrical Code, Part I, Safety Standard for Electrical Installations. – Distance calculated for copper conductors at a temperature of 60 degrees C. 			

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 This section includes:
 - .1 Equipment and accessories for the installation of a continuous grounded system.
 - .2 Specific prescriptions for appropriate grounding and bonding of electrical systems.

1.2 RELATED REQUIREMENTS

- .1 Section 26 05 00 – Common Work Results for Electrical.

1.3 REFERENCE STANDARDS

- .1 American National Standards Institute /Institute of Electrical and Electronics Engineers (ANSI/IEEE)
 - .1 ANSI/IEEE 837-14, IEEE Standard for Qualifying Permanent Connections Used in Substation Grounding.
 - .2 ANSI/IEEE 142-07, IEEE Recommended Practice for Grounding of Industrial and Commercial Power Systems.
- .2 CSA Group (CSA)
 - .1 CSA Z32-15 (R2020), Electrical Safety and Essential Electrical Systems in Health Care Facilities.
- .3 Building Industry Consulting Service International (BICSI):
 - .1 Telecommunications Distribution Methods Manual (TDMM), 14th Edition
- .4 American National Standards Institute/Telecommunications Industry Association:
 - .1 ANSI/TIA-606-C, Administration Standard for Telecommunications Infrastructure
 - .2 ANSI/TIA-607-D, Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Submit grounding compliance certificate complete with test results.

1.5 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 – Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for grounding equipment for incorporation into manual.

Part 2 Products

2.1 EQUIPMENT

- .1 Insulated grounding conductors: green, copper conductors, size as indicated.
- .2 All grounding conductors shall be minimum gauge 6 AWG.
- .3 High-conductivity wrought copper compression lug, electro-tin plated, 600 V certified, for copper conductors:
 - .1 One (1) hole for conductors smaller than 1/0AWG.
 - .2 Two (2) hole long barrel for 1/0 AWG conductors or larger.
 - .3 Silicone bronze or stainless steel bolts.
- .4 Non-corroding accessories necessary for grounding system, type, size, material as indicated, including but not necessarily limited to:
 - .1 Grounding and bonding bushings.
 - .2 Protective type clamps.
 - .3 Bolted type conductor connectors.
 - .4 Bonding jumpers, straps.
 - .5 Pressure wire connectors.
 - .6 Silicone bronze or stainless steel bolts.

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 grounding equipment installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.
- .2 Perform test in accordance with Section 26 05 00 – Common Work Results for Electrical
- .3 Verify the continuity of the grounding system across all joints and connections.
- .4 Perform all tests prior to energizing electrical system.
- .5 During testing, make all pertinent disconnections, such as a ground leakage indicator.

3.2 INSTALLATION GENERAL

- .1 Install complete permanent, continuous grounding system including, electrodes, conductors, connectors, accessories in accordance with Electrical Code.
- .2 Where EMT is used, run ground wire in conduit.
- .3 Make grounding connections in radial configuration only, with connections terminating at single grounding point. Avoid loop connections.

- .4 Install connectors in accordance with manufacturer's instructions.
- .5 Protect exposed grounding conductors from mechanical injury.
- .6 Use mechanical connectors for grounding connections to equipment provided with lugs.
- .7 Soldered joints not permitted.
- .8 Install flexible ground straps for bus duct enclosure joints, where such bonding is not inherently provided with equipment.
- .9 Grounding continuity for electrical systems:
 - .1 Install bonding wire for flexible conduit, connected at both ends to grounding bushing, solderless lug, clamp or cup washer and screw. Neatly cleat bonding wire to exterior of flexible conduit.
 - .2 Install a ground conductor in concrete encased metallic conduits installed in slab on grade.
 - .3 Install ground conductor in all PVC conduits.
 - .4 Bond single conductor, metallic armoured cables to cabinet at supply end, and provide non-metallic entry plate at load end.
- .10 Grounding continuity, general:
 - .1 Ground secondary service pedestals, sanitary piping, rainwater piping and gas piping.
 - .2 Ensure conductive continuity across any electrically insulated part of a metallic domestic water distribution system. Conductive continuity across backflow preventers, water meters, pumps or other equipment shall be assured using bonding conductors.
 - .3 Connect building structural steel and metal siding to ground by welding copper to steel.

3.3 SYSTEM AND CIRCUIT GROUNDING

- .1 Install system and circuit grounding connections to neutral at secondary of service. Only one connection between neutral and ground is permitted per system and subsystem.

3.4 EQUIPMENT GROUNDING

- .1 Install grounding connections to typical equipment included in, but not necessarily limited to following list: Service equipment, transformers, switchgear, duct systems, frames of motors, starters, control panels, building steel work, distribution panels.
- .2 Ground motor frames or other vibrating equipment by installing a separate green insulated ground conductor in the flexible conduit servicing the equipment. Terminate the green insulated conductor to a rigid surface at each end of the flexible conduit.

3.5 COMMUNICATION SYSTEMS

- .1 Install grounding connections for telephone, sound, fire alarm, security systems, intercommunication systems as follows: Telephones: make telephone grounding system in accordance with telephone company's requirements.

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 This section includes:
 - .1 U shape support channels for surface mounting, suspended installation or recessing in concrete walls or ceilings.

1.2 REFERENCE STANDARDS

- .1 CSA International :
 - .1 CAN/CSA G164-18 – Hot Dip Galvanized of Irregularly Shaped Articles

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Provide shop drawings for:
 - .1 U shape support channels
 - .2 Channel supports (sleepers)

1.4 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 – Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for incorporation into Operation and Maintenance Manual.

Part 2 Products

2.1 SUPPORT CHANNELS

- .1 U shape, size 41 x 41 mm, 2.5 mm thick, surface mounted, set in poured concrete walls and ceilings or suspended.
 - .1 Material and Finish:
 - .1 Interior installations: Pregalvanized zinc coated steel (mill galvanized)
 - .2 Temporary exterior installations: Hot-dipped galvanized steel
 - .3 Permanent exterior installations: Aluminum
 - .2 U shape support channels shall be slotted type.
 - .3 Fasteners used for exterior installations or damp locations shall match material and finish of support channels.

2.2 CHANNEL SUPPORTS (SLEEPERS)

- .1 Supports for conduits and cabling for rooftop installation:
 - .1 No rooftop penetrations required.

- .2 Material: Recycled rubber or thermoplastic
- .3 UV resistant
- .4 Through bolted to accommodate U shape support channel
- .5 Minimum uniform load capacity of 2.22 kN per unit.

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 hangers and supports installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied.

3.2 INSTALLATION

- .1 Secure equipment to hollow or solid masonry, tile and plaster surfaces with lead anchors.
- .2 Secure equipment to poured concrete with expandable inserts.
- .3 Secure equipment to hollow masonry walls or suspended ceilings with toggle bolts.
- .4 Secure surface mounted equipment with twist clip fasteners to inverted T bar ceilings. Ensure that T bars are adequately supported to carry weight of equipment specified before installation.
- .5 Support equipment, conduit or cables using clips, spring loaded bolts, cable clamps designed as accessories to basic channel members.
- .6 Suspended support systems.
 - .1 Support individual cable or conduit runs with 6 mm diameter threaded rods and spring clips.
 - .2 Support two (2) or more cables or conduits on channels supported by 6 mm diameter threaded rod hangers where direct fastening to building construction is impractical.
- .7 For surface mounting of two (2) or more conduits use channels at 1 m intervals to the centerline of channel.
- .8 Provide metal brackets, frames, hangers, clamps and related types of support structures where indicated or as required to support conduit and cable runs.
- .9 Ensure adequate support for raceways and cables dropped vertically to equipment where there is no wall support.
- .10 Do not use wire lashing or perforated strap to support or secure raceways or cables.
- .11 Do not use supports or equipment installed for other trades for conduit or cable support except with permission of other trade and approval of Departmental Representative.

- .12 Install fastenings and supports as required for each type of equipment cables and conduits, and in accordance with manufacturer's installation recommendations.
- .13 Coat (touch-up) all scratched, altered or cut surfaces with a galvanized coating product.
- .14 Provide diagonal brace from the building structure to meet seismic requirement in accordance with the requirements of the Building Code.
- .15 Channel Supports (Sleepers):
 - .1 For conduits and cables installed on rooftops, install a system of supports made of U-channels in an inverted trapezes configuration and secured to channel supports (sleepers). Spacing of channel supports (sleepers) shall not exceed 1.5 m.
 - .2 Installation height of trapezes shall be minimum 150 mm from top of roof, or as indicated on plans.

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 This section includes:
 - .1 Specification and installation requirements of splitters, junction boxes, pull boxes and cabinets.

1.2 REFERENCE STANDARDS

- .1 CSA Group (CSA)
 - .1 CSA C22.1-21, Canadian Electrical Code, Part 1, 25th Edition, Safety Standard for Electrical Installations.
 - .2 CSA C22.2 No. 40-17, Junction and Pull Boxes.
 - .3 CSA C22.2 No. 76-14 (R2019), Splitters.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Product Data:
 - .1 Provide manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.

Part 2 Products

2.1 JUNCTION AND PULL BOXES

- .1 Construction: minimum 14 gauge welded steel enclosure, coated with electrostatically applied paint, dimensions as required by the Electrical Code or as indicated.
- .2 Covers Flush Mounted: 25 mm minimum extension all around.
- .3 Covers Surface Mounted:
 - .1 Screw-on-flat covers for boxes sized less than 400 mm square.
 - .2 Flat covers on hinges for boxes sized 400 mm square or larger.
- .4 Without knockouts, factory made openings for FS and FD type boxes
- .5 Steel angle framing to form rigid assembly for boxes sized larger than 600 mm square. Integral keyed handle at two (2) locations; top and bottom.

Part 3 Execution

3.1 JUNCTION, PULL BOXES AND CABINETS INSTALLATION

- .1 Install pull boxes in inconspicuous but accessible locations.

- .2 Mount cabinets with top not higher than 2 m above finished floor except where indicated otherwise.
- .3 Only particular junction and pull boxes are indicated, the noted locations and dimensions are indicative only. The Contractor is solely responsible for placing and sizing junction boxes and pull boxes as required. Install additional junction boxes and pull boxes as required by CSA C22.1.
- .4 Install all junction boxes and pull boxes indicated on plans.

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 This section includes:
 - .1 General and specific requirements regarding outlet boxes, conduit boxes and associated accessories / appurtenances.

1.2 RELATED REQUIREMENTS

- .1 Section 26 05 00 - Common Work Results for Electrical.

1.3 REFERENCE STANDARDS

- .1 CSA Group (CSA)
 - .1 CAN/CSA-C22.2 No.18.1-13(R2018), Metallic Outlet Boxes

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 – Submittal Procedures.

Part 2 Products

2.1 OUTLET AND CONDUIT BOXES GENERAL

- .1 Size boxes in accordance with CSA C22.1.
- .2 Minimum 102 mm square outlet boxes, minimum depth of 40 mm, unless indicated otherwise. Larger outlet boxes as required.
- .3 Minimum 14 gauge steel construction.
- .4 Gang boxes where wiring devices are grouped.
- .5 Blank cover plates for boxes without wiring devices.
- .6 347 V outlet boxes for 347 V switching devices.
- .7 Combination boxes with barriers where outlets for more than one system are grouped.
- .8 All surface mounted boxes located at less than 2400 mm above finished floor shall be FS type.

2.2 GALVANIZED STEEL OUTLET BOXES

- .1 One-piece electro-galvanized construction.
- .2 Single and multi gang flush device boxes for flush installation, minimum size 76 x 50 x 38 mm or as indicated. 102 mm square outlet boxes when more than one conduit enters one side with extension and plaster rings as required.
- .3 Utility boxes for outlets connected to surface-mounted EMT conduit, minimum size 102 x 54 x 48 mm.

- .4 102 mm square or octagonal outlet boxes for lighting fixture outlets.
- .5 Extension and plaster rings for flush mounting devices in finished plaster wall or tile.

2.3 MASONRY AND GYPSUM BOARD BOXES

- .1 Electro-galvanized steel masonry multi gang boxes for devices flush mounted in exposed block walls or gypsum board.
- .2 Minimum 12.5 mm plaster ring.
- .3 Low-profile single gang boxes for installation in exterior walls with vapor barrier. Equivalent to Thomas & Betts BCR2000.

2.4 CONDUIT BOXES

- .1 Cast FS or FD boxes as required with factory-threaded hubs and mounting feet for surface wiring of devices.

2.5 OUTLET BOXES FOR NON-METALLIC SHEATHED CABLE

- .1 Electro-galvanized, sectional, screw ganging steel boxes, minimum size 76 x 50 x 63 mm with two double clamps to take non-metallic sheathed cables.

2.6 CEILING BOXES

- .1 102 mm diameter surface mount octagonal box, depth as required.
- .2 102 mm diameter flush mount box, depth as required.

2.7 FITTINGS - GENERAL

- .1 Bushing and connectors with nylon insulated throats.
- .2 Knock-out fillers to prevent entry of debris.
- .3 Conduit outlet bodies for conduit up to 35 mm and pull boxes for larger conduits.
- .4 Double locknuts and insulated bushings on sheet metal boxes.

2.8 SERVICE FITTINGS

- .1 'High tension' receptacle fitting made of 2 piece die-cast aluminum with brushed aluminum housing finish for two duplex receptacles. Bottom plate with two knockouts for centered or offset installation. 12 x 102 mm extension piece as indicated .
- .2 Pedestal type 'low tension' fitting made of 2 piece die cast aluminum with brushed aluminum housing finish to accommodate two telecommunication jack connectors.

Part 3 Execution

3.1 INSTALLATION

- .1 Support boxes independently of connecting conduits.
- .2 Fill boxes with paper, sponges or foam or similar approved material to prevent entry of debris during construction. Remove upon completion of work.

- .3 For flush installations mount outlets flush with finished wall using plaster rings to permit wall finish to come within 6 mm of opening.
- .4 For flush installations on a wall with two (2) finishes of varying thickness (for example: tile and plaster in a washroom), do not place an outlet on the boundary line between the two (2) finishes.
- .5 Provide correct size of openings in boxes for conduit, mineral insulated and armoured cable connections. Do not install reducing washers.
- .6 Group in one box switches, outlets, and other devices placed side by side. For two devices or more, use pre-ganged outlet boxes with compatible plaster ring.
- .7 Outlet boxes indicated as 'back-to-back' shall be separated by 300 mm minimum along the linear path of the wall.
- .8 Attach outlet boxes to metal studs in gypsum walls as indicated.
- .9 For outlet boxes installed at exterior walls or ceilings, install low-profile outlet box without damaging the vapor barrier. If the vapor barrier is punctured, install a minimum 300mm x 300mm sheet of the same material as existing over the damaged area. Ensure the vapor barrier is restored and functions as intended.
- .10 Vacuum clean interior of outlet boxes before installation of wiring devices.
- .11 Repair junction boxes as required.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 26 05 00 - Common Work Results for Electrical.
- .2 Section 26 05 20 – Wire and Box Connectors 0-1000 V.

1.2 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CAN/CSA C22.2 No.18-98 (R2003), Outlet Boxes, Conduit Boxes and Fittings.
 - .2 CSA C22.2 No. 56-17, Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit.
 - .3 CSA C22.2 No. 83-M1985 (R2017), Electrical Metallic Tubing.
 - .4 CSA C22.2 No. 211.2-06 (R2016), Rigid PVC (Unplasticized) Conduit. Update No.1(2011).
 - .5 CAN/CSA C22.2 No. 227.3-21, Non-Metallic Mechanical Protection Tubing (NMPT) and Fittings.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Product data: submit manufacturer's printed product literature, specifications and datasheets.
 - .1 Submit cable manufacturing data.
- .3 Quality assurance submittals:
 - .1 Test reports: submit certified test reports by recognized independent laboratories.
 - .2 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
 - .3 Instructions: submit manufacturer's installation instructions.

1.4 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate waste materials for reuse or recycling in accordance with Section 01 74 19 – Waste Management and Disposal.
- .2 Place materials defined as hazardous or toxic waste in designated containers.
- .3 Ensure emptied containers are sealed and stored safely for disposal away from children.

Part 2 Products

2.1 CONDUITS

- .1 Electrical metallic tubing (EMT): to CSA C22.2 No. 83, with couplings.

- .2 Flexible metal conduit: to CSA C22.2 No. 56, liquid-tight flexible metal and steel.
- .3 The size required by Canadian Electrical Code, Part I, Safety Standard for Electrical Installations, unless otherwise indicated, is a minimum of 21 mm diameter.
- .4 Galvanized steel, rigid, thin-walled, unless otherwise indicated.
- .5 Galvanized steel, flexible waterproof kind, between the ductwork and the unit's connections box (\pm 900 mm in length) for connecting motors.

2.2 CONDUIT FASTENINGS

- .1 One hole steel straps to secure surface conduits 50 mm and smaller.
 - .1 Two-hole steel straps for conduits larger than 50 mm.
- .2 Beam clamps to secure conduits to exposed steel work.
- .3 U Channel type supports for two or more conduits at 1.5 m on centre.
- .4 Threaded rods, 6 mm diameter, to support suspended channels.
- .5 Install cross braces spaced up to 12 m and longitudinal braces on all horizontal runs of suspended conduits at 300 mm or more from ceiling slab. This requirement may be omitted if the maximum conduit diameter is less than 65 mm for a single conduit or if a group of conduits has a total weight less than 6.8 kg/m.

2.3 CONDUIT FITTINGS

- .1 Fittings: to CAN/CSA C22.2 no. 18, manufactured for use with conduit specified.
Coating: same as conduit.
- .2 Ensure factory "ells" where 90 degrees bends for 25 mm and larger conduits.
- .3 Type C, LB, LL, LR and T connections are prohibited.
- .4 Set-screw connectors and couplings for EMT.
 - .1 Set-screws are not acceptable.
- .5 Mechanically bend steel conduit over 19 mm diameter.

2.4 FISH CORD

- .1 Polypropylene.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 INSTALLATION

- .1 Install conduits to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass.

- .2 Unless indicated otherwise, use electrical metallic tubing (EMT).
- .3 Unless otherwise noted, minimum conduit size of 21 mm for power and 27 mm for communication pathways.
- .4 Bend conduit cold. Replace conduit if kinked or flattened more than 1/10th of its original diameter.
- .5 Mechanically bend steel conduit over 27 mm diameter.
- .6 Install 3 mm diameter fish cord in empty conduits.
- .7 Remove and replace blocked conduit sections. Do not use liquids to clean out conduits.
- .8 Dry conduits out before installing wire.
- .9 Install all conduits in parallel with structural lines and so as not to harm the equipment of other trades.
- .10 No drilling is to be done through beams to run conduits.
- .11 Maintain grounding integrity for the entire installation by installing a green insulated ground conductor in each conduit.
- .12 The minimum inner bending radius of conduits shall be at least six times the internal diameter of the conduit. When a group of conduits run side by side, the bending radii are to be concentric.
- .13 During construction, equip ducts with plugs to prevent foreign bodies from entering.
- .14 Conduit runs between two outputs, pull boxes or sliding sleeves must not have more than three 90° elbows or equivalent or be more than 30 m in length, except the external telephone network, where indicated in the plans.
- .15 Support conduits suspended using galvanized brackets, as described elsewhere in these specifications.
- .16 Support vertical conduits at floor level and use intermediate supports required by the code.
- .17 The conduits should not touch the conduit insulation, mechanical equipment, or be buried in the insulation or fireproofing materials.

3.3 SURFACE CONDUITS

- .1 Run parallel or perpendicular to building lines.
- .2 Take all necessary precautions with respect to installation of exposed conduits on heritage walls to ensure the highest degree of diligence is undertaken to maintain the integrity of heritage surfaces. The impact of the work must be very minimal. For brick walls, drilling is allowed only on mortar joints.
- .3 Locate conduits behind infrared or gas fired heaters with 1.5 m clearance.
- .4 Run conduits in flanged portion of structural steel.
- .5 Group conduits wherever possible on suspended or surface channels.
- .6 Do not pass conduits through structural members except as indicated.

- .7 Do not locate conduits less than 75 mm parallel to steam or hot water lines with minimum of 25 mm at crossovers.
- .8 No surface conduits to be installed in finished areas.

3.4 CONCEALED CONDUITS

- .1 Run parallel or perpendicular to building lines.
- .2 Do not install horizontal runs in masonry walls.
- .3 Do not install conduits in terrazzo or concrete toppings.

3.5 CONDUIT IDENTIFICATION

- .1 Do conduit identification in accordance with Section 26 05 00 - Common Work Results for Electrical.

3.6 CLEANING

- .1 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 26 05 00 - Common Work Results for Electrical.

1.2 REFERENCE STANDARDS

- .1 CSA Group (CSA)
 - .1 CAN/CSA-C22.2 No.47-13(R2018), Air-Cooled Transformers (Dry Type).
 - .2 CSA C9-17, Dry-Type Transformers.
 - .3 CAN/CSA-C802.2-18, Test Method and Minimum Efficiency Values for Dry Type Transformers.
- .2 National Electrical Manufacturers Association (NEMA)

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for dry type transformers and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Sustainable Design Submittals:
 - .1 Construction Waste Management:
 - .1 Submit project Waste Reduction Workplan highlighting recycling and salvage requirements.

1.4 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 – Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for dry type transformers for incorporation into manual.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground, in dry location, indoors, and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect dry type transformers from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

Part 2 Products

2.1 DESIGN DESCRIPTION

- .1 Design 1:
 - .1 Type: ANN.
 - .2 3 phase,
 - .3 Voltage taps: standard.
 - .4 Insulation: Class H
 - .5 Basic Impulse Level (BIL): standard.
 - .6 Hipot: standard.
 - .7 Average sound level: standard
 - .8 Impedance at 17 degrees C: standard
 - .9 Enclosure: CSA, removable metal front panel.
 - .10 Mounting: wall.
 - .11 Finish: in accordance with Section 26 05 00 - Common Work Results for Electrical.
 - .12 Copper windings.
 - .13 Winding configuration to be as noted on drawings.
 - .14 K-13 Rated Transformers
 - .15 Voltage Regulation to be 4% or better.

2.2 EQUIPMENT IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Label size: 7.

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 dry type transformers installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 INSTALLATION

- .1 Mount dry type transformers up to 75 kVA as indicated.

- .2 Mount dry type transformers above 75 kVA on floor.
- .3 Ensure adequate clearance around transformer for ventilation.
- .4 Install transformers in level upright position.
- .5 Remove shipping supports only after transformer is installed and just before putting into service.
- .6 Loosen isolation pad bolts until no compression is visible.
- .7 Make primary and secondary connections in accordance with wiring diagram.
- .8 Energize transformers after installation is complete.
- .9 Make conduit entry into bottom 1/3 of transformer enclosure.

3.3 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 – Cleaning.
 - .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.

3.4 PROTECTION

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

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 26 28 16.02 – Moulded Case Circuit Breakers.

1.2 REFERENCE STANDARDS

- .1 CSA Group (CSA)
 - .1 CSA C22.2 No.29-15 (R2019), Panelboards and Enclosed Panelboards.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for panelboards and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Include on drawings:
 - .1 Electrical detail of panel, branch breaker type, quantity, ampacity and enclosure dimension.

1.4 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 – Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for panelboards for incorporation into manual.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials in dry location, indoors, off ground and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect panelboards from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

Part 2 Products

2.1 PANELBOARDS

- .1 Distribution panel boards as per CSA C22.2 No.29 and product of the same one manufacturer. Install circuit breakers in panel boards before shipment.
- .2 250 to 600 V panel boards, capacity of bus bars, rated breaking capacity and circuit breakers, as indicated on the panel board sheets.
- .3 Sequence phase bussing with odd numbered breakers on left and even on right, with each breaker identified by permanent number identification as to circuit number and phase.
- .4 Minimum of two (2) flush locks for each panel board. Two keys for each panel board and key panel boards alike.
- .5 Copper bus bars; neutral bar of the same carrying capacity as the phase bar or a carrying capacity double that of the phase bar where indicated.
- .6 Bus Bars will have bolted-on breakers.
- .7 Frame of the door panels with concealed bolts and hinges
- .8 Door and door frame coated with oven-baked enamel.
- .9 Isolated ground bus.
- .10 Include grounding bus bar with 3 of terminals for bonding conductor equal to breaker capacity of the panel board.
- .11 Gray painted steel housing, 12 gauges minimum, hinged door with concealed lock for access to the circuit breakers and integrated with hinged exterior door lock for access to the wiring spaces of the area.
 - .1 Types of panel boards:
 - .1 Lighting 120/208 V: 18 kA
 - .2 Distribution c/w breakers 347/600V: 35 kA
 - .2 The panels should have either nominal short-circuit holding or the nominal value of integrated protection of the equipment with the upstream protective device as shown in the panel paperwork. The panel's face value protection equipment must meet CSA C22.2 testing requirements No. 29 and must be labeled to show the face value of integrated protection, voltage, and enabled devices downstream.
 - .3 All panels installed in mechanical and electrical rooms protected by sprinklers must have sprinkler-proof housing.

2.2 BREAKERS

- .1 Breakers: to Section 26 28 16.02 – Moulded Case Circuit Breakers.
- .2 Breakers with thermal and magnetic tripping in panel boards except as indicated otherwise.
- .3 Main breaker, separately mounted on top or bottom of panel to suit cable entry. When mounted vertically, down position should open breaker.

- .4 Lock-on devices for receptacles, fire alarm, clock outlet, emergency, door supervisory, intercom, stairway, exit and night light circuits.

2.3 EQUIPMENT IDENTIFICATION

- .1 Full nomenclature for circuits with typewritten legend showing the location and the load of each circuit in a plastic coated tag inside the panel board.

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 panel board installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of the Departmental Representative.
 - .2 Inform the Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from the Departmental Representative.

3.2 INSTALLATION

- .1 Locate panel boards as indicated and mount securely, balanced, and square, to adjoining surfaces.
- .2 Fit the distribution panels on fireproof plywood, fire protection of two (2) hours. Wherever possible, group the distribution panels on a common backboard at 21 mm.
- .3 Mount distribution panel boards to the height as indicated.
- .4 Connect loads to circuits.
- .5 Connect neutral conductors to common neutral bus with respective neutral identified.
- .6 Where panels of different systems (i.e. standard and vital power) supply a common patient care area, ground busses in panels to be interconnected to ground conductor.
- .7 Provide three (3) empty conduits, 27 mm from each panel, recessed in walls and ducts which end in a pull box in the ceiling space.
- .8 Measure the voltage load currents stabilized in each power circuit board and rearrange circuits in the panel to balance the loads on the phases with a maximum deviation of 20% from each. Maintain adequate phasing out of derivations of multiphase circuits. Submit the expense report to the Departmental Representative for approval and make corrections if necessary.
- .9 Verify bolted connections and circuit breaker connections are appropriately tight using a torque wrench or torque screwdriver in accordance with manufacturer requirements.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 26 05 00 – Common Work Results for Electrical.

1.2 SUMMARY

- .1 This section includes :
 - .1 This section covers wiring devices and related installation methods.

1.3 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CSA-C22.2 No.42-10 (R2020), General Use Receptacles, Attachment Plugs and Similar Devices.
 - .2 CSA-C22.2 No.42.1-13 (R2017), Cover Plates for Flush-Mounted Wiring Devices (Bi-national standard, with UL 514D).
 - .3 CSA-C22.2 No.55-15 (R2020), Special Use Switches.
 - .4 CSA-C22.2 No.111-18, General-Use Snap Switches (Bi-national standard, with UL 20).

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Shop Drawings:
 - .1 Without exception, shop drawings are required for the following :
 - .1 Power receptacles.
 - .2 Cover Plates.
 - .3 Switches.
 - .4 Dimmers.

1.5 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 – Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for wiring devices for incorporation into manual.

1.6 COLOUR CODE

- .1 Assign a color code to receptacles and switches:
 - .1 Normal network of 120 V, 20 A: white
 - Emergency network of 120 V, 20 A: red
 - .2 Outlets on UPS network: blue

Part 2 Products

2.1 SWITCHES

- .1 15 A or 20 A, 120 or 347 V, single pole or three way switch as indicated on drawings to: CSA-C22.2 No.55 and CSA-C22.2 No.111.
- .2 Manually-operated general purpose ac switches with following features:
 - .1 Terminal holes approved for No. 10 AWG wire.
 - .2 Silver alloy contacts.
 - .3 Urea or melamine moulding for parts subject to carbon tracking.
 - .4 Suitable for back and side wiring.
 - .5 Specification Grade
- .3 Switches of one manufacturer throughout project.
- .4 Toggle operated fully rated for tungsten filament, fluorescent lamps and LED lamps, and up to 80% of rated capacity of motor loads.
- .5 Low-Voltage Switches : rated full load rated for fluorescent and incandescent fixtures, 80% of load, for motors and heaters.

2.2 RECEPTACLES

- .1 Duplex receptacles, CSA type 5-20R (T-Type), 125 V, 15 A, U ground, to: CSA-C22.2 No.42 with following features:
 - .1 Urea moulded housing.
 - .2 Suitable for No. 10 AWG for back and side wiring.
 - .3 Four (4) rear connection ports, two (2) screw terminals for side connections.
 - .4 Eight back wired entrances, four side wiring screws.
 - .5 Triple wipe contacts and riveted grounding contacts.
 - .6 Specification grade.
- .2 Other receptacles with ampacity and voltage as indicated.
- .3 All outlets and switches grouped together must be of the same model and covered with a single plaque.
- .4 Receptacles of one manufacturer throughout project.
- .5 Provide receptacles c/w cover for clocks and television sets.

2.3 COVER PLATES

- .1 Cover plates for wiring devices to: CSA-C22.2 No.42.1.
- .2 Cover plates from one manufacturer throughout project.
- .3 Specification grade brushed stainless steel finish, 1 mm thick.

- .4 Galvanized sheet steel utility box cover for wiring devices installed in surface-mounted utility boxes.

2.4 COLORS

- .1 Receptacles and switches shall have the following colour finish:
 - .1 Normal network: white.
 - .2 Emergency network: red.

2.5 SOURCE QUALITY CONTROL

- .1 Cover plates from one manufacturer throughout project.

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 wiring devices installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of the Departmental Representative.
 - .2 Inform the Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied, and after receipt of written approval to proceed from the Departmental Representative.

3.2 INSTALLATION

- .1 Receptacles:
 - .1 Install receptacles in gang-type outlet box when more than one receptacle is required in one location.
 - .2 Mount receptacles at height as indicated in section 26 05 00 – Common Work Results for Electrical.
 - .3 Install GFI type receptacles as indicated.
 - .4 Change location of outlets or receptacles at no extra cost or credit, providing distance does not exceed 3 000 mm, and information is given before installation.
- .2 Cover plates:
 - .1 Install suitable common cover plates where wiring devices are grouped.
 - .2 Do not use cover plates meant for flush outlet boxes on surface-mounted boxes.
 - .3 Add "P-Touch" label indicating "UPS" when the outlet is serviced from an uninterruptible power supply.
- .3 Switch:
 - .1 Install single throw switches with handle in "UP" position when switch closed.

- .2 Install switches in gang type outlet box when more than one switch is required in one location.
- .3 Install toggle switches to the height specified in Section 26 05 00 – Common Work Results for Electrical.
- .4 Place lighting switches adjacent to door on handle side.
 - .1 In mechanical and elevator machinery spaces, place switches adjacent to doors, on handle side.

3.3 PROTECTION

- .1 Protect installed products and components from damage during construction.
- .2 Protect stainless steel cover plate finish with paper or plastic film until painting and other work is finished.
- .3 Repair damage to adjacent materials caused by wiring device installation.

3.4 IDENTIFICATION

- .1 Identify all electrical outlets with an adhesive tape of "P -Touch" type made by Brothers and marked with the following: circuit, number, panel, identification in accordance with Section 26 05 00 – Common Work Results for Electrical.

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 This section includes:
 - .1 Requirements of various types of moulded case circuit breakers available with optional features.

1.2 RELATED REQUIREMENTS

- .1 Section 26 05 00 – Common Work Results for Electrical.

1.3 REFERENCE STANDARDS

- .1 CSA Group (CSA)
 - .1 CSA C22.2 No. 5-16, Moulded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures (Tri-national standard with UL 489, and NMX-J-266-ANCE-2016).

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Product Data:
 - .1 Without exception, shop drawings are required for the following items:
 - .1 All circuit breaker types covered by this section.
 - .2 Include time-current characteristic curves for breakers with ampacity of 60 A and over or with interrupting capacity of 22,000 A symmetrical (rms) and over at system voltage.
- .3 Certificates:
 - .1 Prior to installation of circuit breakers in either new or existing installation, Contractor must submit three (3) copies of a production certificate of origin from the manufacturer. Production certificate of origin must be duly signed by factory and local manufacturer's representative certifying that circuit breakers come from this manufacturer and are new and meet standards and regulations. Production certificate of origin must be submitted to Departmental Representative.
 - .2 Delay in submitting production of certificate of origin will not justify any extension of contract and additional compensation.
 - .3 Any work of manufacturing, assembly or installation to begin only after acceptance of production certificate of origin by Departmental Representative. Unless complying with this requirement, Departmental Representative reserves the right to mandate manufacturer listed on circuit breakers to authenticate new circuit breakers under the contract, and to Contractor's expense.
 - .4 Production certificate of origin must contain:
 - .1 Manufacturer's name and address and person responsible for authentication. Person responsible must sign and date certificate.

- .2 Licensed dealer's name and address and person of distributor responsible for Contractor's account.
- .3 Contractor's name and address and person responsible for project.
- .4 Local manufacturer's representative name and address. Local manufacturer's representative must sign and date certificate.
- .5 Name and address of building where circuit breakers will be installed:
 - .1 Project title (title indicated in specifications or on plans)
 - .2 End user's reference number

1.5 CLOSEOUT DOCUMENTS

- .1 Submit in accordance with Section 01 78 00 – Closeout Submittals.
- .2 Operations and Maintenance Manual (O&M): Provide operating and maintenance instructions to be incorporated into the O&M Manual.

Part 2 Products

2.1 BREAKERS GENERAL

- .1 Circuit breakers, Moulded-case circuit breakers and accessory high-fault protectors, ground-fault circuit-interrupters to CSA C22.2 No. 5
- .2 Bolt-on moulded case circuit breaker: quick- make, quick-break type, for manual and automatic operation with temperature compensation for 40 degrees C ambient.
- .3 Common-trip breakers: with single handle for multi-pole applications. Do not use single pole circuit breakers interconnected through an interlocking pin, or similar arrangement, for multi-pole applications.
- .4 Magnetic instantaneous trip elements in circuit breakers to operate only when value of current reaches setting.
 - .1 Trip settings on breakers with adjustable trips to range from three (3) to (eight) 8 times current rating.
- .5 Circuit breakers with interchangeable trips as indicated.
- .6 Circuit breakers to have minimum interrupting capacity as indicated.
- .7 Minimum short-circuit current rating (SCCR) of circuit breakers:
 - .1 120/208 V : 18 kA
 - .2 347 V : 35 kA
 - .3 600 V : 35 kA

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 OPTIONAL FEATURES

- .1 Include the following as indicated:
 - .1 Shunt trip.
 - .2 Auxiliary switch.
 - .3 Motor-operated mechanism c/w time delay unit.
 - .4 Under-voltage release.
 - .5 On-off locking device.
 - .6 Handle mechanism.

2.4 EQUIPMENT IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 05 00 – Common Work Results for Electrical.

Part 3 Execution

3.1 INSTALLATION

- .1 Install circuit breakers as indicated.
- .2 Provide associated appurtenances and fittings as required by additional features and accessories.

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 This section includes:
 - .1 Characteristics of the assembly, accessories and installation methods associated with fused and non-fused disconnect switches.

1.2 RELATED REQUIREMENTS

- .1 Section 26 05 00 – Common Work Results for Electrical.

1.3 REFERENCE STANDARDS

- .1 CSA Group
 - .1 CAN/CSA-C22.2 No.4-16 (R2020), Enclosed and Dead-Front Switches (Tri-National Standard, with ANCE NMX-J-162-2016 and UL 98).
 - .2 CSA C22.2 No.39-13 (R2017), Fuseholder Assemblies.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 – Submittal Procedures.

1.5 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 – Closeout Submittals.
- .2 Operations and Maintenance Manual (O&M): Provide operating and maintenance instructions to be incorporated into the O&M Manual.

Part 2 Products

2.1 DISCONNECT SWITCHES

- .1 Heavy Duty Fusible and Non-fusible disconnect switches in CSA enclosure, size as indicated.
- .2 Provision for padlocking in off switch position by 3 locks.
- .3 Mechanically interlocked door to prevent opening when handle in ON position. Interlock may be defeatable-type for use by qualified electrician.
- .4 Quick-make, quick-break action.
- .5 Contact viewing window.
- .6 ON-OFF switch position indication on switch enclosure cover.
- .7 “Make before break” auxiliary contact capable of sending “stop” signal to variable frequency drive prior to disconnection of power source to motor.
- .8 NEMA 1 enclosure with sprinklerproof rating for interior installation. NEMA 4X enclosure for exterior installation.

2.2 EQUIPMENT IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Indicate name of load controlled on size 4 nameplate.

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 disconnect switches - fused and non-fused installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 INSTALLATION

- .1 Install disconnect switches complete with fuses if applicable.
- .2 Install disconnects on fire-rated plywood in unfinished rooms such as mechanical and electrical service rooms. Ensure rating of plywood is visible after installation.
- .3 Install disconnects on a self-supporting frame constructed using U-channels. Provide frame for disconnects when connected to motors in outdoor installation, or in mechanical rooms where no wall space is available at indicated location.
- .4 Ensure required clearance of 1 m is provided in front of disconnects.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 26 05 00 – Common Work Results for Electrical.

1.2 REFERENCES

- .1 CSA International
 - .1 CSA C22.2 No.14-18, Industrial Control Equipment.
- .2 National Electrical Manufacturers Association (NEMA)
 - .1 NEMA ICS 2-2000 (R2020), Controllers, Contactors and Overload Relays Rated 600 V.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit required documents and samples in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for contactors and include product characteristics, performance criteria, physical size, finish and limitations.

1.4 CLOSEOUT SUBMITTALS

- .1 Submit required documents in accordance with Section 01 78 00 – Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for contactors for incorporation into manual.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect contactors from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

Part 2 Products

2.1 CONTACTORS

- .1 Contactors: to CSA C22.2 No.14.

- .2 Electrically held controlled by pilot devices as indicated and rated for type of load controlled. Half size contactors not accepted.
- .3 Complete with 2 normally open and 2 normally closed auxiliary contacts unless indicated otherwise.
- .4 Mount contactors as indicated on drawings.

2.2 EQUIPMENT IDENTIFICATION

- .1 Identify equipment in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Size 4 nameplate indicating name of load controlled.

Part 3 Execution

3.1 INSTALLATION

- .1 Install contactors and connect power wires and auxiliary control devices.
- .2 Identify contactors with nameplates or labels indicating panel and circuit number.
- .3 Test contactors in accordance with Section 26 05 00 - Common Work Results for Electrical.

3.2 PROTECTION

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

END OF SECTION