

**ELEVATORS REFECTION
RDC QUEBEC
2560, HOCHELAGA BOULEVARD, QUÉBEC, G1V 2J3**

**ENGINEERING SPECIFICATIONS
MECHANICAL AND ELECTRICAL BUILDING**

Dossier Arch no 43007TTA
Dossier SPCA : R 112643



**FOR TENDER
SEPTEMBER 3rd, 2021**

ELEVATORS REFECTION
RDC QUEBEC
2560, HOCHELAGA BLVD, QUEBEC
PROJECT SPAC : R. 112643

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For tender
SEPTEMBER 3RD 2021

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No	Titre
PROTECTION INCENDIE/FIRE PROTECTION	
PI00	FRONTISPICE / COVER PAGE
PI01	LÉGENDE, DÉMOLITION ET CONSTRUCTION / LEGEND, DEMOLITION AND CONSTRUCTION
PLOMBERIE/PLUMBING	
P00	FRONTISPICE / COVER PAGE
P01	LÉGENDE / LEGEND
P02	LÉGENDE / LEGEND
P03	DÉMOLITION / DEMOLITION
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E00	FRONTISPICE /COVER PAGE
E01	LÉGENDE / LEGEND
E02	LÉGENDE / LEGEND
E03	SS MONTE-CHARGE – DÉMOLITION ET CONSTRUCTION / FREIGHT ELEVATOR BASEMENT – DEMOLITION AND CONSTRUCTION
E04	NIV. 1 MONTE-CHARGE – DÉMOLITION ET CONSTRUCTION / FREIGHT ELEVATOR LEVEL 1 – DEMOLITION AND CONSTRUCTION
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E09	ZONE DE TRAVAUX – SOUS-SOL AILES A, B ET C / WORK AREAS – BASEMENT WINGS A, B AND C

Part 1 General**1.01 SUMMARY**

- .1 General requirements relating to commissioning of project's components and systems.
- .2 Acronyms:
 - .1 AFD - Alternate Forms of Delivery, service provider.
 - .2 BMM - Building Management Manual.
 - .3 Cx - Commissioning.
 - .4 EMCS - Energy Monitoring and Control Systems.
 - .5 O&M - Operation and Maintenance.
 - .6 PI - Product Information.
 - .7 PV - Performance Verification.
 - .8 TAB - Testing, Adjusting and Balancing.

1.02 GENERAL

- .1 Cx is performed after systems and integrated systems are completely installed, functional and Contractor's Performance Verification responsibilities have been completed and approved. Objectives:
 - .1 Verify installed equipment, systems and integrated systems operate in accordance with contract documents and design criteria and intent.
 - .2 Effectively train O&M staff.
- .2 Contractor assists in Cx process, operating equipment and systems, troubleshooting and making adjustments as required.
 - .1 Systems to be operated at full capacity under various modes to determine if they function correctly and consistently at peak efficiency. Systems to be interactively with each other as intended in accordance with Contract Documents and design criteria.
 - .2 During these checks, adjustments to be made to enhance performance to meet environmental or user requirements.
- .3 Design Criteria: as per client's requirements or determined by designer. To meet Project functional and operational requirements.

1.03 COMMISSIONING OVERVIEW

- .1 Cx activities supplement field quality and testing procedures described in relevant technical sections.
- .2 Cx is conducted in concert with activities performed during stage of project delivery. Cx identifies issues in Planning and Design stages which are addressed during Construction and Cx stages to ensure the built facility is constructed and proven to operate satisfactorily under weather, environmental and occupancy conditions to meet functional and operational requirements. Cx activities includes transfer of critical knowledge to facility operational personnel.
- .3 Departmental Representative will issue Interim Acceptance Certificate when:
 - .1 Equipment, components and systems have been commissioned.
 - .2 O&M training has been completed.

1.04 NON-CONFORMANCE TO PERFORMANCE VERIFICATION REQUIREMENTS

- .1 Should equipment, system components, and associated controls be incorrectly installed or malfunction during Cx, correct deficiencies, re-verify equipment and components within the unfunctional system, including related systems as deemed required by Departmental Representative, to ensure effective performance.
- .2 Costs for corrective work, additional tests, inspections, to determine acceptability and proper performance of such items to be borne by Contractor. Above costs to be in form of progress payment reductions or hold-back assessments.

1.05 PRE-CX REVIEW

- .1 Before Construction:
 - .1 Review contract documents, confirm by writing to Consultant.
 - .1 Adequacy of provisions for Cx.
 - .2 Aspects of design and installation pertinent to success of Cx.
- .2 During Construction:
 - .1 Co-ordinate provision, location and installation of provisions for Cx.
- .3 Before start of Cx:
 - .1 Ensure installation of related components, equipment, sub-systems, systems is complete.
 - .2 Understand completely design criteria and intent and special features.
 - .3 Ensure "As-Built" system schematics are available.

1.06 COMMISSIONING SCHEDULE

- .1 Provide detailed Cx schedule as part of construction.
- .2 Provide adequate time for Cx activities prescribed in technical sections and commissioning sections including:
 - .1 Approval of reports.
 - .2 Verification of results.
 - .3 Repairs, retesting, re-commissioning, re-verification.
 - .4 Training.

1.07 STARTING AND TESTING

- .1 Contractor assumes liabilities and costs for inspections. Including disassembly and re-assembly after approval, starting, testing and adjusting, including supply of testing equipment.

1.08 WITNESSING OF STARTING AND TESTING

- .1 Provide 14 days notice prior to commencement.
- .2 Consultant to witness of start-up and testing.

1.09 MANUFACTURER'S INVOLVEMENT

- .1 Integrity of warranties:
 - .1 Use manufacturer's trained start-up personnel where specified elsewhere in other divisions or required to maintain integrity of warranty.

- .2 Qualifications of manufacturer's personnel:
 - .1 Experienced in design, installation and operation of equipment and systems.
 - .2 Ability to interpret test results accurately.
 - .3 To report results in clear, concise, logical manner.

1.10 PROCEDURES

- .1 Verify that equipment and systems are complete, clean, and operating in normal and safe manner prior to conducting start-up, testing and Cx.
- .2 Conduct start-up and testing in following distinct phases:
 - .1 Included in delivery and installation:
 - .1 Verification of conformity to specification, approved shop drawings.
 - .2 Visual inspection of quality of installation.
 - .2 Start-up: follow accepted start-up procedures.

1.11 TEST RESULTS

- .1 If commissioning and testing results are not satisfactory, repair or replace the defective equipment, if applicable, or repeat the required commissioning procedures until acceptable results are achieved.
- .2 Provide manpower and materials, assume costs for re-commissioning.

1.12 START OF COMMISSIONING

- .1 Notify Departmental Representative at least 14 days prior to start of Cx.
- .2 Start Cx after elements of building affecting start-up.

1.13 COMMISSIONING PERFORMANCE VERIFICATION

- .1 Carry out Cx:
 - .1 Under actual operating conditions, over entire operating range, in all modes.
 - .2 On independent systems and interacting systems.
- .2 Follow equipment manufacturer's operating instructions.

1.14 WITNESSING COMMISSIONING

- .1 Departmental Representative to witness activities and verify results.

1.15 COMPLETION OF COMMISSIONING

- .1 Upon completion of Cx leave systems in normal operating mode.

1.16 MAINTENANCE MATERIALS, SPARE PARTS, SPECIAL TOOLS

- .1 Supply, deliver, and document maintenance materials, spare parts, and special tools as specified in contract.

Part 2 Products

2.01 NOT USED

.1 Not Used.

Part 3 Execution

3.01 NOT USED

.1 Not Used.

END OF SECTION

PART 1 GENERAL**1.1 SUMMARY**

- .1 Related Sections:
 - .1 Section 01 78 00 – Documents / Items to be submitted upon completion of work
 - .2 Section 01 91 13 – Requirements.
 - .3 Section 01 91 33 – Commissioning Forms.

1.2 REFERENCES

- .1 ASHRAE GUIDELINE 202-2013 - The Commissioning Process for building and systems

1.3 GENERAL

- .1 This plan is intended to be a blueprint for the commissioning of the equipment and systems involved. The plan:
 - .1 Will provide the organization, timing, allocation of resources and documents relating to the commissioning;
 - .2 Details the responsibilities of team members in charge of the MS calendar, required documentation and control procedures;
 - .3 States the expected results regarding the operation and maintenance (O & M), the commissioning process and the administration of commissioning;
 - .4 Describes the control process relating to the conformity of the built work with regards to the design requirements;
 - .5 Allows the adjustment and tune-up of equipment and complete functional systems before issuing the certificate of occupancy;
 - .6 Is a management tool outlining the scope, standards, roles and responsibilities, expectations and deliverables. MS The plan contains:
 - .1 An overview of the commissioning;
 - .2 A general description of its components;
 - .3 The process and method to be used to carry out commissioning of equipment and systems involved.
 - .2 Acronyms:
 - .1 Cx - Commissioning.
 - .2 BMM - Building Management Manual.
 - .3 EMCS - Energy Monitoring and Control Systems.
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- .4 PI - Product Information.
- .5 PV - Performance Verification.
- .6 TAB - Testing, Adjusting and Balancing.
- .3 Commissioning terms used in this section
 - .1 Bumping: short term start-up to prove ability to start and prove correct rotation.
 - .1 Deferred Cx - Cx activities delayed for reasons beyond Contractor's control due to lack of occupancy, weather conditions, need for heating/cooling loads.

1.4 DEVELOPMENT OF 100% CX PLAN

- .1 MS plan attached to the project specification is 95% completed.
- .2 Cx Plan to be 100% completed within 16 weeks of award of contract. The Cx Plan to take into account:
 - .1 Approved shop drawings and product data.
 - .2 Approved changes to contract.
 - .3 Contractor's project schedule.
 - .4 Cx schedule.
 - .5 Contractor's, sub-contractor's, suppliers' requirements.
 - .6 Project construction team's and Cx team's requirements.

1.5 CX PLAN UPDATE

- .1 During construction phase, revise, refine and update Cx Plan as often as required or necessary such that it will include:
 - .1 Changes resulting from Client program modifications.
 - .2 Approved design and construction changes.

1.6 COMPOSITION, ROLES AND RESPONSIBILITIES OF CX TEAM

- .1 Representative departmental to maintain overall responsibility for contract and to ensure compliance with contractual terms, including compliance with commissioning terms.
- .2 The contractor's Project Manager is responsible for development and implementation of an efficient quality management system, including commissioning activities.
- .3 The contractor commissioning agent: will ensure the implementation of all commissioning activities in order to deliver a fully operational project. The contractor's commissioning agent can't be part of the contractor's firm and shall come from an external firm. He can't be a member of the team that took part in the project design. Services associated fees for the contractor's commissioning agent shall be assumed by the contractor. The contractor's commissioning agent can't take up other functions such as quality manager, project manager, etc. He must have the required skills and experience to ensure a quality commissioning process. The contractor shall submit the contractor commissioning agent's resume, before the commencement of services. The contractor's commissioning agent will be in direct contact with the commissioning agent for commissioning activities. His responsibilities include among others the following:

-
- .1 He coordinates and supervises the participation of the construction team members for the whole commissioning process.
 - .1 He assists and / or performs (assists means a constant presence of the commissioning agent of the contractor) among others:
 - .1 Commissioning meetings
 - .2 Testing of Technical Sections and Form C-2
 - .3 Deliveries when the presence of the manufacturer is required in the technical sections and / or identified in Form C-2.
 - .4 Static and dynamic verifications
 - .5 Compliance checks of the installation
 - .6 At the product intelligence stage
 - .7 Start up,
 - .8 ERE operations
 - .9 Performance checks
 - .10 NRM (average performance level) 30 days
 - .11 Verification of reported results / commissioning
 - .12 Training
 - .13 At the visits of the commissioning agent
 - .2 He participates in the updating of the commissioning plan,
 - .3 He is in charge of the commissioning schedule.
 - .4 He is in charge of the test process, he must produce the test procedures, have them approved by the commissioning agent, transmit them to the contractor, ensure that they are respected and classify them to the MGB.
 - .5 It is in charge of reviewing the shop drawings, commenting on them and passing them on to the Commissioning Agent.
 - .6 Establish a logical and consistent schedule for tests to be performed for all disciplines and ensure that the order is respected.
 - .7 He undertakes the design and preparation of documents for commissioning up to four weeks (4) following acceptance of shop drawing: information form product (RP), a checklist of the installation / the commissioning, performance monitoring form (CP); Commissioning form;
 - .8 He is responsible for transmitting to the commissioning agent and to include in the BMM the equipment installation and maintenance manuals, no later than four weeks (4) following acceptance of shop drawing. The facilities and maintenance manuals must be optimised to reduce the documentation to the maximum.
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- .9 Prepare and submit to the commissioning agent the preventative maintenance program applicable to the project (for all disciplines / specialties) at least sixteen weeks (16) before the contractual date of completion.
 - .10 Produces and maintains a register including visits, activities and deficiencies related to the commissioning process and all equipment involved in the commissioning process. This registry must also include all activities of the Contractor's commissioning agent, and the progress of all elements of the commissioning process (procedure, test, PR, MR, CP, HHT, etc.). It must be submitted once a week. This registry must be available at the very beginning of the project, evolve throughout it and must be available to Commissioning Agent at all times. It must be updated in real time.
 - .11 He maintains Form C-2. It must be submitted once a week.
 - .12 He is in charge of completing the information reporting forms on products (PI).
 - .13 He is in charge of completing installation and start-up checklists,
 - .14 He coordinates and supervises the start-ups and ensures that all necessary stakeholders participate in the start-ups,
 - .15 He is in charge for completing the performance verification forms (PV)
 - .16 He takes the steps to obtain the new equipment performance specifications, at actual operating point, after TAB operations.
 - .17 He is in charge of coordinating and executing the 30-day testing period (Section 25) before the verification of the reported results.
 - .18 He is in charge of producing the MGB in real time. The Contractor's Commissioning Agent must include all documents provided within a maximum of two weeks (2) of the completed activity. Prior to filing a document in the MGB, the Contractor's Commissioning Agent must send it to the Commissioning Agent for approval.
 - .19 He shall demonstrate the operation of equipment and systems,
 - .20 He shall assist the commissioning agent in all the tasks of the latter shall undertake,
 - .21 He shall prepare and submit to the commissioning agent, the training programs, and shall assist and attend them,
 - .22 He shall establish the list of replacement parts and special tools to be provided.
- .4 The commissioning agent (Consultant) shall have the following responsibilities;
- .1 He oversees the commissioning process,
 - .2 He verifies the following documents produced but the contractor's commissioning agent, ie. :
 - .1 Product information Form
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- .2 Control list for installation and start-up
 - .3 Performance control form
 - .4 Commissioning form
 - .5 Any other document
 - .3 He monitors Cx activities.
 - .4 Ensures that the contractor's commissioning agent does all he needs to do and deliver the required documents.
 - .5 Performs updates to the MS plan;
 - .6 Calls and organises all commissioning meetings, chairs and writes the minutes of meeting;
 - .7 Is present in the TAB, and certifies the results;
 - .8 Ensures all test, product information, installation compliance verification, and static and dynamic verification documents are completed and results certified by the commissioning agent. contractor and approves the start of commissioning.
 - .9 Ensures all performance control documents are completed and results certified by the Contractor's commissioning agent and approves the commencement of the 30-day section 25 trial period.
 - .10 Follows up on site verifications during the 30 days testing period (section 25),
 - .11 Verifies the declared results / commissioning, completes the completion of the NRM, completes the commissioning forms and certifies the results.
 - .12 He prepares and edits the commissioning report to be included in the BMM.
 - .13 Approves the training plans prior to the event.
 - .14 Attends training sessions and ensures compliance with the training plan. He keeps track of comments following the training sessions,
 - .15 He approves the preventive maintenance program submitted by the Contractor's commissioning agent.
 - .5 Construction Team: Shall consist of the Contractor, subcontractors and suppliers. This team has to realize the construction / installation in accordance with the requirements of the contract documents. Their responsibilities' include among others the following:
 - .1 Designation of Contractor's commissioning agent,
 - .2 Attendance at commissioning meetings;
 - .3 Performance of tests;
 - .4 Performing TAB;
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- .5 Execution of commissioning activities;
- .6 Provision of training and provision of MS documents;

1.7 COMMISSIONING (Cx) PARTICIPANTS.

- .1 The required members of the Construction Team for the activities are detailed in form C2 attached to this section and in the technical sections, for the tests, the different equipment and systems that will be put into service.

1.8 EXTENT OF COMMISSIONING (Cx)

- .1 The systems and equipment to be put into service are detailed in form C2 attached to this section and in the technical sections. This list is not exhaustive.

1.9 COMMISSIONING (Cx) ACTIVITIES EXPECTED RESULTS

- .1 General Requirements:
 - .1 Specific requirements, conditions related to reception and hand-over, and the requirements for start-up, testing and commissioning are contained in the relevant sections technical specifications.
- .2 Definitions:
 - .1 For the purpose of this section, the commissioning (CxS) includes the following.
 - .1 Commissioning of components, equipment, systems, integrated subsystems and systems.
 - .2 Inspections and performance monitoring tests at the factory.
- .3 Expected results: provide or indicate the following:
 - .1 Testing required in different specification sections duly made.
 - .2 Information Report Forms product (RP), duly completed.
 - .3 Checklist Forms for installation and commissioning, duly completed.
 - .4 Performance audit report forms (CP) duly completed.
 - .5 Results of performance control tests and inspections.
 - .6 Description of the commissioning activities and related documents.
 - .7 Description of the commissioning of integrated systems and related materials.
 - .8 Training Plans
 - .9 Cx Reports.
 - .10 Activities carried out during the warranty period.

1.10 ACTIVITIES PRECEDING THE PROCESS OF START-UP IN THE CONSTRUCTION PHASE

- .1 Activities defined in the Cx plan include the following.
 - 1 Appointment and approval of the commissioning agent of the contractor.
 - 2 Updating the commissioning plan until the end of the process.
 - 3 Establishing the commissioning schedule and updating it until the end of the process.
 - 4 Transmission of approved shop drawings and manuals for installation and maintenance of each equipment under the commissioning process.
 - 5 Preparing PI forms, checklist of installation / start-up, PV forms / commissioning, by the commissioning agent of the contractor.
 - 6 Updating the table of contents and real-time editing of the BMM.
 - 7 Preparing a deficiency register in connection with the commissioning process and updated until the end of the process.
 - 8 Update form C-2 and update until the end of the process.
 - 9 Establishment of the list of spare parts and special tools to provide
 - 10 Transmission of test procedures.
 - 11 Establish critical scheduling for testing.

1.11 PRE CX START-UP

- .1 Activities defined in the MS plan include the following:
 - .1 Authorization of Commissioning Agent to confirm completion of prerequisite steps.
 - .2 Tests prior to start-up: pressure testing, static testing, rinsing, cleaning and initial start-up tests, etc., executed during construction in accordance with the requirements of the technical sections. These tests shall be performed in the presence of the contractor commissioning agent and certified by it.
 - .3 Inspections prior to commissioning: performed by the contractor's commissioning agent before the authorization to proceed with the start-up and before the correction of anomalies
 - .4 Equipment Delivery Process.
 - .5 Static and dynamic verification.
 - .6 Validation of the installation conformity (according to contractual documents and installation manual of the manufacturer)
 - .7 Product Intelligence Process.
-

1.12 ACTIVITIES PRIOR TO CONTROL PERFORMANCE / COMMISSIONING

- .1 Activities defined in the MS plan include the following.
 - .1 Authorization of Commissioning Agent to confirm completion of prerequisite steps
 - .2 Operation: performed in the presence of the contractor commissioning agent, which will use checklists approved; either the PI form and installation and start-up checklist.
 - .3 Repeat the tests until the results meet the requirements.
 - .4 Transmission of completed documentation to the commissioning agent.
 - .5 TAB Operations, in accordance with the specification sections and transmission of the report.
 - .6 Repeat the tests until the results meet the requirements.
 - .7 Obtaining new equipment performance in real operating mode.

1.13 ACTIVITIES PRIOR TO VERIFICATION OF REPORTED RESULTS

- .1 Authorization of Commissioning Agent to confirm completion of prerequisite steps
- .2 Performance control: performed by the Contractor commissioning agent, which will use the PV approved forms.
- .3 Repeat the test until the results meet the requirements.
- .4 Integrated Systems: Put in service the different equipment that make up the system before the system is operated in all operating conditions which must be checked.
- .5 Transmission of completed documentation to the commissioning agent.
- .6 Approval of the beginning of the 30 day test period (section 25).
- .7 Thirty (30) day test period (section 25).

1.14 VERIFICATION OF REPORTED RESULTS

- .1 Demonstrate the performance of equipment and systems in the presence of the commissioning agent, proceed to the final commissioning (Section 25).
- .2 Commissioning agent verifies and certifies the results.

1.15 FINAL SETTINGS

- .1 After commissioning is completed to the satisfaction of the commissioning agent, lock control / regulation devices in their final position and permanently mark set points; These set points must be included in the Cx reports.

1.16 SPARE PARTS AND SPECIALTY TOOLS

- .1 Coordination by the contractor commissioning agent for the delivery of spare parts and special tools.

1.17 PREVENTIF MAINTENANCE PROGRAM

- .1 Presentation of the preventive maintenance program applicable to the project (for all disciplines / specialties. The preventive maintenance program must be submitted 16 weeks before the provisional acceptance.

1.18 TRAINING

- .1 Training courses: in accordance with Section 01 91 41 - Commissioning (Cx) – Training.

1.19 COMMISSIONING REPORTS

- .1 Preparation of the final commissioning report by the commissioning agent, working with the entire project commissioning team.

1.20 ACTIVITIES DURING THE WARRANTY PERIOD

- .1 Seasonal Commissioning:
 - .1 Depending on the timing of completion of the work, provide for the heating, or air conditioning as part of the seasonal startup.
 - .2 The list of set seasonal commissioning will be completed in the final commissioning plan, once the period for completion of the work is known.
- .2 In order to ensure that the performance of some systems is maintained throughout the warranty period, provide for the Contractors in the following specification sections the length of the following works:
 - .1 See technical section.

PART 2 Products**2.1 NOT USED**

- .1 Not used.

PART 3 Execution**3.1 ADDITIONAL REQUIREMENTS FOR FIRE AND SMOKE DAMPERS**

- .1 Fire dampers
 - .1 The subcontractor will submit an installation report for each fire damper compliant with the recommendations of the manufacturer, the requirements of the contract documents, standard NFPA80 and the manufacturer's installation and operation manual. After the reception of the report and the completion of the work, the subcontractor will carry out the tests listed in standard NFPA 80 for each fire damper with the commissioning officer in attendance.

- .1 The operation of the fire dampers will be tested after installation.
- .2 The damper must close completely from the open position.
- .3 If equipped with a smoke detector, the damper will be tested so that the smoke detector is activated, in accordance with standard NFPA 72.
- .4 For a dynamic damper, verify/confirm that the louver moves in accordance with the velocity rating of the damper listing.
- .5 Ensure that the damper's movement is not hindered.
- .6 Full access to the fire damper will be ensured.
- .7 The fuse's operation temperature will comply with standards NFPA 90A *Standard for installation of air-conditioning and ventilation systems*, and ANSI/UL 33, *Standard for heat responsive links for fire-protection*, as well as the temperature classes and notes.
- .8 Visually inspect the dampers after testing to make sure there are no hindrances.
- .9 All tests will be documented. Records will include the location of the damper, the date of the inspection, the name of the inspector and the deficiencies, if any. The document will include a section to record when and how the deficiencies were addressed and corrected.
- .10 The subcontractor will provide stickers to sign and affix to the damper's access door, confirming inspection.

END OF SECTION

PART 1 GENERAL**1.1 INSTALLATION/START-UP CHECKLISTS**

- .1 These lists shall include the following.
 - .1 Installation instructions provided by the manufacturer and controls recommended by the manufacturer.
 - .2 Specific procedures prescribed in the applicable technical sections.
 - .3 Procedures considered to be good engineering practice in mechanical/electrical installation and construction, and deemed necessary for proper and efficient operation of the equipment and systems involved.
- .2 Lists provided by the manufacturer are also acceptable. If deemed necessary by the Departmental Representative, additional data lists will be required for projects with special conditions.
- .3 Use checklists to verify installation of applicable equipment and systems. Confirm on the document the checks performed, indicate anomalies and defects found and the corrective measures implemented.
- .4 Provide the Departmental Representative with checklists, duly signed by the installer, upon completion of the process, to confirm that the indicated checks and inspections have been performed. These checklists will be required at the time of commissioning and will be attached to the Building Management Manual (BMP) at the completion of the project.
- .5 Commissioning checklists are to be completed thoroughly at the time of initial and final commissioning of relevant equipment and systems.

1.2 PRODUCT INFORMATION REPORT (PR) FORMS

- .1 Product Information Report (PIR) forms are documents that record the manufacturer's data on the components, equipment and systems involved, including nameplate data, parts lists, operating instructions, maintenance guidelines, and all relevant technical data and recommended controls necessary to prepare for commissioning and functional testing, as well as the operation and maintenance of the equipment and systems. These report forms shall be incorporated into the Building Management Manual upon completion of the project.
- .2 Prior to performance monitoring (PM) of installed equipment and systems, complete Product Information Report forms first and submit to the Departmental Representative for approval. Forms are provided in the Appendix.

1.3 PERFORMANCE CONTROL REPORT FORMS (PCR)

- .1 Performance Control (PC) Report Forms are documents that record the results of checks, dynamic tests and adjustments that have been performed on the equipment and systems involved to ensure that they are operating properly and efficiently, alone or in interaction with others, as required by the Work.
 - .2 The PC report forms also include the Contractor's documentation of readings and data measured during the functional testing and performance monitoring process of the affected equipment and systems.
-

- .3 Prior to conducting performance monitoring of integrated systems, complete the associated System Performance Monitoring Report forms and submit to the Departmental Representative for approval. Forms are provided in the Appendix.

1.4 LANGUAGE

- .1 Forms shall be prepared and supplied in the language of the Contractor.

PART 2 PRODUCTS

2.01 NOT APPLICABLE

- .1 Not applicable

PART 3 EXECUTION

3.01 NOT APPLICABLE

- .1 Not applicable

END OF SECTION

LIST OF VERIFICATION, TESTING AND PERFORMANCE RECORDS FOR INDIVIDUAL SYSTEMS

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1.1 PRODUCT INFORMATION SHEET (PIS)

Project

Name :	
Building :	
Project number :	

Identification

Equipment :			
Brief description :			
Identification to plans :		EMS Identification :	
System Related Equipment :			

Information

Manufacturer :			
Model :			
Serial number :			
Capacity :		Size :	
Efficiency :			
Voltage :	Volt ./ #Ø / Frequency		
Current :	FLA/LRA		
Other :			

Purchase

Supplier :	Name/address
Distributor :	Name/address
Warranty :	
Date of purchase :	
Specific warranty :	
Start date :	
Replaced on :	

Technician :	Date :
Approuved by :	Date :

1.2 Motorized shutter

Plan number :	Service :	Location :
Manufacturer :	Model :	Serial number :
Specified characteristics		
Hose dimension :	Type : <input type="checkbox"/> Electric / <input type="checkbox"/> Pneumatic	
Insulated : <input type="checkbox"/> yes / <input type="checkbox"/> no	Action : <input type="checkbox"/> Modulating / <input type="checkbox"/> 2 positions	

Prerequisites (check to confirm that the prerequisite is documented)

- ☐ Shop drawings received
 ☐ Complete Installation
 ☐ Balanced network
 ☐ Connected to BAS
- ☐ Control sequence completed

Comments :

Property	Type of observation/Tool	Prescribed	Measured
100% open position at BOTTOM			
Position at 100 % closing at BOTTOM			
Tightness at 100 % closing			

Comments :**Participants in the conduct (R), validation (V) and approval (A) of tests:**

Authority / Company	name	Activity	Signature	Date
Plumbing				
Ventilation				
Controls				
Balancing				
Witness (general contractor)				
Commissioning Agent				

1.3 Ventilator

Plan number :	Service :	Location :
Manufacturer :	Model :	Serial number :
Specified characteristics		
Motor power :	Nominal flow rate :	Motor speed :
Pressure loss (Po of water) :	Electricity : V/ Φ/ Hz	

Prerequisites (check to confirm that the prerequisite is documented)

<input type="checkbox"/> Shop drawing received	<input type="checkbox"/> Installation complete	<input type="checkbox"/> Connected to BAS
<input type="checkbox"/> Control sequence completed	<input type="checkbox"/> Network cleaned and screen	
<input type="checkbox"/> Configuration by manufacturer		
Comments:		

Measured Item	Flow Rate Prescribed	Flow Rate Measured 1	Pressure upstream of the fan (Po of water)	Motor RPM
Motor speed at 100 %				
Motor speed at 50 %				

Authority / Company	name	Activity	Signature	Date
Plumbing				
Ventilation				
Controls				
Balancing				
Witness (general contractor)				
Commissioning Agent				

PART 1 GENERAL**1.1 PARTICIPANTS**

- .1 Participants: building operations and maintenance staff, including property manager, security staff and technical specialists as appropriate.
- .2 Participants must be able to attend training sessions during the final stages of construction to become familiar with the equipment and systems installed.

1.2 INSTRUCTORS

- .1 The Department Representative will provide the following.
 - .1 A description of the equipment and systems.
 - .2 Information and instructions regarding the design philosophy, criteria, and intent of the designer.
- .2 The Contractor and the manufacturer's factory trained and certified personnel will provide training to participants in the following
 - .1 Start-up/start-up, operation/operation and shutdown/decommissioning of applicable components, equipment and systems.
 - .2 Characteristics of control/regulation/control devices and systems, including the reasons for and results of these characteristics, the impact of the intervention of these devices and systems on controlled equipment and systems, the setpoint settings of control/regulation/control devices and safety devices.
 - .3 Instructions for servicing, maintaining and adjusting the components, equipment and systems involved.
- .3 The Contractor and manufacturers will provide training to participants in the following
 - .1 Start-up/start-up, operation/operation and shutdown/shutdown of components, equipment and systems for which they have certified the installation, performed start-up and tested for performance.

1.3 TRAINING OBJECTIVES

- .1 The training shall be of sufficient length and detail to enable participants to acquire the knowledge and skills necessary to do the following
 - .1 Ensure safe, reliable and cost effective operation of all installed equipment and systems in normal and emergency modes and under all operating conditions.
 - .2 Implement an effective continuous inspection and performance monitoring program for equipment and systems.
 - .3 Implement an appropriate preventive maintenance, diagnostic and troubleshooting program.
 - .4 Maintain current documentation.
 - .5 Operate equipment and systems under emergency conditions until qualified personnel arrive.
-

1.4 TRAINING MATERIALS

- .1 Instructors are responsible for the content and quality of materials used for training purposes.
- .2 Training materials shall include the following.
 - .1 "After Action" documents.
 - .2 Operations manual.
 - .3 Maintenance manual.
 - .4 Building/Facility Management Manual.
 - .5 TAB and PC reports.
- .3 The Project Manager, Commissioning Manager and Building Manager will review the manuals and training materials.
- .4 Manuals and materials to be used shall be prepared to allow for the same detailed level of training in subsequent sessions.
- .5 Additional Training Materials
 - .1 Overhead transparencies.
 - .2 Multimedia presentations.
 - .3 Training videos provided by the manufacturer.
 - .4 Equipment and system models.

1.5 TRAINING SCHEDULE

- .1 Allow time for training in the commissioning schedule.
- .2 Training shall be conducted during normal working hours.
- .3 Training shall be completed prior to building/facility acceptance.

1.6 RESPONSIBILITY

- .1 Assume responsibility for the following.
 - .1 Implementing training activities.
 - .2 Coordination of the work and participation of the various instructors.
 - .3 Quality of training and materials used in training.
- .2 The Departmental Representative will evaluate the quality of the training and training materials.
- .3 Upon completion of the training, submit a written report signed by the instructors and certified by the Department Representative.

1.7 TRAINING CONTENT

- .1 Training shall include demonstrations by instructors of installed equipment and systems.
 - .2 Training shall address or include the following.
 - .1 Functional requirements.
-

- .2 Design philosophy of equipment and systems, capabilities of each and emergency procedures.
 - .3 Review of the layout of the various equipment and systems and the associated control/regulation/control components and devices.
 - .4 Start-up/start-up, operation, monitoring, maintenance, servicing, shutdown/decommissioning procedures for equipment and systems.
 - .5 Sequences of operation of various equipment and systems including step-by-step instructions for start-up/start-up and shutdown/decommissioning of equipment and systems, operation of valves, dampers, switches/switches, setpoint adjustments and emergency procedures.
 - .6 Service and maintenance.
 - .7 Troubleshooting diagnosis.
 - .8 Interaction between systems in integrated operation.
 - .9 Review operating and maintenance documentation.
- .3 Provide specialized training as specified in the appropriate technical sections of the project specifications.

PART 2 PRODUCTS**2.01 NOT APPLICABLE**

- .1 Not applicable

PART 3 EXECUTION**3.01 NOT APPLICABLE**

- .1 Not applicable

END OF SECTION

Part 1 GENERAL**1.1 RELATED SECTIONS**

- .1 Section 21 05 29 – Hanging, Bracing and Restraint of Fire Protection System Piping and Equipment.
- .2 Section 21 05 53 – Fire Protection Identification.
- .3 Section 21 13 13 – Wet-Pipe Sprinkler Systems.

1.2 REFERENCES

- .1 Unless otherwise indicated, execute work in accordance with the most recent edition of the following standards in effect in Canada:
 - .1 NFPA/ANSI 13, latest edition.
 - .2 Requirements of the National Building Code 2015.
 - .3 National Fire Code of Canada (NFCC) 2015 and all documents referred.
 - .4 All components such as fittings, accessories, and supervisory and control elements must be new and ULC and FM approved.

1.3 SCOPE OF WORK

- .1 Work includes, without being limited to, manpower, provision and installation of all materials and equipment necessary for fire protection as indicated on drawings and/or in specifications.
 - .2 This work includes, particularly:
 - .1 Coordination, supply and installation of new sections of piping, fittings, supports and sprinklers to connect to the existing fire protection system to allow mechanical elevator room modifications.
 - .2 The dismantling of certain portions of the existing fire protection system in order to allow the work to be carried out.
 - .3 Identify all piping, equipment, valves, wall plates and other accessories.
 - .4 Paint all visible piping. Paint must be applied in workshop and only touch-ups are permitted on site. Colours are indicated in Section 21 05 53 – Fire Protection Identification.
-

- .5 Provision of architectural access doors required for equipment access and maintenance.
 - .1 Installation of these access doors falls under the responsibility of another division.
 - .2 Drawings do not necessarily illustrate all required access doors, exact location or dimension. Therefore, the Subcontractor must pay particular attention to this because all required access doors must to be provided and installed, and no additional remuneration will be granted with regard to this.
- .6 Provision of operating and maintenance manuals.
- .7 All cutting in walls, floors or other elements required in addition to coordination and positioning of such is the responsibility of the present Subcontractor.
- .8 Perform all necessary works for acoustic and air-sealing systems for all electrical conduit penetrations through walls, floors and any other building elements.
- .9 Provide and install all required couplings.
- .10 Obtain all authorizations with regard to cutting.
- .11 Protection of sprinklers prior to painting.
 - .1 It is the Painter's responsibility to adequately protect the sprinklers prior to his work. No sprinkler shall be painted. Protect sprinklers with bags before painting.
 - .2 Upon completion of painting, replace any painted or damaged sprinkler and assume the costs.
- .12 This list is not restricted to these items and does not release the Subcontractor of his responsibilities to provide a complete and operational system.

1.4 INSTALLATION REQUIREMENTS

- .1 Provide and install a fire protection system including the following elements:
 - .1 The new network is to be composed of supports and hangars and all components necessary to create a complete operating and approved system by the competent authorities and the insurance company's technical service advisor.

1.5 SHOP DRAWINGS

- .1 Prepare and provide the following shop drawings for verification purposes:
 - .1 Piping, fittings, accessories, piping supports, sprinkler heads and guards.
- .2 This list is not restrictive and does not relieve the Subcontractor of his responsibility to submit all drawings required by the Departmental Representative.

1.6 CONNECTIONS TO EXISTING SYSTEMS

- .1 Drain existing system when required to accomplish the work and refill them thereafter.

1.7 CONTINUITY OF SERVICES

- .1 As much as possible, maintain existing the automatic sprinkler system operational in areas under renovation and in existing unmodified areas. Restart the automatic sprinkler system of the completed sections as soon as possible.
- .2 In areas under renovation, when temporary shutdowns of the fire protection system are required, provide two 4.5 kg (10 lb) portable fire extinguishers, type ABC, per 100 square meters (1000 square feet) of building not protected by automatic sprinklers.

Part 2 Products**2.1 DOCUMENTS AND SAMPLES TO SUBMIT**

- .1 Submit shop drawings for verification to the Departmental Representative as indicated in section 01 33 00 - Documents and samples to be submitted :
 - .1 Piping.
 - .2 Fittings.
 - .3 Supports and suspension rod.
 - .4 Sprinklers.
 - .5 Sprinkler guards.
 - .6 This list is not restrictive and does not relieve the Subcontractor of his responsibility to submit all samples or shop drawing requested by the Departmental Representative.
- .2 Certificates of compliance.

Part 3 EXECUTION**3.1 INSPECTION**

- .1 Have the systems inspected once the installation is complete.
- .2 Defray the cost of this inspection.
- .3 Correct defects.

3.2 COORDINATION

- .1 Coordinate the fire protection system installation with all architectural, structural, mechanical and electrical elements.
-

- .2 The Subcontractor is to position and indicate in a timely manner the location of all couplings, openings, and other requirements of his work that have an impact on the course of other work.
 - .3 The Subcontractor is not to claim additional amounts for work that must be completed by him in order to coordinate his needs and those of other disciplines.
 - .4 The Subcontractor is to execute at his own costs, all required cutting and patching, dismantling and replacement of existing system equipment or that already installed in order to coordinate his work with the work of other disciplines or elements of the existing building.
-

Part 1 General**1.1 RELATED REQUIREMENTS**

- .1 The requirements of the section 21 05 05 – Common Work Results for Fire Suppression are an integral part of this section.

1.2 REFERENCES

- .1 NFPA: National Fire Protection Association
 - .1 NFPA 13, Installation of Sprinkler Systems, latest edition.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit required documents and samples as per Section 01 33 00 – Documents and samples to be submitted.
- .2 Product Data
 - .1 Provide manufacturer's printed product literature and data sheets for hangers and supports and include product characteristics, performance criteria, physical size, finish and limitation.
- .3 Identify the following items listed on manufacturer's documentation, including:
 - .1 Upper attachment.
 - .2 Middle attachment.
 - .3 Pipe attachment.
 - .4 Riser clamps.
 - .5 Sway braces.
- .4 Certificates:
 - .1 Submit certificates signed by the manufacturer certifying that products, materials and equipment comply with specified performance characteristics and physical properties.
- .5 Manufacturer's Instructions:
 - .1 Provide manufacturer's installation instructions.
 - .1 Provide one (1) copy of systems supplier's installation instructions.

1.4 DOCUMENTS/ELEMENTS TO BE SUBMITTED ON COMPLETION OF THE WORK

- .1 Provide the required maintenance sheets and insert them into the manual mentioned in section 01 78 00 Documents / Items to be submitted upon completion of the work.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials and equipment in accordance with Section 01 61 00 - General Product Requirements.
-

- .2 Delivery and Acceptance Requirements:
 - .1 Deliver materials and equipment to site in original factory packaging, labelled with manufacturer's name, address.
- .3 Packaging Waste Management: in accordance with Section 01 74 21 - Management and Disposal construction/demolition waste.

Part 2 Products

2.1 GENERAL

- .1 All supports must be approved for use in a fire protection system, as required by NFPA 13.
- .2 Manufacture suspensions, supports and bracing pieces in accordance with ANSI B31.1 and MSS-SP58 standards.
- .3 Unless otherwise indicated, all supports must be attached directly to the structure; it is not permitted to hang one piece of equipment from another piece of equipment, duct or pipe. It is not permitted to use perforated metal tape as a collar or support for piping or equipment. The supports must be attached to the structure by means of mechanical fasteners.
- .4 Attach the supports and suspensions to the upper part of the structural elements. If there are no structural members or if the anchor sleeves are not in the right place, provide and install all the necessary additional structural parts. Do not hang from the metal apron.
- .5 No anchor to the rifle must be used without written authorization from the Professional. Obtain permission before using expanding vertical anchor sleeves. Use at least (2) two sockets to hold each bracket or support.
- .6 Fasten piping and equipment parts in accordance with supplier's recommendations. Have the anchor plan and type of supports and hangers, including spreadsheets, checked.
- .7 All supports must include at least the following three parts: anchor sleeve, hanging rod, collar or bracket
- .8 The spacing between the grouped pipe supports will be established according to the smallest pipe.

2.2 ANCHORING ELEMENTS

- .1 Concrete structure
 - .1 Anchor socket for concrete work poured in place: corner socket, galvanized steel, compliant with standard MSS-SP58, type 18, approved by ULC, for piping with diameters ND 20 to ND 200 (NPS $\frac{3}{4}$ " to NPS 8 ").
 - .1 Acceptable products :
 - .1 Anvil, fig. 281;
 - .2 Cooper-B-Line B2501;
 - .3 Tolco 109 AF.

-
- .2 Adhesive anchor bolts: pre-drilled and capsule anchor system containing polyvinyl resin or urethane methacrylate resin and accelerator, or with polymeric adhesive or injected hybrid mortar. Provide anchor bolts and accessories in galvanized steel. Choose the anchor bolts having the resistance prescribed for anchoring according to tests according to ASTM E 488.
 - .3 Mechanical anchorages evaluated by ICC-ES according to acceptance criteria AC193 including requirements ACI 355.2-07 / ACI 355.2-04.
 - .1 Acceptable products:
 - .1 Hilti KH-EZ et KH-EZ I;
 - .2 Power-Stud+ SD2 et Vertigo+;
 - .3 Simpson Titen HD Rod Hanger.
 - .4 Carbon steel plate with bracket, for surface mounting: malleable iron socket, expanding plug and bolt; at least two (2) expandable dowels and two (2) bolts for each suspension
 - .1 Acceptable products :
 - .1 Anvil : fig. 49 plate, fig. 290 socket;
 - .2 Cooper-B-Line : fig.B3086 plate, fig.B3203 socket;
 - .3 Erico : fig.374 plate, fig.26 socket.
 - .2 Steel beam (bottom flange)
 - .1 C bracket, malleable iron, conforms to standard MSS-SP58, type 19, approved by ULC, for use with piping with a diameter equal to or less than ND 50 (NPS 2).
 - .1 Acceptable products :
 - .1 Anvil, fig. 93. or fig.94 according to calculations;
 - .2 Cooper-B-Line fig.66;
 - .3 Erico 310.
 - .2 Bracket for beam, in malleable iron, conforming to standard MSS-SP58, type 28 or 29, approved by ULC, for use with piping with a diameter equal to or greater than ND 65 (NPS 2½).
 - .1 Acceptable products :
 - .1 Anvil, fig. 218 and extension piece, fig.157;
 - .2 Cooper-B-Line fig. B3054;
 - .3 Erico 360.
 - .3 Steel beam (upper sole)
 - .1 C bracket, malleable iron, for attachment to the top flange of a beam, in accordance with standard MSS-SP58, type 19, approved by ULC, for use with piping with a diameter equal to or less than ND 50 (NPS 2).
 - .1 Acceptable products :
 - .1 Anvil, fig. 93. or fig.94 according to calculations;
 - .2 Cooper-B-Line fig.66;
 - .3 Erico 310.

- .2 Bracket for fixing to the upper sole of a beam, consisting of a steel jaw, a hook rod with nut, an elastic washer and an ordinary washer, in accordance with standard MSS-SP58 , type 25, approved by ULC, for use with piping with a diameter equal to or greater than ND 65 (NPS 2½).
 - .1 Acceptable products :
 - .1 Anvil, fig. 227;
 - .2 Cooper-B-Line B3042;
 - .3 Erico 359.
- .4 Profiled beam or steel angle (lower chord)
 - .1 Piping with a diameter equal to or less than ND 50 (NPS 2): C-bracket, malleable iron, conforms to standard MSS-SP58, type 23, approved by ULC
 - .1 Acceptable products :
 - .1 Anvil, fig. 86;
 - .2 Cooper-B-Line fig.B351L;
 - .3 Erico 200.
 - .2 Piping with a diameter equal to or greater than ND 65 (NPS 2½): universal lateral bracket, approved by ULC.
 - .1 Acceptable products :
 - .1 Anvil, fig. 93 or fig.94 according to calculations;
 - .2 Cooper-B-Line fig.66;
 - .3 Erico 310.
- .5 Profiled beam or steel angle (upper chord)
 - .1 C-bracket (for attachment to the top flange of a beam), in malleable iron, in accordance with standard MSS-SP58, type 19, approved by ULC
 - .1 Acceptable products :
 - .1 Anvil, fig. 93 or fig.94 according to calculations;
 - .2 Cooper-B-Line fig.66;
 - .3 Erico 310.

2.3 MEDIUM ELEMENT (SUSPENSION ROD)

- .1 Threaded rod, carbon steel, electro-galvanized finish.
 - .1 Acceptable products:
 - .1 Anvil, fig. 146;
 - .2 Cooper-B-Line ATR;
 - .3 Erico 50 and 51.

2.4 SUPPORT ELEMENT

- .1 The grouped pipe supports will be made of structural steel of I.U.H. or prefabricated galvanized steel profiles or angles. The welding will be continuous and free of lumps. These supports will be attached to the structure with anchors.
 - .1 Acceptable products:
 - .1 Philipps Red Head;
 - .2 Confast;
 - .3 Hilti.
 - .2 Guides must be provided and installed in the required places to avoid lateral displacement of the piping.
 - .3 Steel piping: adjustable bracket, in accordance with standard MSS-SP58, type 1 or MSS-SP58, type 10, approved by ULC
 - .1 Acceptable products:
 - .1 Anvil, fig. 260 or fig. 69 according to calculations;
 - .2 Cooper-B-Line fig. B-3100;
 - .3 Erico 400 or 100 serie;
 - .4 Tolco, fig. 200.

2.5 PAINT AGAINST CORROSION

- .1 Unless otherwise indicated in the contractual documents, use the type of product described below.
- .2 Coating used to prime a complete surface or to make touch up on already protected galvanized metal surfaces; provides cathodic protection to steel substrates and prevents significant underlying corrosion of damaged surfaces.
 - .1 Coating rich in organic zinc, ready to use.
 - .1 Acceptable products:
 - .1 Sherwin Williams, Corothane I – GalvaPac Zinc Primer 1K;
 - .2 ZRC Worldwide, ZRC 221;
 - .3 Carboline Co., Carbozinc 585.
 - .2 Two-component epoxy primer with high filling power and low VOC content. Contains metallized aluminum pigments and micaceous iron oxide lamellar, which improves corrosion resistance.
 - .1 Acceptable products:
 - .1 Akzo Nobel, Interplus®356 – « Surface Tolerant Epoxy »;
 - .2 Sherwin Williams;
 - .3 Carboline.

Part 3 Execution

3.1 SPACING BETWEEN HANGERS/SUSPENSIONS

- .1 Unless otherwise indicated, the spacing between the supports / suspensions as well as the diameter of the suspension rods must comply with the strictest of the requirements specified in the following paragraphs or in the table below.
- .2 One (1) hanger / suspension within 300 mm (12 in) of each horizontal elbow.

Nominal Pipe diameter (ND)	Rod diameter	Maximum spacing
		Steel
Until :		
25 mm (1 in)	10 mm (3/8 in)	3.6 m (12 ft)
32 mm (1¼ in)	10 mm (3/8 in)	3.6 m (12 ft)
40 mm (1½ in)	10 mm (3/8 in)	4.5 m (15 ft)
50 mm (2 in)	10 mm (3/8 in)	4.5 m (15 ft)
65 mm (2½ in)	10 mm (3/8 in)	4.5 m (15 ft)
75 mm (3 in)	10 mm (3/8 in)	4.5 m (15 ft)
90 mm (3½ in)	10 mm (3/8 in)	4.5 m (15 ft)
100 mm (4 in)	10 mm (3/8 in)	4.5 m (15 ft)
150 mm (6 in)	13 mm (1/2 in)	4.5 m (15 ft)
200 mm (8 in)	13 mm (1/2 in)	4.5 m (15 ft)
250 mm (10 in)	16 mm (5/8 in)	4.5 m (15 ft)
300 mm (12 in)	16 mm (5/8 in)	4.5 m (15 ft)

- .3 Unsupported horizontal length (« end line »):

Nominal Pipe diameter (ND)	Maximum unsupported length
	Steel
25 mm (1 po)	0.9 m (3 pi)
32 mm (1¼ po)	1.2 m (4 pi)
40 mm (1½ po)	1.5 m (5 pi)
50 mm (2 po)	1.5 m (5 pi)
65 mm (2½ po)	1.5 m (5 pi)
75 mm (3 po)	1.5 m (5 pi)
90 mm (3½ po)	1.5 m (5 pi)
100 mm (4 po)	1.5 m (5 pi)
150 mm (6 po)	1.5 m (5 pi)
200 mm (8 po)	1.5 m (5 pi)
250 mm (10 po)	1.5 m (5 pi)
300 mm (12 po)	1.5 m (5 pi)

3.2 HANGER / SUSPENSIONS INSTALLATION

- .1 Stagger the suspensions anchors so that the suspension rods are straight when the fire protection system is in function.
- .2 Adjust the height of the suspension rods so that the load is evenly distributed between the hangers / suspensions.
- .3 Attach suspensions to structural members. In this regard, if there are no structural hangers in place at the planned installation points or if anchor sleeves are not placed in the required locations, supply and install all the necessary additional structural steel parts.

3.3 PAINTING AGAINST CORROSION

- .1 Unless otherwise indicated in the contractual documents, proceed as described below to apply the products used to counter corrosion.
 - .2 Prepare the surface in accordance with the standards recommended by the Supplier. Remove scale, rust, removable paint and any other harmful foreign matter. Any material that adheres firmly and cannot be removed with a non-cutting putty knife can be kept.
 - .3 Apply two (2) coats of premixed coating rich in organic zinc or epoxy coating to non-galvanized ferrous metal brackets, supports and parts. Apply according to the Supplier's recommendations.
-

Part 1 GENERAL**1.1 RELATED SECTIONS**

- .1 The requirements of the section 21 05 05 – Common Work Results for fire suppression an integral part of this section.

1.2 REFERENCES

- .1 Canadian General Standards Board (CGSB)
 - .1 CAN / CGSB-1.60-97, Interior Alkyd Gloss Enamel.
 - .2 CAN / CGSB-24.03-92, Identification of Piping Systems.
- .2 National Fire Protection Association (NFPA)
 - .1 NFPA 13-2013, Standard for the Installation of Sprinkler Systems.

1.3 SUBMITTALS

- .1 Product Data:
 - .1 Submittals: in accordance with data sheets required under Section 01 33 00 – Documents and samples to be submitted.
 - .2 Product data to include paint colour chips and other products specified in this section.
- .2 Samples:
 - .1 Submit samples in accordance with Section 01 33 00 – Documents and samples to be submitted.

1.4 QUALITY ASSURANCE

- .1 Health and Safety:
 - .1 Do construction occupational health and safety in accordance with Section 01 35 29.06 – Health and Safety.

1.5 DELIVERY, STORAGE AND HANDLING

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

- .2 Waste Management and Disposal:
 - .1 Construction/Demolition Waste Management and Disposal: in accordance with Section 01 74 21 - Management and Disposal construction/demolition waste.
 - .2 Do not dispose of unused paint or coating material into sewer system, into streams, lakes onto ground or in locations where it will pose health or environmental hazard.

Part 2 PRODUCTS

2.1 SYSTEM NAMEPLATES

- .1 Colours:
 - .1 Hazardous: red lettering on white background.
 - .2 Elsewhere: black lettering on white background (except where required otherwise by applicable codes).
- .2 Construction:
 - .1 3 mm thick laminated plastic or white anodized aluminum, matte finish, with square corners, letters accurately aligned and machine engraved into core.
- .3 Sizes:
 - .1 Conform to following table:

Size #	Sizes (mm)	No. of Lines	Height of Letters (mm)
1	10 x 50	1	3
2	13 x 75	1	5
3	13 x 75	2	3
4	20 x 100	1	8
5	20 x 100	2	5
6	20 x 200	1	8
7	25 x 125	1	12
8	25 x 125	2	8
9	35 x 200	1	20

- .2 Use maximum of 25 letters/numbers per line.

- .4 Locations:
 - .1 Terminal cabinets, control panels: use size #5.
 - .2 Equipment in mechanical rooms: use size #9.
- .5 Identification for Departmental Representative Preventive Maintenance Support System (PMSS):
 - .1 Use arrangement of Main identifier / Source identifier / Destination identifier.
 - .2 Equipment in mechanical room:
 - .1 Main identifier: size #9.
 - .2 Source and Destination identifiers: size #6.
 - .3 Terminal cabinets, control panels: size #5.
 - .3 Equipment elsewhere: sizes as appropriate.

2.2 EXISTING IDENTIFICATION SYSTEM

- .1 Apply existing identification system to new work.
- .2 Where existing identification system does not cover for new work, use identification system specified in this section.

2.3 PIPING SYSTEMS GOVERNED BY CODES

- .1 Identification:
 - .1 Sprinklers: NFPA 13.

2.4 IDENTIFICATION OF PIPING SYSTEMS

- .1 Identify contents by background colour marking, pictogram (as necessary), legend: direction of flow by arrows. To CAN / CGSB 24.3 except where specified otherwise.
- .2 Pictograms:
 - .1 Where required: Workplace Hazardous Materials Information System (WHMIS) regulation.
- .3 Legend:
 - .1 Block capitals to sizes and colours listed in CAN / CGSB 24.3. Inscriptions in legend shall be affixed in french and in english.

- .4 Arrows showing direction of flow:
- .1 Outside diameter of pipe less than 75 mm: 100 mm long x 50 mm in high.
 - .2 OD of pipe 75 mm and greater: 150 mm long x 50 mm high.
- .5 Extent of background colour marking:
- .1 Height: to full circumference of pipe/insulation.
 - .2 Length: to accommodate pictogram, full length or legend and arrows.
- .6 Materials for background colour marking, legend, arrows:
- .1 Pressure sensitive plastic-coated cloth or vinyl stickers, with protective overcoating, waterproof contact adhesive undercoating, suitable for ambient of 100% RH and continuous operating temperature of 150°C and intermittent temperature of 200°C.

.7 Colours and legends:

- .1 Where not listed, obtain direction from the Departmental Representative.
- .2 Colours for legends and arrows: to following table:

Background Color	Legends, Arrows
Red	WHITE

- .3 Background color markings and legends for piping systems:

Contents	Background Color Marking	Legend
Sprinklers	Red	EAU EXTINCTEURS AUTO / SPRINKLERS

- .8 Fire protection systems: the coating to be applied to the black steel and cast iron piping and fittings must:
- .1 Be low VOC content: VOC content compliant with Green Seal GC-3 "Environmental Criteria for anticorrosive Paints" standard, January 1997 edition (VOC limit: 250 g / L);
 - .2 Provide corrosion protection;
 - .3 Do not alter itself over time (following prolonged sunlight exposure, for example);
 - .4 Be easy to clean: all surface finishes must be glossy or semi-glossy;

- .5 Be compatible with black steel and cast iron;
- .6 Be able to be colored according to the color of the choice of the Departmental Representative.
- .7 Be easy to apply; especially for touch-ups on site;
- .8 Acceptable products:
 - .1 Benjamin Moore, Ultra Spec® HP
 - .1 Acrylic primer for metal FP04 (primer). VOC content: 48 g / L;
 - .2 FP28 D.T.M. (finish paint) or FP29 D.T.M semi-gloss acrylic enamel. VOC content: 45 g / L
 - .2 Akzo Nobel, Intercure® 99 (primer and finish paint):
 - .1 Polyaspartic technology resin which can be applied in a single layer directly on black steel. VOC content of 195 g / L.
 - .3 Tnemec Chembuild Series 135 (primary) and Tnemec Enduratone Series 1028 (finish):
 - .1 Primer: Modified polyamidoamine epoxy, coating with high filling power. VOC content: 86 g / L.
 - .2 Finish Paint: HDP (High Dispersion Pure) acrylic polymer. VOC content: 94 g / L.
- .9 Paint the fire protection piping and fittings according to the colors specified :
 - .1 For sprinkler systems : safety red.

2.5 LANGUAGE

- .1 Identification in English and French.
- .2 Use one (1) nameplate and label for both languages.

Part 3 PERFORMANCE

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 TIMING

- .1 Provide identification only after painting work is finished.

3.3 INSTALLATION

- .1 Perform work in accordance with CAN / CGSB 24.3 except as specified otherwise.
- .2 Provide ULC and/or CSA registration plates as required by respective agency.
- .3 Identify systems to conform to Departmental Representative PMSS.

3.4 NAMEPLATES

- .1 Locations:
 - .1 In conspicuous locations to facilitate easy reading and identification from operating floor.
- .2 Protection:
 - .1 Do not paint, insulate or cover.
- .3 Secure plates in conspicuous places.
- .4 Provide type and number of the device (e.g. pump no. 2), and the service provided, the area or sector of the building served (e.g. southern zone, fire water).

3.5 LOCATION OF IDENTIFICATION ON PIPING

- .1 On long straight runs in open areas in boiler rooms, equipment rooms, galleries, tunnels: at not more than 17 m intervals and more frequently if required to ensure that at least one is visible from any one viewpoint in operating areas and walking aisles.
 - .2 Adjacent to each change in direction.
 - .3 At least once in each small room through which piping passes.
 - .4 On both sides of visual obstruction or where run is difficult to follow.
 - .5 On both sides of separations such as walls, floors, partitions.
 - .6 Where system is installed in pipe chases, ceiling spaces, galleries, confined spaces, at entry and exit points, and at access openings.
 - .7 At beginning and end points of each run and at each piece of equipment in run.
 - .8 At point immediately upstream of major manually operated or automatically controlled valves. Where this is not possible, place identification as close as possible, preferable on upstream side.
-

- .9 Identification easily and accurately readable from usual operating areas and from access points.
 - .1 Position of identification approximately at right angles to most convenient line of sight, considering operating positions, lighting conditions, risk or personal damage or injury and reduce visibility over time due to dust and dirt.

3.6 PAINTING OF FIRE PROTECTION PIPING AND FITTINGS

- .1 Unless otherwise indicated in the contractual documents, proceed as described below for painting the piping.
- .2 Paint full length black steel piping in exposed areas and mechanical rooms.
- .3 Unless otherwise indicated, cover all visible piping of this contract, including threaded fittings, but excluding galvanized supports, grooved fittings and galvanized steel piping with a primer and two (2) layers of paint applied in the workshop. Clean and prepare the piping according to the standards recommended by the manufacturer before applying the primer. Make touch-ups, when required, on site, once the installations are completed.
- .4 Apply each layer of paint so as to obtain a continuous film of uniform thickness according to the specifications of the Paint Product Supplier.

3.7 CLEANING

- .1 Proceed in accordance with Section 01 74 11 – Cleaning.
 - .2 Upon completion and verification of performance of installation, remove surplus materials, waste, tools and equipment.
-

Part 1 General**1.1 RELATED REQUIREMENTS**

- .1 The requirements of the section 21 05 05 - Common Work Results for Fire Suppression are an integral part of this section.

1.2 REFERENCES

- .1 National Fire Prevention Association (NFPA)
 - .1 NFPA 13, Standard for the Installation of Sprinkler Systems, latest edition.
 - .2 NFPA 25, Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems, latest edition.
- .2 Underwriter's Laboratories of Canada (ULC)
 - .1 CAN4 S543-M984, Standard for Internal Lug Quick Connect Couplings for Fire Hose.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Documents and samples to be submitted.
- .2 Product Data:
 - .1 Provide manufacturer's printed product literature and data sheets, and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Test reports:
 - .1 Submit certified test reports for wet pipe fire protection sprinkler systems, indicating compliance with specifications for specified performance characteristics and physical properties.
- .4 Manufacturers' Instructions:
 - .1 Provide manufacturer's installation instructions.

1.4 CLOSEOUT SUBMITTALS

- .1 Provide operation, maintenance and engineering data for incorporation into manual specified in Section 01 78 00 - Documents / Items to be submitted upon completion of work.
-

- .2 Manufacturer's Catalog Data, including specific model, type, and size for:
 - .1 Pipe and fittings.
 - .2 Sprinkler heads.
 - .3 Sprinkler guards.
 - .4 Pipe hangers and supports.
 - .5 Mechanical couplings.
- .3 Records:
 - .1 As-built drawings of each system.
 - .1 After completion, but before final acceptance, submit complete set of as-built drawings of each system for record purposes.
- .4 Operation and Maintenance Manuals:
 - .1 Provide Material Certificate for aboveground piping and other documentation for incorporation into manual in accordance with NFPA 13.

1.5 QUALITY ASSURANCE

- .1 Qualifications:
 - .1 Installer: company or person specializing in wet sprinkler systems with documented experience and approved by manufacturer.
- .2 Supply grooved joint couplings, fittings, valves, grooving tools and specialties from a single manufacturer. Use date stamped castings for coupling housings, fittings, valve bodies, for quality assurance and traceability.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- .1 Extra Materials:
 - .1 Provide maintenance materials in accordance with Section 01 78 00 - Documents / Items to be submitted upon completion of work.
 - .2 Provide spare sprinklers and tools in accordance with NFPA 13.

1.7 DELIVERY, STORAGE AND HANDLING

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

- .2 Delivery and Acceptance Requirements:
 - .1 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
- .3 Storage and Protection:
 - .1 Store materials indoors in dry location.
 - .2 Store and protect materials from exposure to harmful weather conditions and at temperature and humidity conditions recommended by manufacturer.
- .4 Packaging Waste Management: In accordance with Section 01 74 21 - Management and Disposal construction/demolition waste.

Part 2 Products

2.1 GENERAL

- .1 Include with each system materials, accessories, and equipment inside and outside building to provide each system complete and ready for use.
- .2 Devices and equipment for fire protection service: ULC approved for use in wet pipe sprinkler systems.

2.2 ABOVE GROUND PIPING SYSTEMS

- .1 Provide fittings for changes in direction of piping and for connections.
 - .1 Make changes in piping sizes through tapered reducing pipe fittings.
- .2 Perform welding in shop.
- .3 Conceal piping in areas with suspended ceiling.

2.3 PIPE, FITTINGS AND VALVES

- .1 Pipe:
 - .1 Black steel suitable for operation pressures of 1200 kPa (175 psi), UL/ULC and FM certified.
 - .1 Up to 50 DN (NPS 2) : Series 40 pipes compliant with the ASTM A 53/A53 M standard, Type E, Grade A.
 - .2 65 DN (NPS 2½) and above: Series 10 pipes compliant with the ASTM 795/A 795M standard.

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- .2 All piping must be approved for fire protection and be marked with the name of the manufacturer, the thickness of the walls (schedule 10 or 40) and the approval received as prescribed in NFPA 13.
 - .3 Piping and fittings must be from a North American supplier. Any wall thickness deviating from North American standards is prohibited for this project.
 - .4 Acceptable products, schedule 10:
 - .1 Nova Tube;
 - .2 Bull Moose;
 - .3 Wheatland.
 - .2 Fittings and joints
 - .1 Fittings for operating pressures of 2 070 kPa (300 psi) up to a temperature of 65 °C (150 °F).
 - .1 In threaded ductile iron; class 150, according to ASME, B16.3, UL / ULC and FM approved.
 - .1 Acceptable products :
 - .1 Anvil Star;
 - .2 Ward;
 - .3 Smith-Cooper International.
 - .2 Cast iron with flanges; class 250, according to ANSI, B16.1, UL / ULC and FM approved.
 - .3 Welded steel according to ASTM A-234.
 - .4 Couplings and fittings for grooved piping.
 - .1 Acceptable products - rigid :
 - .1 Victaulic style 009N or 107;
 - .2 Anvil Star C-4;
 - .3 Viking VGS serie, model V-Z05.
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- .2 Acceptable products - flexible :
 - .1 Victaulic style 75;
 - .2 Anvil Star C-1;
 - .3 Viking VGS serie model V-7705.
 - .2 Mechanical tees
 - .1 ULC approved fittings (otherwise UL and FM) for connection of reduced diameter pipes.
 - .1 Acceptable products :
 - .1 Victaulic style 920/920N or 922;
 - .2 Anvil Mt-1 or Mt-2;
 - .3 Grinnell, figure 730;
 - .4 Viking, V-M21 or VM-22.
 - .3 Joints on threaded piping
 - .1 Sealant, for threaded type joints, approved for use in a fire protection system.
 - .2 Acceptable products :
 - .1 La-co;
 - .2 Slic-tite;
 - .3 FPPI, Pipe Fit;
 - .4 Whitlam Plumb-Pro.
 - .3 Valves:
 - .1 ULC listed for fire protection service.
 - .4 Ball valve
 - .1 Install in locations shown on plans.
 - .1 Acceptable products :
 - .1 Nibco, Kt-585-70-UL;
 - .2 Anvil, fig.171N;
 - .3 Crane F9202.
-

- .5 Drain valve
 - .1 Install a drain valve in all low points of the piping to facilitate drainage when required by current standards.
 - .2 Provide drain valves with a minimum diameter of 19 mm DN (NPS $\frac{3}{4}$) with plug for portions of piping to be drained ("trapped piping") with a capacity between 18.9 L (5 gal) and 189 L (50 gal).
- .6 Pipe hangers:
 - .1 ULC listed for fire protection services in accordance with NFPA.

2.4 SPRINKLER HEADS

- .1 General: to NFPA 13 and ULC listed for fire services.
 - .1 The fusible link of the sprinkler heads will activate at a temperature set in accordance with the needs defined for the protected zone.
 - .2 In areas where the structure or piping is exposed, the sprinklers will be straight, made of bronze or brass with a natural metal finish.
 - .3 Provide corrosion-resistant sprinkler heads and sprinkler head guards in accordance with NFPA 13.
 - .4 Provide sprinkler heads as indicated.
 - .5 Ceiling cups: not permitted.
 - .6 The sprinklers table is shown on the plans.
 - .1 Acceptable products :
 - .1 Tyco;
 - .2 Viking;
 - .3 Victaulic;
 - .4 Reliable.

2.5 SPRINKLER GUARD

- .1 Guard in steel rod covered with zinc plating, with clamping screw or clamping ring, to protect the sprinklers exposed to mechanical shock. The protective baskets must be chosen according to the model of sprinkler selected.
 - .1 Acceptable products :
 - .1 LynCar model 305692;
 - .2 Tyco model G1 and G4;
 - .3 Viking model D-1 or XG.

2.6 PIPE SLEEVES

- .1 Provide pipe sleeves where piping passes through walls, floors, and roofs.
 - .2 Secure sleeves in position and location during construction.
 - .3 Provide sleeves of sufficient length to pass through entire thickness of walls, floors, and roofs.
 - .4 Provide 2.5 cm minimum clearance between exterior of piping and interior of sleeve or core-drilled hole.
 - .1 Firmly pack space with mineral wool insulation.
 - .2 Seal space at both ends of sleeve or core-drilled hole with plastic waterproof cement which will dry to firm but pliable mass.
 - .3 In fire walls and fire floors, seal both ends of pipe sleeves or core-drilled holes with ULC listed fill, void, or cavity material.
 - .4 The General Contractor will be responsible for supplying and installing all fire seals in Section 07 84 00 - Fire stopping. The Mechanical Subcontractor shall coordinate this work with the General Contractor.
 - .5 Sleeves in Masonry and Concrete Walls, Floors, and Roofs:
 - .1 Provide cast-iron sleeves.
 - .2 Core drilling of masonry and concrete may be provided in lieu of pipe sleeves when cavities in core-drilled hole are completely grouted smooth.
 - .6 Sleeves in Other Than Masonry and Concrete Walls, Floors, and Roofs:
 - .1 Provide 0.61 mm thick galvanized steel sheet.
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2.7 ESCUTCHEON PLATES

- .1 Provide one-piece type metal plates for piping passing through walls, floors, and ceilings in exposed spaces.
- .2 Provide polished chromium-plated finish in finished spaces.
- .3 Provide paint finish on metal plates in unfinished spaces.

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 Install, inspect and test to acceptance in accordance with NFPA 13 and NFPA 25.

3.3 PIPE INSTALLATION

- .1 Install piping straight and true to bear evenly on hangers and supports. Do not hang piping from plaster ceilings.
- .2 Keep interior and ends of new piping and existing piping thoroughly cleaned of water and foreign matter.
- .3 Keep piping systems clean during installation by means of plugs or other approved methods. When work is not in progress, securely close open ends of piping to prevent entry of water and foreign matter.
- .4 Inspect piping before placing into position.

3.4 EQUIPMENT INSTALLATION

- .1 Ensure that maintenance and dismantling can be done without having to move the connecting elements of the piping and conduits by the use of fittings, unions and flanges, without the structural elements of the building or any other installation constitute an obstacle.
- .2 Unless otherwise indicated, comply with manufacturer's most recent written instructions regarding materials and equipment to be used and installation methods.
- .3 Provide fasteners and metal accessories of the same texture, color and finish as the support metal to which they are attached. Use fasteners, anchors and non-corrosive shims to secure exterior and interior works.

- .4 Check the connections made in the factory and tighten them if necessary to ensure the integrity of the installation.
- .5 Include all necessary drainage piping up to the nearest open drain. All low points must have auxiliary drains.
 - .1 Volume of less than 18.9L (5 gal): nipple and plug 15mm (½ in) minimum.
 - .2 Volume between 18.9 to 189L (5 and 50 gal): valve with nipple and plug 20 mm (¾ in) minimum.
 - .3 Volume of 189L (50 gal) and more: valve of 25 mm (1 in) minimum with duct to a drain or accessible place for drainage.
- .6 Installation difficulties:
 - .1 The Contractor shall communicate with the Departmental Representative for any ambiguity, difficulty and incorrect dimensions and wait for the latter's agreement before proceeding with the installation of the piping, conduits and devices of any kind. Dimensions should be checked before installation. If the Contractor does not take this clause into account, the Contractor must assume all the costs of its premature installation and demolition of the incorrect work.

3.5 SPRINKLERS

- .1 Unless otherwise indicated, all sprinklers must be centered in at least one direction when a tiled suspended ceiling is provided.

3.6 SPRINKLER GUARDS

- .1 Install sprinkler guards to sprinklers located at the following locations :
 - .1 Under obstructions in mechanical rooms.
 - .2 All sprinklers located at 2 135 mm and less from the floor level.
 - .3 As indicated on drawings.

3.7 SPARE SPRINKLERS CABINET

- .1 Install the required spare sprinklers and keys in the existing spare sprinklers cabinet in the fire protection system room.

3.8 CONNECTIONS TO EXISTING WATER SUPPLY SYSTEMS

- .1 Notify Contracting Officer in writing at least 15 days prior to connection date.
- .2 Use tapping or drilling machine valve and mechanical joint type sleeves for connections to be made under pressure.

- .3 Bolt sleeves around main piping.
- .4 Bolt valve to branch connection. Open valve, attach drilling machine, make tap, close valve, and remove drilling machine, without interruption of service.
- .5 Furnish materials required to make connections into existing water supply systems, and perform excavating, backfilling, and other incidental labour as required.

3.9 FIELD QUALITY CONTROL

- .1 Site inspection:
 - .1 Inspect, and approve piping before covering or concealing.

3.10 PAINTING

- .1 For exposed piping and fittings, degrease and clean surfaces according to standards recommended by the manufacturer prior to priming and painting work.

3.11 CLEANING

- .1 Clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Remove surplus materials, excess materials, rubbish, tools and equipment.
-

Partie 1 General**1.1 RELATED REQUIREMENTS**

- .1 The requirements of the section 23 05 00 – Common Work Results for HVAC are an integral part of this section.

1.2 USE OF SYSTEMS

- .1 ENVIRONMENTAL PROTECTION: Operation of mechanical systems during construction may have a negative impact on indoor air quality post-occupancy. For improved indoor air quality post-occupancy, it is important to meet or exceed the design requirements of the Sheet Metal and Air Conditioning Contractors Association (SMACNA) set out in chapter 3 of the document “IAQ Guideline for Occupied Buildings Under Construction”. Submit documents and samples required in accordance with Section 01 33 00 – Submittal Procedures.
 - .2 Use of new heating and/or ventilation systems for supplying temporary building heat and ventilation is permitted only under following conditions.
 - .1 Entire system is complete, pressure tested, cleaned and flushed out.
 - .2 Specified water treatment system has been commissioned, water treatment is being continuously monitored.
 - .3 Building has been closed in, areas to be heated/ventilated are clean and will not thereafter be subjected to dust-producing processes.
 - .4 There is no possibility of damage.
 - .5 Supply ventilation systems are protected by 60% filters, inspected daily, changed every two (2) weeks or more frequently as required.
 - .6 Return systems have approved filters over openings, inlets, outlets.
 - .7 Systems will be:
 - .1 Operated as per manufacturer’s recommendations and instructions.
 - .2 Operated by Subcontractor.
 - .3 Monitored continuously by Subcontractor.
 - .8 Warranties and guarantees are not relaxed.
 - .9 Regular preventive and other manufacturer’s recommended maintenance routines are performed by Subcontractor at own expense and under supervision of Departmental Representative.
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- .10 Prior to completion of static work, facilities and systems used must be cleaned inside and out and returned to their original state, and air filters replaced.
 - .1 Filters specified in this section are over and above those specified in other sections of this project.
 - .2 Exhaust systems are not included in approvals for temporary heating ventilation.

Partie 2 Products**2.1 PRODUCTS**

- .1 N/A.

Partie 3 Execution**3.1 EXECUTION**

- .1 N/A.

END OF SECTION

Part 1 GENERAL**1.1 RELATED SECTIONS**

- .1 Section 23 01 05 – Operation and maintenance of HVAC Systems During Construction.
- .2 Section 23 05 48 – Vibration and Seismic Controls for HVAC.
- .3 Section 23 05 53 – Identification for HVAC Piping and Equipment.
- .4 Section 23 05 93 – Testing, Adjusting and Balancing for HVAC.
- .5 Section 23 05 94 – Pressure Testing of Ducted Air Systems.
- .6 Section 23 07 13 – Duct Insulation.
- .7 Section 23 07 15 – Thermal insulation for piping.
- .8 Section 23 31 13.01 – Metal Ducts – Low Pressure to 500 Pa.
- .9 Section 23 33 00 – Air Duct Accessories.
- .10 Section 23 33 16 – Dampers – Fire and Smoke.
- .11 Section 23 34 00 – HVAC Fans.
- .12 Section 23 37 13 – Diffuser, Registers and Grilles.
- .13 Section 23 37 20 - Louvres, air intakes and other vents
- .14 Section 23 44 00 – HVAC Air Filtration.

1.2 REFERENCE

- .1 Manufacturer: the company responsible for manufacturing the equipment in factory.
- .2 Manufacturer's representative: personnel trained by the manufacturer to start up the equipment on the work site.

1.3 REFERENCE STANDARDS

- .1 Perform work in accordance with project applicable code standards.
- .2 Obtain all authorizations, approvals, permits and certificates required by authorities. Pay all costs for such authorizations, approvals, permits and certificates.

1.4 SUBMITTALS

- .1 Submittals: in accordance with Section 01 33 00 - Documents and samples to be submitted.
 - .1 Shop Drawings
 - .1 Submit shop drawings for review by the Departmental Representative as follows:
 - .1 Fans and accessories, motors.

- .2 Drawings and seismic control equipment.
- .3 Drawings of the locations of penetrations, sleeves, openings and fire dampers.
- .4 Flexible air ducts.
- .5 All accessories and dampers for air ducts.
- .6 Acoustic lining for air ducts.
- .7 Grilles and diffusers.
- .8 Terminal air volume boxes.
- .9 Anti-vibration devices.
- .10 Filters and filter housings.
- .11 Air intake and evacuation equipment.
- .12 Products for sealing air ducts.
- .13 Sealants for caulking.
- .14 Firewall products.
- .15 Products and procedures for cleaning ducts.
- .2 This list is not restrictive and does not relieve the Subcontractor of his responsibility to submit all shops drawings and/or technical data required by the Departmental Representative.

1.5 QUALITY ASSURANCE

- .1 Quality Assurance: in accordance with Section 01 45 00 – Quality Control.
- .2 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 35 29.06 – Health and Safety.

1.6 MAINTENANCE

- .1 Furnish spare parts in accordance with Section 01 78 00 - Documents / Items to be submitted upon completion of work.
- .2 Provide a list of all spare parts recommended by equipment suppliers and provide, among other things, the following change parts:
 - .1 One (1) filter cartridge or (1) filter media set for each filter or filter bank, in addition to final operating set.
 - .2 One (1) set of belts for each unit.
 - .3 One (1) set of pulleys for each fan for flow balancing.
 - .4 Three (3) fusible links (at each temperature) for fire dampers.
- .3 This list is not exhaustive and does not relieve the Subcontractor of his responsibility to provide any other spare part considered essential by the Departmental Representative.

- .4 Once work is complete and just before final acceptance of the installation, replace cartridge filters and filter banks in accordance with specifications.
- .5 Provide one set of special tools required to service equipment as recommended by manufacturers and in accordance with Section 01 78 00 - Documents / Items to be submitted upon completion of work.
- .6 Furnish one (1) commercial quality grease gun, grease and adapters to suit different types of grease and grease fittings.

1.7 DELIVERY, STORAGE AND HANDLING

- .1 Waste Management and Disposal:
 - .1 Construction/Demolition Waste Management and Disposal: in accordance with Section 01 74 21 - Management and disposal of construction / demolition waste.

1.8 COORDINATION

- .1 The Subcontractor shall locate and indicate in a timely manner to the Construction Manager, the location of sleeves, openings and other work requirements having an impact on other trades.
- .2 The Subcontractor shall not ask for any additional amount for work to be performed by him to coordinate his work with other trades and/or to account for lack of coordination.
- .3 The Subcontractor shall perform, at his own expense, all required sealing, dismantling and reinstallation of equipment and systems already installed in order to coordinate his work with other trades.

1.9 START-UP AND CALIBRATION

- .1 The Subcontractor is responsible for start-up of all equipment and systems supplied and installed by him.
- .2 The manufacturer's representative must be present during the start-up. It is this one which starts the equipment.
- .3 The Subcontractor is responsible for performance of systems and equipment supplied and installed by him. In this respect, the Subcontractor is responsible for correcting, modifying and adjusting any equipment, system or network which does not provide adequate performance as stated in specifications.
- .4 The Subcontractor responsible for the scope of work of Section 23 05 93 – Testing, Adjusting and Balancing for HVAC shall supply labour, equipment and material to measure and/or calibrate the performance of networks and systems which are part of his scope of work.
- .5 However, the Subcontractor in charge of work described in the present section is responsible for all work required on systems and networks for which he is responsible, to allow the Subcontractor responsible for Section 23 05 93 Testing, Adjusting and Balancing for HVAC to perform his work.

- .6 The Subcontractor responsible for the scope of control works (Division 25) shall supply and install all automatic control systems in order to provide proper operation and performance of systems and networks which are part of the scope of work of present section.
- .7 Consequently, the Subcontractor responsible for work described in the present section is responsible for all work required on systems and networks for which he is responsible, to allow the Division 25 Subcontractor to perform his work.

1.10 MOTORS

- .1 All motors of all systems and/or equipment in accordance with requirements of Section 21 05 01 – Mechanical - Common Work Results for Mechanical.

1.11 COORDINATION OF TESTS

- .1 Coordination of FPT mentioned in Section 23 05 93 – Testing, Adjusting and Balancing for HVAC and of PPT mentioned in Division 25 is the General Contractor's responsibility.
- .2 The Subcontractor responsible for the scope of work of Section 23 05 93 – Testing, Adjusting and Balancing for HVAC is responsible for all TAB as well as FPT described in Section 23 05 93. However, the Subcontractor in charge of work described in Section 23 05 00 – Common Work Results for HVAC is responsible for all work and adjusting related to systems for which he is responsible during FPT. Consequently, in the price of his tender, the Subcontractor responsible for work described in Section 23 05 00 shall include all costs related to his participation in FPT program. No additional amount of money shall be paid by the Departmental Representative for Subcontractor's participation in test program.
- .3 The Subcontractor in charge of the scope of work of Section 23 05 00 is responsible for supplying all labour, equipment and material required for handling, adjusting and modification of systems that are part of the scope of work so as to allow the Subcontractor in charge of Section 23 05 93 – Testing, Adjusting and Balancing for HVAC, to calibrate systems pressure and flow to specified values.

1.12 SYSTEMS OPERATION

- .1 Pay all costs related to systems operation, from work start-up to substantial completion.
- .2 Supply all labour required for systems operation, from work start-up to substantial completion.

Part 2 Products

2.1 MATERIALS / EQUIPMENT

- .1 Not applicable.

Part 3 Execution**3.1 PAINT TOUCH-UPS**

- .1 Do painting in accordance with Sections 09 91 23 and 09 91.23.01 (Interior painting).
- .2 Prime and touch up marred finished paintwork to match original.
- .3 Restore to new condition, finishes which have been damaged.

3.2 CLEANING

- .1 The Subcontractor shall be responsible for taking all measures, both ordinary and extraordinary, in order to protect all ducting systems (new and existing) against dust, as well as against all substances that may become dirty such as the inside and outside of ducts and accessories.
- .2 If, in the opinion of the Departmental Representative, the Subcontractor fails to take adequate protective measures and/or if portions of pipes already installed become contaminated, the Subcontractor shall clean such portions of pipes at his own expense. If cleaning is inadequate, Subcontractor shall remove those portions of pipes and replace them with new pipes at his own expense.
- .3 Any activity that, in the opinion of the Departmental Representative, generates dust and/or dirt and/or contaminants that may affect project environmental quality will be executed outside perimeter of the building.
- .4 Obstruct openings: prevent dust, dirt and other foreign matter from entering openings of installations and equipment using appropriate means.
- .5 Clean equipment and mechanical devices every day.
- .6 At the end of duct erection, and before ventilation systems start-up, Subcontractor shall clean inside and outside of all elements, devices and systems, including screens and filters, and vacuum inside the ducts and air handling units and leave them in perfect working order, replace all air unit system filters and clean water filters in anticipation of provisional acceptance. To do this, the Subcontractor shall provide and install all doors required to clean all parts of duct systems.
- .7 Do not discharge to sewers cleaning products whose contents do not meet competent authorities' requirements. The Subcontractor must collect these products and dispose of them in a manner approved by competent authorities.
- .8 Cleaning methods will be presented to the Departmental Representative for review prior to cleaning.

3.3 FIELD QUALITY CONTROL

- .1 Site Tests: conduct the following tests in accordance with Section 01 45 00 – Quality Control and submit reports as described in PART 1 – SUBMITTALS.
-

.2 Manufacturer's Field Services:

- .1 The Subcontractor will be responsible for establishing and maintaining an on-site quality control system to ensure the Departmental Representative of the highest quality work.
- .2 Obtain written report from manufacturer verifying compliance of work, in handling, installing, applying, protecting and cleaning of products and submit Manufacturer's Field Reports as described in PART 1 – SUBMITTALS.
- .3 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.
- .4 Schedule site visits, to review work, as directed in PART 1 – QUALITY ASSURANCE.

3.4 SYSTEM START-UP

- .1 All starts must be made by the respective manufacturer of the equipment started.

3.5 COMMISSIONING

- .1 Apply the setting operation of all systems as prescribed in this Section 01 91 13 – General Requirements and the requirements of this section
- .2 Provide labour, materials and instruments for carrying out tests.
- .3 The Departmental Representative must be able to use facilities and equipment for testing before they are accepted. Provide labour, equipment and instruments necessary for carrying out tests.
- .4 The following facilities and equipment will undergo temporary testing:
 - .1 Leak testing of ventilation ducts.
 - .2 Flow balancing of ventilation systems and chilled and heating water.
 - .3 Performance tests of ventilation and air conditioning equipment.
 - .4 Leak testing of chilled and heating water systems.
- .5 As the requirements of CAN/ULC - S1001 (Integrated systems testing of fire protection and life safety systems), the Contractor and these subcontractors shall provide the Test Coordinator with documentation confirming that such systems are installed as designed and ready for testing as described in the standard. The contractor shall participate in the test procedures established by the test coordinator for the tests to be conducted after completion of the work. Provide for the presence and participation of technicians who meet the requirements established by the coordinator for eight 4-hour sessions to perform the required tests.

3.6 OPERATING AND MAINTENANCE PERSONNEL TRAINING

- .1 Conduct staff training as prescribed in Section 01 91 41 - Commissioning - Training and the requirements of this section.

- .1 Provide tools, materials and services of qualified instructors to give training, during normal working hours, to operating and maintenance personnel on the operation, control, adjustment, diagnostics/troubleshooting and maintenance of equipment, materials and systems, before their acceptance.
- .2 Training must be provided during normal working hours, prior to acceptance and turnover of systems and facilities, and prior to substantial completion.
- .3 For all equipment such as:
 - .1 Fans;
 - .2 Etc.

This list is not limited; demonstrations and instructions will be given by the manufacturer of the equipment concerned.
- .4 Learning materials must include, among other things, the operations and maintenance manual, and as-built drawings.
- .5 Requirements for necessary training hours are listed in each relevant section.
- .6 Training courses to be based on contents of the operations and maintenance manual.
- .7 Training time must conform to the specifications of the appropriate sections and the manufacturer's recommendations.
- .8 The Departmental Representative may, if desired, record training on video or audio media for use at a later date.

3.7 PROTECTION

- .1 Protection of work:
 - .1 The Subcontractor shall protect his installation against damage until entire work has been accepted by proper authorities.
 - .2 All materials will be stored carefully in appropriate locations, without disturbing traffic.
 - .3 Ensure physical protection of materials and equipment installed and/or stored on site. Promptly remove all debris, tools or materials inside and on top of equipment.
 - .4 Prevent dust, dirt and other foreign matter from entering the openings of installations and equipment using appropriate means.
 - .5 When work benches are installed inside building, the Subcontractor will protect floor against any deposits or debris that may damage floor.

END OF SECTION

Part 1 GENERAL**1.1 RELATED DOCUMENTS**

- .1 This section applies to the drawings and the general provisions of the contract, including the General Conditions and Supplementary Conditions, as well as the Sections of Division 01.

1.2 PERFORMANCE QUOTE

- .1 This section is a performance specification for the following:
 - .1 Calculation, design and verification of seismic restraint systems for all Division 23 work. It is compulsory to mandate an Engineer for these purposes. Refer to the article *Services of an Engineer*".

1.3 SPECIAL CONDITION

- .1 In the administrative building, the wooden structure is protected by gypsum with fire resistance under the beams.

1.4 SERVICES OF AN ENGINEER

- .1 Retain the services of an Engineer and mandate him to:
 - .1 Perform calculations, complete design and verification of seismic restraint systems and devices required for all Division 23 work in accordance with all requirements of this Section. Calculations for outdoor equipment must take into account wind load.
 - .2 Produce, assemble and provide shop drawings, data sheets, calculation notes and other documents related to calculation, design and products. Refer to articles "*Submittals for action* " and "*Quality assurance* ".
 - .3 Gather information needed for calculations for equipment described in other Sections, for example:
 - .1 The dimensions of the equipment.
 - .2 The location of the center of gravity of the equipment.
 - .3 The location of the mounting and anchoring devices.
 - .4 Conduct periodic visits to verify the quality of implementation. Refer to the article On-site quality control Of Part 3.
 - .5 Supervise the testing and inspection activities mentioned in the article " On-site quality control Of Part 3.
 - .6 Produce and sign certificates of compliance.
 - .1 Elements to be Submitted upon Completion of the Work.
-

.2 Qualifications

- .1 The Engineer must be a member in good standing of the OIQ, specialized and recognized in the field of seismic protection of the functional and operational components of buildings. He must be familiar with the standards referenced in this Section and the requirements of Part 4 of the CCQ relating to the design of earthquake restraint systems.
- .2 Provide, upon request, the curriculum vitae of the Engineer.

1.5 ELEMENTS TO BE SUBMITTED UPON COMPLETION OF THE WORK

- .1 The elements must be submitted before the provisional acceptance of the works.
- .2 Provide the operation and maintenance sheets and attach them to the mentioned manual as requested in the contract documents of the client.
- .3 On-site quality control and verification reports. Refer to the article *On-site quality control* Of Part 3.
- .4 Certificates of conformity.
 - .1 The Engineer must produce and sign certificates of compliance at the following stages:
 - .1 At the completion of the concealed work;
 - .2 Upon completion of all work.
 - .1 The certificate must certify:
 - .1 That all of Division 23's work complies with the requirements of the CCQ for protection against earthquake loads and wind loads.
 - .2 That all seismic restraint devices comply with the requirements of this Section as well as submitted and reviewed workshop drawings.

END OF SECTION

Part 1 GENERAL**1.1 RELATED SECTIONS:**

- .1 The requirements of the section 23 05 00 – Common Work Results for HVAC are an integral part of this section.

1.2 REFERENCES

- .1 Canadian Gas Association (CGA):
 - .1 CSA / CGA B149.1-10, 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-24.03-92, Identification of Piping Systems.
- .3 National Fire Protection Association (NFPA)
 - .1 NFPA 13-2013, Standard for the Installation of Sprinkler Systems.
 - .2 NFPA 14-2010, Standard for the Installation of Standpipe and Hose Systems.

1.3 SUBMITTALS

- .1 Product Data:
 - .1 Submittals: in accordance with data sheets required under Section 01 33 00 – Documents and samples to be submitted.
 - .2 Product data to include paint colour chips and other products specified in this section.
- .2 Samples:
 - .1 Submit samples in accordance with Section 01 33 00 – Documents and samples to be submitted.
 - .2 Samples to include nameplates, labels, tags, and lists of proposed legends.

1.4 QUALITY ASSURANCE

- .1 Health and Safety:
 - .1 Take the necessary health and safety measures in accordance with Section 01 35 29.06 – Health and Safety.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Packaging, shipping, handling and unloading:
 - .1 Deliver, store and handle equipment and materials in accordance with Section 01 61 00 – General Product Requirements.
-

- .2 Deliver, store and handle equipment and materials in accordance with Manufacturer's written instructions.
- .2 Waste Management and Disposal:
 - .1 Construction/Demolition Waste Management and Disposal: in accordance with Section 01 74 19 - Management and Disposal waste.
 - .2 Do not dispose of unused paint or coating material into sewer system, into streams, lakes onto ground or in locations where it will pose health or environmental hazard.

Part 2 PRODUCTS

2.1 MANUFACTURER'S EQUIPMENT NAMEPLATES

- .1 Provide nameplates with raised or recessed lettering, and mechanically secured to each piece of equipment.
- .2 Provide CSA or Underwriters' Laboratories plates as required by the respective organizations.
- .3 Nameplate manufacturers must indicate size, model, manufacturer name, serial number, voltage, power factor, phases, and motor rating.
- .4 Install nameplates in plain view and not covered with insulation or paint.

2.2 NAMEPLATES – GENERAL REQUIREMENTS

- .1 Metal or plastic laminate nameplate mechanically fastened to each piece of equipment by manufacturer.
- .2 Lettering and numbers raised or recessed.
- .3 Information to include on nameplates, as appropriate:
 - .1 Equipment: manufacturer's name, model, size, serial number, capacity.
 - .2 Motor: voltage, Hz, phase, power factor, duty, frame size.

2.3 SYSTEM NAMEPLATES

- .1 Colours:
 - .1 Hazardous: red lettering on white background.
 - .2 Elsewhere: black lettering on white background (except where required otherwise by applicable codes).

.2 Construction:

- .1 3 mm thick laminated plastic or white anodized aluminum, matte finish, with square corners, letters accurately aligned and machine engraved into core.

.3 Sizes:

- .1 Conform to following table:

Size #	Sizes (mm)	No. of Lines	Height of Letters (mm)
1	10 x 50	1	3
2	13 x 75	1	5
3	13 x 75	2	3
4	20 x 100	1	8
5	20 x 100	2	5
6	20 x 200	1	8
7	25 x 125	1	12
8	25 x 125	2	8
9	35 x 200	1	20

- .2 Use maximum of 25 letters/numbers per line.

.4 Locations:

- .1 Terminal cabinets, control panels: use size #5.
 .2 Equipment in mechanical rooms: use size #9.

.5 Identification for PWGSC Preventive Maintenance Support System (PMSS):

- .1 Use arrangement of Main identifier / Source identifier / Destination identifier.
 .2 Equipment in mechanical room:
 .1 Main identifier: size #9.
 .2 Source and Destination identifiers: size #6.
 .3 Terminal cabinets, control panels: size #5.
 .3 Equipment elsewhere: sizes as appropriate.

2.4 IDENTIFICATION OF PIPING SYSTEMS

- .1 Identify contents by background colour marking, pictogram (as necessary), legend: direction of flow by arrows. To CAN / CGSB 24.3 except where specified otherwise.

- .2 Pictograms:
- .1 Where required: Workplace Hazardous Materials Information System (WHMIS) regulation.
- .3 Legend:
- .1 Capital letters to sizes and colours listed in CAN / CGSB 24.3. Inscriptions in legend shall be affixed in french and in english.
- .4 Arrows showing direction of flow:
- .1 Outside diameter of pipe/insulation less than 75 mm: 100 mm long x 50 mm in high.
- .2 OD of pipe/insulation 75 mm and greater: 150 mm long x 50 mm high.
- .3 Use double-headed arrows where flow is reversible.
- .5 Dimensions of background colour markings:
- .1 Height: to full circumference of pipe/insulation.
- .2 Length: to accommodate pictogram, full length or legend and arrows.
- .6 Materials for background colour marking, legend, arrows:
- .1 Pipes and tubing 20 mm and smaller: waterproof and heat-resistant pressure sensitive plastic marker tags.
- .2 Other pipes: pressure sensitive plastic-coated cloth or vinyl stickers, with protective overcoating, waterproof contact adhesive undercoating, suitable for ambient of 100% RH and continuous operating temperature of 150°C and intermittent temperature of 200°C.
- .7 Background colours and legends:
- .1 Where not listed, obtain direction from the Departmental Representative.
- .2 Colours for legends and arrows: to following table:

Background Color	Legends, Arrows
Yellow	BLACK
Green	WHITE
Red	WHITE

- .3 Background color markings and legends for piping systems:

Contents/ Fluid conveyed	Background Color Marking	Legend
** Add design temperature		
+ + Add design temperature and pressure		
Raw water	Green	EAU BRUTE / RAW WATER
River water	Green	EAU RIVIÈRE / RIVER WATER

Contents/ Fluid conveyed	Background Color Marking	Legend
Sea water	Green	EAU MER / SEA WATER
Sanitary	Green	EAUX SANITAIRES / SAN
Plumbing vent	Green	VENTILATION SANITAIRE / SAN. VENT

2.5 IDENTIFICATION FOR DUCTWORK SYSTEMS

- .1 50 mm high stencilled letters and directional arrows 150 mm long x 50 mm high.
- .2 Color: black or coordinated with base colour to ensure strong contrast.

2.6 IDENTIFICATION OF VALVES

- .1 Brass tags with 12 mm stamped identification data filled with black paint.
- .2 Include flow diagrams for each system, of approved size, showing charts and schedules with identification of each tagged item, valve type, service, function, normal position, location of tagged item.

2.7 CONTROL COMPONENTS IDENTIFICATION

- .1 Identify all systems, equipment, components, controls and sensors with system nameplates specified in this section.
- .2 Inscriptions to include function and (where appropriate) fail-safe position.

2.8 LANGUAGE

- .1 Identification in English and French.
- .2 Use one (1) nameplate and label for both languages.

Part 3 PERFORMANCE

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 TIMING

- .1 Provide identification only after painting specified in Sections 09 91 23 and 09 91 23.01 (Painting).

3.3 INSTALLATION

- .1 Perform work in accordance with CAN / CGSB 24.3 except as specified otherwise.
- .2 Provide ULC and/or CSA registration plates as required by respective agency.
- .3 Identify systems to conform to Departmental representative.

3.4 NAMEPLATES

- .1 Locations:
 - .1 In conspicuous locations to facilitate easy reading and identification from operating floor.
- .2 Standoffs:
 - .1 Provide for nameplates on hot and/or insulated surfaces.
- .3 Protection:
 - .1 Do not paint, insulate or cover.
- .4 Secure plates in conspicuous places. If they cannot be installed on cold surfaces, supply and install spacers.
- .5 Provide type and number of the device (e.g. pump no. 2), and the service provided, the area or sector of the building served (e.g. southern zone, chilled water, primary).
- .6 Have list of plates verified prior to etching message.

3.5 LOCATION OF IDENTIFICATION ON PIPING AND DUCTWORK SYSTEMS

- .1 On long straight runs in open areas in boiler rooms, equipment rooms, galleries, tunnels: at not more than 17 m intervals and more frequently if required to ensure that at least one is visible from any one viewpoint in operating areas and walking aisles.
 - .2 Adjacent to each change in direction.
 - .3 At least once in each small room through which piping or ductwork passes.
 - .4 On both sides of visual obstruction or where run is difficult to follow.
 - .5 On both sides of separations such as walls, floors, partitions.
 - .6 Where system is installed in pipe chases, ceiling spaces, galleries, confined spaces, at entry and exit points, and at access openings.
 - .7 At beginning and end points of each run and at each piece of equipment in run.
 - .8 At point immediately upstream of major manually operated or automatically controlled valves. Where this is not possible, place identification as close as possible, preferable on upstream side.
 - .9 Identification easily and accurately readable from usual operating areas and from access points.
 - .1 Position of identification approximately at right angles to most convenient line of sight, considering operating positions, lighting conditions, risk or personal damage or injury and reduce visibility over time due to dust and dirt.
-

3.6 LOCATION OF VALVE IDENTIFICATION ELEMENTS

- .1 Valves and operating controllers, except at plumbing fixtures, radiation, or where in plain sight of equipment they serve: secure tags with non-ferrous chains or closes "S" hooks.
- .2 Install one (1) copy of flow diagrams, valve schedules mounted in frame behind non-glare glass where directed by Departmental Representative. Provide one (1) copy (reduced in size if required) in each of the operating and maintenance manual.
- .3 Number valves in each system consecutively.
- .4 Identify all fittings located in between ceilings on suspended ceiling tees or access traps using P-touch labels.

3.7 PAINTING FOR EXPOSED PIPING AND DUCTS

- .1 Unless otherwise indicated, clean and degrease all piping and air ducts in visible ceilings spaces before painting.
- .2 Exposed ceilings spaces: spaces above suspended ceilings where mechanical elements are visible to the occupants. For example, mechanical elements over spaced wooden slat ceilings.
- .3 These painting works are executed by the General Contractor.

3.8 CLEANING

- .1 Proceed in accordance with Section 01 74 11 – Cleaning.
- .2 Upon completion and verification of performance of installation, remove surplus materials, waste, tools and equipment.

END OF SECTION

Part 1 General**1.1 SUMMARY**

- .1 TAB is used throughout this section to describe the process, methods and requirements of testing, adjusting and balancing for HVAC.
- .2 TAB means to test, adjust and balance to perform in accordance with requirements of Contract Documents and to do other work as specified in this section.

1.2 RELATED REQUIREMENTS

- .1 The requirements of section 23 05 00 – Common Work Results for HVAC are an integral part of this section.
- .2 The requirements of section 01 91 13 - General requirements are an integral part of this section.

1.3 REFERENCE STANDARDS

- .1 Perform TAB of mechanical systems over full operating range in accordance with the strictest requirements of the following organizations:
 - .1 AABC (Associated Air Balance Council), MN-1-2002 (National Standards for Total System Balance).
 - .2 ASHRAE (American Society of Heating Refrigeration and Air Conditioning Engineers).
 - .3 NABC (National Air Balance Council).
 - .4 TABES (Procedural Standards for Testing, Adjusting, Balancing of Environmental Systems – 1998).
 - .5 SMACNA (Sheet Metal and Air Conditioning Contractors National Association), HVAC TAB HVAC Systems (Testing, Adjusting and Balancing – 2002).
 - .6 Public Works and Government Services Canada (MD 15128; Laboratory fume hoods: Guidelines for owners, design professionals and maintenance personnel).
 - .7 The requirements of this section or another section of the Contract Documents.

1.4 GENERAL

- .1 TAB: means to test, adjust and balance all systems, including equipment, to perform in accordance with contract documents.
 - .2 FPT: means flow rate and pressurization tests.
 - .3 FPTR: means flow rate and pressurization tests report.
 - .4 PPT: means performance and pressurization tests.
-

- .5 PPTR: means performance and pressurization tests reports.
- .6 Follow start-up procedures as recommended by manufacturers.
- .7 Special start-up procedures may be specified elsewhere.
- .8 Perform TAB and FPT only when work is essentially completed, including:
 - .1 Installation of ceilings, doors, windows and other elements affecting TAB and FPT.
 - .2 Application of sealing and caulking, as well as weather stripping.
 - .3 Start-up by Subcontractors responsible for work involving mechanical installations and systems.
 - .4 DCC Representative's approval.

1.5 QUALIFICATIONS OF TAB PERSONNEL

- .1 TAB: performed in accordance with the requirements of standard.
 - .1 Associated Air Balance Council (AABC), National Standards for Total System Balance, MN-1-2002.
 - .2 National Environmental Balancing Bureau .1.2 (NEBB) TABES, Procedural Standards for Testing, Adjusting, Balancing of Environmental Systems, 1998.
 - .3 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA), HVAC TAB HVAC Systems – Testing, Adjusting and Balancing-2002.
- .2 Recommendations and suggested practices contained in the TAB Standard: mandatory.
- .3 Use TAB Standard provisions, including checklists and report forms to satisfy Contract requirements.
- .4 Use TAB Standard.
- .5 Where instrument manufacturer calibration recommendations are more stringent than those listed in TAB Standard, use manufacturer's recommendations.
- .6 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 applicable to Contract requirements have been published or adopted by body responsible for TAB Standard (AABC, NEBB or TABB), requirements and recommendations contained in these procedures and requirements are mandatory.

1.6 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 and 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 range.

1.7 EXCEPTIONS

- .1 TAB of systems and equipment regulated by codes, standards to satisfaction of authority having jurisdiction.

1.8 COORDINATION

- .1 Schedule time required for TAB (including repairs and re-testing) into project construction schedule to ensure completion before acceptance of project.

1.9 PRE-TAB REVIEW

- .1 Review manufacturing documentation submitted by the Contractor before project construction is started and confirm in writing to the Departmental Representative adequacy of provision for TAB and other aspects of design and installation pertinent to success of TAB.
- .2 Review specified standards and other reference documents and notify the Departmental Representative in writing of proposed procedures which vary from standard.
- .3 During construction, coordinate location and installation of TAB devices, equipment, accessories, measurement ports and fittings.

1.10 START-UP

- .1 Unless otherwise specified, follow start-up procedure as recommended by equipment manufacturer.
- .2 Follow special start-up procedures specified elsewhere in Division 23.

1.11 OPERATION OF SYSTEMS DURING TAB

- .1 Operate systems for length of time required for TAB and as required by the Departmental Representative for verification of TAB reports.
-

1.12 START OF TAB

- .1 Start TAB when building is essentially completed, including:
 - .1 Installation of ceilings, doors, windows and other building elements affecting TAB;
 - .2 Application of weather stripping, sealing and caulking;
 - .3 Pressure, leakage and other tests specified elsewhere in Division 23 have been completed;
 - .4 Provisions for TAB installed and operational;
 - .5 Start-up, verification for proper operation of mechanical and associated electrical and control systems affecting TAB including but not limited to the elements below.
 - .6 Proper thermal overload protection in place for electrical equipment.
 - .7 Air systems:
 - .1 Filters in place and clean.
 - .2 Duct systems clean.
 - .3 Ducts, air shafts, ceiling plenums airtight to within specified tolerances.
 - .4 Correct fan rotation.
 - .5 Fire and smoke volume control dampers installed and open.
 - .6 Access doors and panels installed and closed.
 - .7 Outlets installed and volume control dampers open.

1.13 ACCURACY TOLERANCES

- .1 Measured values accurate to within plus or minus 5% of actual values.

1.14 SUBMITTALS

- .1 Submittals: in accordance with submittals required under Section 01 33 00 – Documents and samples to be submitted.
- .2 Submit, prior to commencement of TAB:
- .3 Proposed methodology and procedures for performing TAB if different from referenced standard.

1.15 TAB REPORT

- .1 Format of report in accordance with referenced TAB standard.

-
- .2 TAB report to show results in SI units and to include:
 - .1 Project record drawings;
 - .2 System schematics.
 - .3 Submit six (6) copies of TAB report to Departmental Representative for verification and approval, in English and French, presented in D-ring binders, complete with index tabs.
 - .4 Verification:
 - .1 Reported results subject to verification by the DCC Representative. Provide personnel and instrumentation to verify up to 30% of reported results. Number and location of verified results as directed by DCC Representative.
 - .2 Pay costs to repeat TAB as required to satisfaction of DCC Representative.
 - .5 Settings: Lock devices in set positions and settings permanently marked.
 - .6 Measurements as required by reference standards for air handling units include but are not limited to the following:
 - .1 Measurements:
 - .1 Air velocity.
 - .2 Static pressure.
 - .3 Velocity pressure.
 - .4 Temperature:
 - .1 Dry bulb.
 - .2 Wet bulb.
 - .5 Cross-sectional area.
 - .6 RPM.
 - .7 Electrical characteristics:
 - .1 Voltage.
 - .2 Current draw.
 - .2 Location of equipment measurements:
 - .1 Inlet and outlet of each:
 - .1 Fan.
 - .2 Coil.
 - .3 Filter.
 - .4 Damper.
 - .5 Other auxiliary equipment (dust collector).
-

- .3 Location of systems measurements at:
 - .1 Main ducts.
 - .2 Main branch ducts.
 - .3 Sub-branch ducts.
 - .4 Each supply, exhaust and return air inlet and outlet.
 - .5 Each grille and air diffuser.
 - .6 Other auxiliary equipment.
 - .7 All areas served by system.
- .4 Other locations:
 - .1 Air velocity at the face of each hood (indicated on fume hood schedule) for three different door positions.
 - .2 Outlet of storage cabinets (solvent, acids, vacuum pumps, etc.).
 - .3 Outlet of specialized equipment (autopsy table, etc.)
 - .4 At each longitudinal exhaust branch.

1.16 VERIFICATION

- .1 Reported results subject to verification by Departmental Representative.
- .2 Provide personnel and instrumentation to verify up to 30% of reported results.
- .3 Number and location of verified results as directed by Departmental Representative.
- .4 Pay costs to repeat TAB as required to satisfaction of Departmental Representative.

1.17 SETTINGS

- .1 After TAB is completed to satisfaction of Departmental Representative, replace drive guards, close access doors, lock devices in set positions, ensure sensors are at required settings.
- .2 Permanently mark settings to allow restoration at any time during life of facility. Do not eradicate or cover markings.

1.18 COMPLETION OF TAB

- .1 TAB considered complete when final TAB Report received and approved by Departmental Representative.

1.19 AIR SYSTEMS

- .1 Standard: TAB to most stringent of this section or TAB standards of AABC, NEBB, SMACNA and ASHRAE.

- .2 Do TAB of systems, equipment, components and controls as specified in Division 23.
- .3 AB operations shall be conducted in accordance with AABC or NEBB standards.
- .4 Measurements: to include as appropriate for systems, equipment, controls: air velocity, static pressure, flow, pressure drop (or loss), temperatures (dry bulb, wet bulb, dewpoint), duct cross-sectional area, RPM, electrical power, voltage, noise and vibration.
- .5 Locations of equipment measurements: to include as appropriate:
 - .1 Inlet and outlet of dampers, filter, coil, humidifier, fan, other equipment causing changes in conditions.
 - .2 At controllers and controlled devices.
- .6 Locations of systems measurements to include as appropriate: main ducts, main branch, sub-branch, run-out (or grille, register or diffuser).

Part 2 List of Tabs**2.1 DESCRIPTION OF FPT**

- .1 General:
 - .1 The FPT lists only represent a minimum of activities for which Subcontractor shall submit a complete and documented report. However, these lists are not restrictive and they do not relieve Subcontractor of his responsibility to supply all labor, material and equipment required to adjust and balance systems until adequate operation.
 - .2 FPTR shall include results of measures under table format.
 - .3 Pressurization diagram included in drawings gives airflow transfer values from one room to another in order to generate pressure differentials. These airflow transfer values are the airflow values to attain.
 - .4 FPTR shall include room pressurization tests results in tables, as follows:
 - .1 Pressure differential measured on the premises.
 - .2 Room supply airflow.
 - .3 Room exhaust airflows.
 - .4 Make sure that Subcontractor in charge of work to be performed as part of Section 23 05 00 has replaced all filters with brand new filters before performing tests.

Part 3 Products

- .1 N/A.

Part 4 Execution

- .1 N/A.

END OF SECTION

Part 1 GENERAL**1.1 RELATED SECTIONS**

- .1 The requirements of section 23 05 00 – Common Work Results for HVAC are an integral part of this section.
- .2 The requirements of section 01 91 13 – Requirements are an integral part of this section.

1.2 REFERENCES

- .1 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
 - .2 Sheet Metal and Air Conditioning Contractor's National Association (SMACNA).
 - .1 SMACNA HVAC Duct Air Leakage Test Manual, 1985.

1.3 SUBMITTALS

- .1 Make submittals in accordance with Section 01 33 00 – Documents and samples to be submitted.
 - .2 Test Reports: Submit certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties. Include pressure test information and results as follows.
 - .1 Submit proposed report form and test report format to Departmental Representative for approval at least three (3) months before proposed date of first series of tests. Do not start tests until approval received in writing from Departmental Representative.
 - .2 Prepare report of results and submit to Departmental Representative within 24 hours of completion of tests. Include:
 - .1 Schematic of entire system.
 - .2 Schematic of section under test showing test site.
 - .3 Required and achieved static pressures.
 - .4 Orifice differential pressure at test sites.
 - .5 Permissible and actual leakage flow rate (L/s) for test sites.
 - .6 Witnessed certification of results.
 - .3 Include test reports in final TAB report.
 - .4 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
 - .5 Instructions: submit manufacturer's installation instructions.
 - .6 Manufacturer's field reports specified.
-

1.4 QUALITY ASSURANCE

- .1 Pre-installation Meetings:
 - .1 Convene pre-installation meeting one (1) week prior to beginning of work covered by this section and installation of equipment, holding a meeting in accordance with section 01 11 01 – General Instructions, in which must be considered :
 - .1 Verify project requirements.
 - .2 Review installation and substrate conditions.
 - .3 Co-ordination with other building subtrades.
 - .4 Review Manufacturer's installation instructions and warranty requirements.

1.5 HEALTH AND SAFETY

- .1 Do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety.

1.6 PRESSURE TESTING - DUCTS

- .1 The Subcontractor shall perform tests and verifications on sealed ducts and pipes manufactured, supplied and installed under the terms of this contract and specifications for all systems, but not limited to:
 - .1 Air supply systems: all ducts from grilles or other supply point to supply fan.
 - .2 Air exhaust system: all ducts from grilles or other exhaust point up to exhaust fan.
 - .3 Small ventilation systems.
 - .2 Do not perform leak tests on air transfer ducts.
 - .3 The Subcontractor shall perform all seal tests on all required ducts to demonstrate that duct sealing meets requirements specified in this section.
 - .4 The Subcontractor shall seal all pipes and ducts found defective, without additional compensation.
 - .5 The Subcontractor shall fabricate and seal all ducts so that leakage rates do not exceed the maximum allowed.
 - .6 Provide all labor, equipment and tools necessary to achieve all duct leak testing.
 - .7 Perform leak test as per procedures of HVAC Air Duct Leakage Test Manual, first edition 1985 published by SMACNA.
 - .8 Seal all ducts whose leakage rates are higher than those measured by the test method. Repeat tests until results comply with the test procedure requirements. The Subcontractor shall seal the ducts and proceed with further testing, if necessary, without additional compensation.
-

- .9 Complete testing before ducts are covered, concealed and insulated.
- .10 Ducts tested shall not show excessive deformation or leaks, as specified in reference standards. Tests shall be repeated, as necessary, until the results meet the standards requirements.

Part 2 PRODUCTS

2.1 TEST INSTRUMENTS

- .1 Test apparatus to include:
 - .1 Fan capable of producing required static pressure.
 - .2 Duct section with calibrated orifice plate mounted and accurately located pressure taps.
 - .3 Flow measuring instrument compatible with the orifice plate.
 - .4 Calibration curves for orifice plates used.
 - .5 Flexible duct for connecting to ductwork under test.
 - .6 Smoke bombs for visual inspections.
- .2 Test apparatus: accurate to within $\pm 3\%$ of flow rate and pressure.
- .3 Submit details of test instruments to be used to Departmental Representative at least three (3) months before anticipated start date.
- .4 The instruments: calibrated and certificate of calibration deposited with Departmental Representative no more than 28 days prior to testing.
- .5 Re-calibrated every six (6) months.

2.2 EQUIPMENT LEAKAGE TOLERANCES

- .1 Equipment and system components such as VAV boxes, duct heating leakage: 1%.

Part 3 EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 TEST PROCEDURES

- .1 Maximum length of ducts to be tested consistent with capacity of test equipment.
- .2 Section of duct to be tested to include fittings, branch ducts and tap-ins.

- .3 Repeat tests until specified pressures are attained. Bear costs for repairs and repetition of tests.
- .4 Base partial system leakage calculation on SMACNA HVAC Air Duct Leakage Test Manual.
- .5 Seal leaks that can be heard or felt, regardless of their contribution to total leakage.

3.3 SITE TOLERANCES

- .1 System leakage tolerances specified are stated as percentage of total flow rate handled by system. Pro-rate specified system leakage tolerances. Leakage for sections of duct systems: not to exceed total allowable leakage.
- .2 Leakage tests on following systems not to exceed specified leakage rates.

3.4 AIR LEAKAGE RATE

- .1 For leak tests use the lowest leak rate between the two following methods:
 - .1 Sealtight class:
 - .1 Refer to Sections 23 31 13.01 and 23 31.13.02 for the classification of air ducts, class sealing and tightness class.
 - .2 Test results must be evaluated based on following two parameters:
 - .1 Effective surface area of duct
 - .2 Its internal pressure.
 - .2 Percentage:
 - .1 Duct systems up to 250 Pa: 2% acceptable leakage rate.
 - .2 Duct systems up to 500 Pa: 2% acceptable leakage rate.
 - .3 High pressure duct systems up to 1000 Pa, including ducts upstream of VAV boxes: 1% acceptable leakage rate.
 - .4 Return and exhaust ducts, including fresh air ducts and other ducts with a negative operating pressure: 2% acceptable leakage rate.

3.5 TESTING

- .1 Test ducts before installation of insulation or other forms of concealment.
- .2 Test after seals have cured.
- .3 Test when ambient temperature will not affect effectiveness of seals and gaskets.
- .4 Flexible connections to VAV boxes.

3.6 FIELD QUALITY CONTROL**.1 Manufacturer's Field Services**

- .1 Have manufacturer of products supplied under this section, review work involved in the handling, installation/application, protection and cleaning, of products and then submit written reports, in acceptable format, to verify compliance of work with Contract.
- .2 Manufacturer's Field Services: provide manufacturer's field services consisting of product use recommendation and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
- .3 Schedule site visits, to review work, at stages listed:
 - .1 After delivery and storage of products, and when preparatory work, or other work, on which the work of this section depends, is complete but before installation begins.
 - .2 Twice during the progress of work at 25% and 60% complete.
 - .3 Upon completion of the work, after cleaning is carried out.
- .4 Obtain reports within three (3) days of review, and submit, immediately, to the Departmental Representative.

.2 Performance Verification

- .1 The Departmental Representative to witness tests and to verify reported results.
- .2 To be certified by same TAB agency approved by Departmental Representative to undertake TAB on this project.

3.7 CLEANING

- .1 Upon completion and verification of performance of installation, remove surplus materials, waste materials, tools and equipment.

END OF SECTION

Part 1 General**1.1 RELATED REQUIREMENTS**

- .1 The prescriptions for the section 23 05 00 -HVAC- General Requirements concerning the work results, are both integral parts of this present section.
- .2 Definitions :
 - .1 For purposes of this section:
 - .1 "CONCEALED" - insulated mechanical services and equipment in suspended ceilings and non-accessible chases and furred-in spaces.
 - .2 "EXPOSED" - means "not concealed" as previously defined.
 - .3 Insulation systems - insulation material, fasteners, jackets and other accessories.
 - .2 TIAC Codes:
 - .1 CRD: Code Round Ductwork,
 - .2 CRF: Code Rectangular Finish.
 - .3 Other codes as indicated in present section.
- .3 Acoustic coatings for air ducts are prescribed in this section and form an integral part thereof.
- .4 The terms "duct(s)" and "air duct(s)" include all plenums and accessories connected to them.

1.2 REFERENCES

- .1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
 - .1 ANSI/ASHRAE/IESNA 90.1-04, SI; Energy Standard for Buildings Except Low-Rise Residential Buildings.
 - .2 ASTM International Inc.
 - .1 ASTM B209M-07, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric).
 - .2 ASTM C335-05ae1, Standard Test Method for Steady State Heat Transfer Properties of Pipe Insulation.
 - .3 ASTM C411-05, Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.
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- .4 ASTM C449/C449M-00, Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.
- .5 ASTM C547-07e1, Standard Specification for Mineral Fiber Pipe Insulation.
- .6 ASTM C553-02e1, Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
- .7 ASTM C612-04e1, Standard Specification for Mineral Fiber Block and Board Thermal Insulation.
- .8 ASTM C795-03, Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.
- .9 ASTM C921-03a, Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.
- .3 Canadian General Standards Board (CGSB)
 - .1 CGSB 51-GP-52Ma-89, Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.
- .4 Green Seal Environmental Standards (GSES)
 - .1 Standard GS-36-00, Commercial Adhesives.
- .5 Thermal Insulation Association of Canada (TIAC): National Insulation Standards (2005).
- .6 Underwriters Laboratories of Canada (ULC)
 - .1 CAN/ULC-S102-03, Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.
 - .2 CAN/ULC-S701-05, Standard for Thermal Insulation, Polystyrene, Boards and Pipe Covering.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Documents and samples to be submitted.
- .2 Product Data:
 - .1 Provide manufacturer's printed product literature and datasheets for air duct insulation and include product characteristics, performance criteria, physical size, finish and limitations including the following data.
 - .1 Description of equipment and materials including manufacturer's name, type, model, year, airflow and capacity.
 - .2 Details of operation, servicing and maintenance.
 - .3 Recommended spare parts list.

- .2 Provide two (2) copies of WHMIS MSDS – Material Safety Data Sheets in accordance with Section 01 35 29.06 – Health and Safety Requirements, and 01 35 43 – Environmental Procedures.
- .3 Samples:
 - .1 Submit for approval: complete assembly of each type of insulation system, insulation, coating, and adhesive proposed.
 - .2 Mount sample on 12 mm plywood board.
 - .3 Affix typewritten label beneath sample indicating service.
- .4 Manufacturers' Instructions:
 - .1 Provide manufacture's written duct insulation jointing recommendations, and special handling criteria, installation sequence and cleaning procedures.

1.4 QUALITY ASSURANCE

- .1 Certificates
 - .1 Submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .2 Installation Instructions
 - .1 Submit manufacturer's installation instructions.
 - .2 The Departmental Representative will make available one (1) copy of systems supplier's installation instructions.

1.5 QUALIFICATIONS:

- .1 The installer shall be an expert in the field, performing work of the type described herein.

1.6 HEALTH AND SAFETY:

- .1 Do construction occupational health and safety in accordance with 01 70 12 – Health and Safety.

1.7 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle in accordance with Section 01 61 00 - General Product Requirements.
- .2 Deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Store at temperatures and conditions recommended by manufacturer.
- .4 Packaging Waste Management: in accordance with Section 01 74 19 - Management and Disposal waste.

Part 2 Products**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 INSULATION

- .1 Mineral fibre: as specified, includes glass fibre, rock wool, slag wool.
 - .2 Thermal conductivity ("k" factor) not to exceed specified values at 24 degrees C mean temperature when tested in accordance with ASTM C335.
 - .3 TIAC Code C-1: Rigid mineral fibre board to ASTM C612, with and without factory applied vapour retardant jacket to CGSB 51-GP-52Ma. Provide this insulation as scheduled in Part 3 of this section.
 - .4 TIAC Code C-2: Mineral fibre blanket to ASTM C553 faced with factory applied vapour retardant jacket to CGSB 51-GP-52Ma. Provide this insulation as scheduled in Part 3 of this section.
 - .1 Mineral fibre: to ASTM C553.
 - .2 Jacket: to CGSB 51-GP-52Ma.
 - .3 Maximum "k" factor: to ASTM C553.
 - .5 Internal acoustical insulation, code number C-A.
 - .1 Square and rectangular ducts
 - .1 Johns Manville brand flexible fiberglass liner, model Linacoustic RC, for internal treatment of ducts with black fiber braiding. Liner thickness to be as specified, with a sound absorption coefficient of 0.14 (minimum) at 250 hertz (for 13 mm thickness). Permacote acrylic reinforced liner. Between each section of liner, coat edge of insulation with Johns Manville Super Seal Edge Treatment.
 - .2 Attach liner with adhesive and fasteners. Adhesive shall be used in temperature range of -29°C to 93°C. Install a minimum of two rows of fasteners on each surface to be lined at a maximum of 425 mm centres.
 - .3 Install this type of insulation in the following locations:
 - .1 Inside diffuser supply air plenums (13mm).
 - .2 Inside all air transfer ducts (25 mm).
 - .3 As indicated on drawings.
 - .4 Other acceptable products: Manson Akousti-Liner, Knauf Ecose.
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2.3 JACKETS

- .1 Adhesive jacketing tape
 - .1 Self-adhesive, vapor barrier and UV resistant white tape.
 - .2 Acceptable products: 3M VentureClad 1577CW or équivalent.
- .2 Canvas:
 - .1 220 g/m² cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C921. Canvas ready to be painted.
- .3 Aluminum:
 - .1 To ASTM B209 with and without moisture barrier as scheduled in PART 3 of this section.
 - .2 Thickness: 0.50 mm sheet.
 - .3 Finish: Corrugated.
 - .4 Jacket banding and mechanical seals: 19 mm wide, 0.5 mm thick stainless steel.
- .4 Stainless steel:
 - .1 Steel grade : 316.
 - .2 Thickness: 0,25 mm sheet.
 - .3 Finish: textured surface.
 - .4 Retaining strips and mechanical seals : stainless steel, 0,5 mm thick, 19 mm width.

2.4 ACCESSORIES

- .1 Adhesives and coatings shall be free of volatile organic compounds (VOCs).
 - .2 Vapour retardant lap adhesive:
 - .1 Water based, fire retardant type, compatible with insulation.
 - .3 Indoor Vapour Retardant Finish:
 - .1 Vinyl emulsion type acrylic, compatible with insulation.
 - .4 Insulating Cement: hydraulic setting on mineral wool, to ASTM C449.
 - .5 ULC Listed Canvas Jacket:
 - .1 220 g/m² cotton, plain weave, treated or untreated with dilute fire retardant lagging adhesive to ASTM C92.
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- .6 Outdoor Vapour Retardant Mastic:
 - .1 Vinyl emulsion type acrylic, compatible with insulation.
 - .2 Reinforcing fabric: Fibrous glass, untreated 305 g/m².
- .7 Tape: self-adhesive, aluminum, reinforced 75 mm wide minimum.
- .8 Contact adhesive: quick-setting
- .9 Canvas adhesive: washable.
- .10 Tie wire: 1.5 mm stainless steel.
- .11 Banding: 12 mm wide, 0.5 mm thick stainless steel.
- .12 Facing: 25 mm galvanized steel hexagonal wire mesh stitched on one face of insulation and insulation with expanded metal lath on other face.
- .13 Fasteners: 4 mm diameter pins with 35 mm diameter clips, length to suit thickness of insulation.

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 PRE-INSTALLATION REQUIREMENTS

- .1 Pressure test ductwork systems complete, witness and certify.
- .2 Ensure surfaces are clean, dry and free from foreign material.

3.3 INSTALLATION

- .1 Install in accordance with TIAC National Standards.
- .2 Apply materials in accordance with manufacturer's instructions and as indicated.
- .3 Use 2 layers with staggered joints when required nominal thickness exceeds 75 mm.
- .4 Maintain uninterrupted continuity and integrity of vapour retardant jacket and finishes.
 - .1 Ensure hangers and supports are outside vapour retardant jacket.
- .5 Hangers and supports in accordance with Section 23 05 29 - Hangers and Supports for HVAC Pipes and Equipment.
 - .1 Apply high compressive strength insulation where insulation may be compressed by weight of ductwork.

- .6 Fasteners: install at 300 mm on centre in horizontal and vertical directions, minimum 2 rows each side.

3.4 TABLE - CALORIFIC AND OTHER AIR DUCT COVERINGS

- .1 Unless otherwise specified, air ducts shall be covered with insulation of the types and thicknesses prescribed in the following table in addition to other requirements.
- .2 Insulation types and thicknesses: conform to following table:

	TIAC (or code)	Code other	Vapour Retardant	Thickness (mm)
Conduits from outside the building to a distance of 3m inside the building.	C-1		yes	50
Air transfer to be covered with internal acoustic insulation.				

3.5 JACKETING

- .1 Cover, with adhesive jacketing tape, the insulation of all ducts and plenums located inside of mechanical rooms and other technical rooms, including the insulation of all ducts and plenums located inside of the heat pumps room.
- .2 Cover with canvas the insulation of all exposed indoor ducts and plenums located outside of mechanical rooms and other technical rooms.
- .3 Also cover with canvas all insulated supply ducts running over openwork suspended ceilings. See architecture drawings.
- .4 Cover with aluminum the insulation of all outdoor ducts and plenums.

3.6 CLEANING

- .1 Clean in accordance with Section 01 74 11 - Cleaning.
- .1 Remove the site materials / equipment surplus, waste, tools and equipment.
- .2 Waste Management: in accordance with Section 01 74 21 - Management and disposal of construction / demolition waste.

END OF SECTION

Part 1 General**1.1 RELATED REQUIREMENTS**

- .1 The prescriptions for the section 22 05 00 -Piping- General Requirements concerning the work results, are both integral parts of this present section.

1.2 REFERENCES

- .1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
 - .1 ANSI/ASHRAE 90.1-04-SI Edition, 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-04, Standard Specification for Aluminum and Aluminum Alloy Sheet and Plate [Metric].
 - .2 ASTM C335-04, Standard Test Method for Steady State Heat Transfer Properties of Horizontal Pipe Insulation.
 - .3 ASTM C411-04, Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.
 - .4 ASTM C449/C449M-00, Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.
 - .5 ASTM C533-2004, Calcium Silicate Block and Pipe Thermal Insulation.
 - .6 ASTM C547-2003, Mineral Fiber Pipe Insulation.
 - .7 ASTM C795-03, Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.
 - .8 ASTM C921-03a, Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.
 - .3 Canadian General Standards Board (CGSB)
 - .1 CGSB 51-GP-52Ma-89, Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.
 - .2 CAN/CGSB-51.53-95, Poly (Vinyl Chloride) Jacketing Sheet, for Insulated Pipes, Vessels and Round Ducts.
 - .4 Department of Justice Canada (Jus)
 - .1 Canadian Environmental Assessment Act (CEAA), 1995, c. 33.
 - .2 Canadian Environmental Protection Act (CEPA), 1999, c. 33.
 - .3 Transportation of Dangerous Goods Act (TDGA), 1992, c. 34.
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- .5 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
- .6 Manufacturer's Trade Associations
 - .1 Thermal Insulation Association of Canada (TIAC): National Insulation Standards (Revised 2004).
- .7 Underwriters' Laboratories of Canada (ULC)
 - .1 CAN/ULC-S102-03, Surface Burning Characteristics of Building Materials and Assemblies.
 - .2 CAN/ULC-S701-01, Thermal Insulation, Polystyrene, Boards and Pipe Covering.
 - .3 CAN/ULC-S702-1997, Thermal Insulation, Mineral Fibre, for Buildings.
 - .4 CAN/ULC-S702.2-03, Thermal Insulation, Mineral Fibre, for Buildings, Part 2: Application Guidelines.

1.3 DEFINITIONS

- .1 For the purposes of this section:
 - .1 "Concealed" – insulated mechanical services and equipment trenches and pipe shafts in hung ceilings and non-accessible chases and furred-in spaces.
 - .2 "Exposed" – will mean "not concealed" as defined herein.
- .2 TIAC codes:
 - .1 CRF: Code Rectangular Finish.
 - .2 CPF: Code Piping Finish (Plumbing).

1.4 SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 – Documents and samples to be submitted.
- .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.
 - .2 Provide two (2) copies of WHMIS MSDS – Material Safety Data Sheets in accordance with Section 01 35 29.06 – Health and Safety, and 01 35 43 – Environmental Procedures.

- .3 Samples:
 - .1 Provide for approval: complete assembly of each type of insulation system, insulation, coating, and adhesive proposed.
 - .1 Mount sample on 12-mm plywood board.
 - .2 Affix typewritten label beneath sample indicating service.
- .4 Manufacturer's Instructions:
 - .1 Include procedures to be used and installation standards to be achieved.

1.5 QUALITY ASSURANCE

- .1 Certificates
 - .1 Submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .2 Installation Instructions
 - .1 Submit manufacturer's installation instructions.

1.6 QUALIFICATIONS

- .1 Installer to be specialist in performing work of this section, and have at least three (3) years successful experience in this size and type of project, qualified to standards of TIAC.

1.7 HEALTH AND SAFETY:

- .1 Do construction occupational health and safety in accordance with 01 35 29.06 – Health and Safety.

1.8 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle 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 Store at temperatures and conditions recommended by manufacturer.
- .4 Packaging Waste Management: in accordance with Section 01 74 21 – Management and disposal of construction / demolition waste.

1.9 OPERATING TEMPERATURES

- .1 Operating temperatures for the equipment are as follows:
 - .1 Condensate and drainage: 104°C.
 - .2 Steam: 176.6°C.
-

1.10 SCOPE OF WORK

- .1 Insulate the following networks to suit the operating temperatures specified above and materials specified in Part 2.
 - .1 Condensate and drainage.
 - .2 Steam.
 - .3 This list is not exhaustive and does not relieve the Contractor of his responsibility to provide a complete installation in accordance with the regulations on energy conservation in new buildings (province of Quebec: *Réglement sur l'économie d'énergie dans les nouveaux bâtiments*).

Part 2 Products**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 INSULATION

- .1 Mineral fiber
 - .1 Glass fibre, rock wool and slag wool
 - .1 Inorganic fibers include glass wool, rock wool and slag wool.
 - .2 The thermal conductivity coefficient ("k") shall not exceed the specified values at 24°C mean temperature when tested in accordance with ASTM C335.

2.3 CEMENT

- .1 Thermal insulating and finishing
 - .1 To: ASTM C449/C449M.
 - .2 Air-drying on mineral wool, to ASTM C449.

2.4 TAPES, ADHESIVES AND FASTENINGS

- .1 Self-adhesive tape, 100 mm wide, rated for less than 25 flame spread and less than 50 smoke development.
- .2 Contact adhesive: quick-setting, non-flammable fire resistive adhesive to adhere insulation material to equipment and tanks. Flame spread 15, smoke development 0.

- .3 For insulation type E-5:
 - .1 Contact adhesive: quick setting for transverse and longitudinal joints of flexible unicellular insulation, Flame spread 5, smoke development 0, Armaflex 520.
- .4 Tie wire: 1.5 mm diameter stainless steel.
- .5 Bands: stainless steel, 19 mm wide, 0.5 mm thick

2.5 COATING

- .1 Systems E-5
 - .1 Finish coating type WB Armaflex, white color.
- .2 Vapour retarder finish
 - .1 Indoor piping
 - .1 Vinyl emulsion, acrylic type, compatible with insulation.
 - .2 Outdoor piping
 - .1 Vinyl emulsion, acrylic type, compatible with insulation.
 - .2 Reinforcing fabric: fibrous glass, untreated, 305 g/m².

2.6 JACKETS

- .1 Canvas
 - .1 120 g/m² cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C921.
 - .2 Lagging adhesive: compatible with insulation.

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 PRE-INSTALLATION REQUIREMENTS

- .1 Pressure testing of equipment and adjacent piping systems complete, witnessed and certified.
- .2 Surfaces clean, dry and free from foreign material.

3.3 INSTALLATION

- .1 Install in accordance with TIAC National Standards.
 - .1 Hot equipment: to TIAC code 1503-H.
 - .2 Cold equipment: to TIAC code 1503-C.
- .2 Apply materials in accordance with insulation and equipment manufacturer's instructions and this specification.
- .3 Use two (2) layers with staggered joints when required nominal wall thickness exceeds 75 mm.
- .4 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.
 - .1 Hangers and supports outside vapour retarder jacket.
- .5 Supports and hangers:
 - .1 Apply high compressive strength insulation, suitable for service, where insulation saddles and shoes have not been provided.
- .6 Elastomeric insulation: to remain dry. Overlaps as manufacturer's instructions. Joints tight and sealed properly.
- .7 Provide vapour retarder as recommended by manufacturer.

3.4 ELASTOMERIC INSULATION

- .1 Insulation shall remain dry. Overlap as manufacturer's instructions. Ensure tight joints.
- .2 Provide vapour retarder as recommended by manufacturer.

3.5 PIPING INSULATION SCHEDULES

- .1 Unless otherwise specified, insulation of pipes includes valves, valve bonnets, filters and strainers, flanges and fittings.
 - .2 TIAC Code: A-1.
 - .1 Securements: bands at 300 mm on centre.
 - .2 Seals: lap seal adhesive, lagging adhesive.
 - .3 Installation: TIAC Code 1501-H.
 - .3 Thickness of insulation as listed in following table.
 - .1 Run-outs to individual units and equipment not exceeding 4000 mm long.
-

- .2 Do not insulate exposed run-outs to plumbing fixtures, chrome plated piping, valves, or fittings.

Piping/Service	Temp. °C	TIAC Code	Pipe Sizes (NPS) and Insulation Thickness (mm)					
			Run- out	to 1	1¼ to 2	2½ to 4	5 to 6	8 and larger
Steam	up to 175	A-1	38	50	65	75	90	90
Steam vent		A-1		38	38	38	38	38
Condensate return	60–94	A-1	25	38	38	38	38	38
Return and pumped condensate	up to 94	A-1	25	38	38	38	38	38

.4 **Finishes**

- .1 Exposed indoor piping: canvas jacket.
- .2 Exposed piping in mechanical rooms: canvas and PVC jacket.
- .3 Concealed indoor piping: canvas on valves and fittings. No further finish.
- .4 Use vapour retarder jacket on TIAC code A-3 insulation compatible with insulation.
- .5 Outdoor piping: waterproof aluminum jacket.
- .6 Finish attachments: SS screws at 150 mm on centre.
- .7 Installation: to appropriate TIAC code CRF/1 through CPF/5.

3.6 **CLEANING**

- .1 Clean in accordance with Section 01 74 11 – Cleaning.
 - .1 Remove surplus materials, rubbish, tools and equipment.
- .2 Waste Management: in accordance with Section 01 74 21 – Management and disposal of construction / demolition waste.

END OF SECTION

Part 1 General**1.1 RELATED SECTIONS**

- .1 The requirements of the section 23 05 00 - Common Work Results for HVAC are an integral part of this section.
- .2 Section 01 33 00 - Documents and samples to be submitted
- .3 Section 01 35 29.06 - Health and Safety
- .4 Section 01 74 21 - Management and disposal of construction / demolition waste
- .5 Section 23 05 94 – Pressure testing of Ducted Air systems

1.2 REFERENCES

- .1 *American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE).*
- .2 *American Society for Testing and Materials International, (ASTM).*
 - .1 ASTM A480/A480M-03c Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip
 - .2 ASTM A635/A635M-02, *Standard Specification for Steel, Sheet and Strip, Heavy-Thickness Coils, Carbon, Hot Rolled.*
 - .3 ASTM A653/A653M-03, *Standard Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process.*
 - .4 Canadian Environmental Protection Act (CEPA), 1999, c. 33.
- .3 Health Canada/Workplace Hazardous Materials Information System (WHMIS).
 - .1 Material Safety Data Sheets (MSDS).
- .4 *National Fire Protection Agency Association (NFPA).*
 - .1 NFPA 90A-02, *Standard for the Installation of Air-Conditioning and Ventilating Systems.*
 - .2 NFPA 90B-02, *Standard for the Installation of Warm Air Heating and Air-Conditioning Systems.*
 - .3 NFPA 96-01, *Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations.*
- .5 *Sheet Metal and Air Conditioning DCC representatives' National Association (SMACNA).*
 - .1 *SMACNA HVAC Duct Construction Standards - Metal and Flexible, 2nd Edition 1995 and Addendum No. 1, 1997.*
 - .2 *SMACNA HVAC Air Duct Leakage Test Manual, 1985, 1st Edition.*

.3 *SMACNA IAQ Guideline for Occupied Buildings Under Construction 1995, 1st Edition.*

.6 Transports Canada (TC).

.1 Transportation of Dangerous Goods Act (TDGA), 1992, c. 34.

1.3 DOCUMENTS/SAMPLES TO BE SUBMITTED

.1 Submit all technical specification sheets and shop drawings in accordance with section 01 33 00 - Documents and samples to be submitted.

.2 Technical specifications: Submit material safety data sheets required under the Work hazardous material information system (WMIS) which must be compliant with the WHMIS system according to section 02 81 01 - Hazardous Materials.

.3 Sealants

.1 Tape.

.2 Trademark prefabricated joints.

.3 Fittings.

1.4 SCOPE OF WORK

.1 Design, manufacture, supply and install all conduits, ducts, equipment and accessories required and / or shown on the drawings.

.2 Design, manufacture, supply and install duct systems according to the design criteria set forth in this section, and whose performance will also obtain the results listed in this section.

.3 Supply and install all necessary products to seal the duct systems comply with the requirements, sealing and testing of new pipes until satisfactory results.

1.5 GENERAL

.1 Neither design criteria mentioned in this section shall be considered restricted in comparison to the other. Use the design criteria the most restrictive.

.2 The Sealing classes are defined in order to establish a minimum criteria of duct sealing, the Subcontractor shall supply and install all the systems of sealing required to meet the other requirements, including requirements of the sealing classes, so that leakage levels comply with the sealing classes indicated.

1.6 COORDINATION

.1 The plans indicate an approximate location for the passage of new and existing equipment and ducts. Their exact location to be determined by the Subcontractor according to the projects architectural design, structure and power and according to the plans of the existing building and site surveys performed by the Subcontractor during the work. The Subcontractor shall verify on site space before submitting shop drawings.

- .2 Coordinate installation of duct systems with all the architectural, structural, mechanical and electrical extension and / or the existing building and renovation project. Coordinate especially the following:
 - .1 Localization of ducts in the ceiling: allow the passage of the ducts under the beams, when required.
 - .2 Locate all required openings in the structural elements in time for incorporation in the structural work
- .3 The Subcontractor may not claim additional amounts for carrying out work to be done by him in order to coordinate their needs with those of other disciplines and / or existing locations. If the dimensions of ducts should be changed to allow such coordination, the net area of ducts should be kept.
- .4 The Subcontractor shall perform, at its expense, all required openings and fillings, the dismantling and replacement of equipment and systems installed to coordinate its work with other disciplines.

1.7 QUALITY ASSURANCE

- .1 Data reliability techniques
 - .1 Data from catalogues and manufacturers' literature should be reliable, confirmed by tests to have been made by the manufacturers themselves or on their behalf by independent laboratories and certifying the compliance of the requirements of codes and standards.

1.8 HEALTH AND SAFETY

- .1 Take the necessary measures for health and safety in construction in accordance with Section 01 35 29.06 - Health and Safety

1.9 DELIVERY, STORAGE AND HANDLING

- .1 Protect on site stored or installed absorptive material from moisture damage.
- .2 Waste Management and Disposal
 - .1 Separate waste materials for reuse and/or recycling in accordance with Section 01 74 21 - Management and disposal of construction / demolition wast.
 - .2 Remove from site and dispose of packaging materials at appropriate recycling facilities.
 - .3 Collect and separate for disposal and packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.
 - .4 Separate for reuse and/or recycling and place in designated waste containers in accordance with Waste Management Plan.
 - .5 Place materials defined as hazardous or toxic in designated containers.

- .6 Handle and dispose of hazardous materials in accordance with CEPA, TDGA, Regional and Municipal regulations.
- .7 Fold up metal and plastic banding, flatten and place in designated area for recycling.

1.10 MANAGEMENT PLAN FOR THE INDOOR AIR QUALITY (IAQ)

- .1 Apply during the construction phase, the SMACNA guidelines for the air quality in occupied buildings and set out in the document entitled "Indoor Air Quality Guideline for Occupied Buildings Under Construction".

Part 2 Products

2.1 Classification of ducts

- .1 The category of static pressure (Pa) for the construction of air ducts for the system is as follows:

SYSTEM	OUTDOOR AIR (1)	SUPPLY (2)	RETURN OR EXHAUST (3)	EXHAUST (4)	CATEGORY OF SEAL
All system, excepted below	-500	+1500 / +500	-500	+500	A
WC Exhaust	--	--	-500	+500	A
Mechanical room systems	-500	+500	-500	+500	B
Fan coils	--	+500	-500	--	B

Note 1: Air duct from outside air to ventilation system.

Note 2: Air duct from the ventilation system to supply diffuser. When two categories are shown, the first applies to the portion of air duct between the ventilation system and the terminal unit and the second applies to the portion of air duct between the terminal unit and the grid or diffuser.

Note 3: Air duct from return or exhaust grilles or other discharge point, to fan or ventilation system. When two categories are shown, the first applies to the portion of the air duct between the diffuser and the terminal unit and the second applies to the portion of the air duct between the terminal unit and the fan.

Note 4: Air duct from the fan or the ventilation system to outside.

2.2 CATEGORY OF AIR DUCT TIGHTNESS

- .1 The category of air tightness of the ducts shall be determined according to data from the table below.

Types of duct	Pressure classes 500 Pa and less – Ref. SMACNA (positive and negative)
Rectangular duct	24
Round and oval ducts	12
Welded pipes	No leaks allowed

2.3 CATEGORY OF SEALING

- .1 The sealing categories are:

CLASSES	SEAL REQUIRED
A	All transverse joints, longitudinal joints, wall bushings, connections and duct penetrations sealed with a product and a sealing tape.
B	All transverse and longitudinal joints and connections sealed with a sealant, tape seal, or a thereof combination.
C	All transverse joints and connections sealed with gaskets, a product, a sealing tape or a combination thereof. Longitudinal joints unsealed.
D	Unsealed joints.

- .2 Sealing classes listed above are the minimum required sealing of the Subcontractor for all ducts. These minimums do not, however, release the Subcontractor from its responsibility to manufacture, supply and install all ducts so as not to exceed the maximum leakage rates stipulated in section 23 05 94. The Subcontractor shall provide and install all sealing equipment necessary to meet the requirements specified in present section and in section 23 05 94, without additional compensation.
- .3 If the opinion of the Subcontractor, the application of sealing classes defined in this section necessarily involves the use of welded joints at other locations, the Subcontractor shall include the cost of welded joints amount of the original submission.

2.4 FITTINGS

- .1 Fabrication: to SMACNA
- .2 Radiused elbows.
- .1 Rectangular: standard radius, short radius with single thickness turning vanes. Centreline radius: 1.5 times width of duct.
- .2 Round: smooth radius five piece. Centreline radius: 1.5 times diameter.
- .3 Mitred elbows, rectangular:
- .1 To 400 mm: with single double thickness turning vanes.
- .2 Over 400 mm: with double thickness turning vanes.
- .3 Not allowed on return air or exhaust air network
- .4 Branches:
- .1 Main Rectangular branch: with radius on branch 1.5 times width of duct 45 degrees entry on branch.
- .2 Main Round branch: enter main duct at 45 degrees with conical connection
- .3 Provide volume control damper in branch duct near connection to main duct.
- .4 Main duct branches: with splitter damper.

- .5 Leads secondary entrance at 45 ° equipped with a damper mounted in the main branch or secondary entrance leads to 90 ° including the register and the directional damper mounted in the main branch
- .5 Transitions:
 - .1 Diverging: 20 degrees maximum including angle.
 - .2 Converging: 30 degrees maximum including angle.
- .6 Offsets:
 - .1 Full short radius elbows as indicated.
- .7 Obstruction deflectors: maintain full cross-sectional area.
 - .1 Maximum included angles: as for transitions.
 - .2 The maximum opening angle must be the same as in the case of transition elements.

2.5 AIR DUCTS

- .1 General
 - .1 Thickness: according to SMACNA standards or as specified.
 - .2 Fabrication: according to SMACNA.
- .2 Joints: according to SMACNA and manufactured made joints. The flanged joints shall be considered to have a class A manufactured seal.
- .3 Round and oval ducts
 - .1 Construction:
 - .1 Ducts made of G90 galvanized steel : spiral ducts with factory-made fittings and accessories according to SMACNA.
 - .2 Transverse joints up to 915 mm with sleeve joints and sealing tape. Above 915 mm, Vanstone joints:
 - .1 90° elbow: made of 5 sections minimum.
 - .2 Fitting branches: conical T.
 - .3 Dimensions: the dimensions of ducts shown in the drawings were selected based on the parameters of air velocity and pressure loss. If certain duct dimensions are not available, select dimensions giving an equivalent diameter but never less. The Subcontractor will be responsible for coordinating the obstructions in the ceiling, mounted, etc.

- .4 The test procedures must be submitted by the Subcontractor to the Departmental representative for verification before running tests.
- .4 Rectangular ducts
 - .1 Materials
 - .1 G90 galvanized steel with lock forming quality, as per ASTM A653/A653M.
 - .2 Thickness: to SMACNA recommendations.
 - .2 Construction
 - .1 Ducts: factory fabricated, spiral wound, with matching fittings and specials to SMACNA.
 - .2 Transverse joints: welded proprietary duct joints SMACNA seal Class A and B.
 - .3 Use of inner reinforcing braces is prohibited. Duct design must incorporate required thickness for design pressures specified without the use of braces.
 - .3 Fittings
 - .1 Elbows: long radius, without baffles, bending radius corresponding to 1.5 x the width of the contractor.
 - .2 Fittings bypass: with branch cut at 45 degrees and 45 degrees bent branch.
 - .3 Sharp angle bends are not permitted.
 - .4 Application:
 - .1 All ducts, unless otherwise indicated.

2.6 ALUMINUM AIR DUCTS

- .1 Material
 - .1 Aluminum: Type 3003 H 14, according to ASHRAE.
 - .2 Thickness, manufacturing and building: according to ASHRAE.
- .2 Joints: according to ASHRAE, continuously welded.
- .3 Application:
 - .1 As indicated on drawings.

2.7 FIRE STOPPING

- .1 Retaining angles around duct, on both sides of fire separation in accordance with Section 07 84 00 – Fire stopping.

- .1 Ducts should not be distorted by the fire-stop material or its installation

2.8 SEALANT PRODUCTS

- .1 Sealant: Duct, polymer-based, fire retardant, oil resistant and can withstand temperatures ranging from 30 degrees Celsius to 93 degrees Celsius.

2.9 SEALANT TAPE

- .1 Sealing Tape: Glass fibber membrane, loose weave, treated with polyvinyl, 50 mm wide.

2.10 HANGERS AND SUPPORTS

- .1 Hangers and Supports: in accordance with Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.

- .1 Strap hangers: of same material as duct but next sheet metal thickness heavier than duct.

- .1 Maximum size duct supported by strap hanger: 500 mm.

- .2 Hanger configuration: to ASHRAE and SMACNA.

- .2 Hangers: black galvanized steel angle with black galvanized steel rods according to ASHRAE and SMACNA following table:

Duct size (mm) until 750	Angle size (mm) 25 x 25 x 3	Rode size (mm) 6
751 to 1050	40 x 40 x 3	6
1051 to 1500	40 x 40 x 3	10
1501 to 2100	50 x 50 x 3	10
2101 to 2400	50 x 50 x 5	10
2401 and greater	50 x 50 x 6	10

- .3 Round duct: hangers according to SMACNA and made of galvanized steel.

- .4 Fastener suspension

- .1 Attachment to the structure:

- .1 Concrete structure: bolt expansion.

- .2 Steel structure: manufactured attachments.

- .5 Maximum spacing of supports: 3 m
- .6 Provide and install all structural elements required to secure the brackets to the building structure. Cover all the structural elements of a layer of zinc rich paint, color chosen by the DCC representative.
- .7 All materials exposed to bad weather shall be hot dip galvanized after welding. All hardware attachment and bracing required must be stainless steel.
- .8 Roof duct supports:
 - .1 All materials exposed to bad weather shall be hot dip galvanized after welding. All hardware attachment and bracing required must be stainless steel.
 - .2 Fully recycled rubber base, 150 mm wide x 143 mm high, UV resistant and approved for installation on all types of roof area. Adapter and leg hot dip galvanized steel to accommodate a 42 mm profile. Maximum load 1330 kg.

Part 3 Execution

3.1 GENERAL

- .1 Do work in accordance with NFPA 90A, NFPA 90B, ASHRAE, SMACNA as indicated.
- .2 Unless otherwise stated, all ducts shall be constructed with G90 galvanized steel.
- .3 Do not break continuity of insulation vapour barrier with hangers or rods.
 - .1 Insulate strap hangers 100 mm beyond insulated duct. Ensure diffuser is fully seated.
- .4 Fasten vertical ducts in accordance with the requirements of relevant standards of ASHRAE and SMACNA standards relevant.
- .5 Install breakaway joints in ductwork on each sides of fire-stop partitions
- .6 Install proprietary manufactured flanged duct joints in accordance with manufacturer's instructions.
- .7 Manufacture duct in lengths and diameter to accommodate installation of acoustic duct lining.
- .8 Install the fire stop material in a way to avoid to twist air ducts. The General Contractor will be responsible for supplying and installing all fire seals in Section 07 84 00 - Fire stopping. The Mechanical Subcontractor shall coordinate this work with the General Contractor.

3.2 DUCT CLEANLINESS

- .1 Ducts, including all fittings, must be delivered clean to the job site, with their ends temporarily sealed with self-adhesive plastic film (lpde, polyethylene or pvc). These protections must only be removed one end at a time, at the time of connection. Upon acceptance of the work, the ductwork must be clean and free of dust and debris. Failure to comply with this article shall result in the ductwork having to be thoroughly cleaned by a specialist in this field at the ventilation Subcontractor's expense.

3.3 HANGERS

- .1 Strap hangers: install in accordance with SMACNA.
- .2 Angle hangers: complete with locking nuts and washers.
- .3 Hanger spacing : in accordance with ASHRAE and SMACNA as follows:

Duct size (mm)	Spacing (mm)
Up to 1500	3000
1501 and up	2500

3.4 WATERTIGHT DUCT

- .1 Provide watertight duct for:
 - .1 Fresh air intake boxes and ducts;
 - .2 Air exhaust boxes and ducts;
- .2 Shape the bottom of horizontal ducts without making any longitudinal joints.
 - .1 Weld end joints of the bottom plates and side.
 - .2 Seal all other joints using a product for sealing air ducts.
- .3 Slope horizontal branch ductwork down towards fume hoods served.
 - .1 Slope header ducts down toward risers.

3.5 JOINT SEALING

- .1 Apply sealant to outside of joint to manufacturer's recommendations.
- .2 Bed tape in sealant and recoat with a minimum of one coat of sealant to manufacturers recommendations.

3.6 AIR DUCT LEAKAGE TESTS

- .1 Refer to Section 23 05 94 - Pressure Testing of Ducted Air Systems.
- .2 Perform leak tests in accordance with the requirements contained in the HVAC Contractor Leakage Test Manual of SMACNA. Requirements of present section and section 23 05 94 have priority on SMACNA prescriptions.
- .3 Do leakage pass tests in sections.
- .4 Make preliminary test sealing (to detect air leakage) as directed, to check the quality of work.

- .5 Do not install additional ductwork until trial test has been passed.
- .6 Test section minimum of 30 m long with not less than three branch takeoffs and two 90 degrees elbows.
- .7 Complete test before performance insulation or concealment Work.

END OF SECTION

Part 1 General**1.1 SUMMARY**

- .1 Section Includes:
 - .1 Materials and installation for duct accessories including flexible connections, access doors, vanes and collars.

1.2 RELATED SECTIONS:

- .1 The requirements of Section 23 05 00 - Common Work Results For HVAC are an integral part of this section .
- .2 Section 01 33 00 - Documents and samples to be submitted.
- .3 Section 01 35 29.06 - Health and Safety.
- .4 Section 01 45 00 - Quality Control.
- .5 Section 01 74 21 - Management and disposal of construction / demolition waste.
- .6 Section 01 78 00 - Documents / Items to be submitted upon completion of work.

1.3 REFERENCES

- .1 Health Canada/Workplace Hazardous Materials Information System (WHMIS).
 - .1 Material Safety Data Sheets (MSDS).
- .2 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA).
 - .1 SMACNA - HVAC Duct Construction Standards - Metal and Flexible, 95.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00 - Documents and samples to be submitted.
 - .2 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and data sheet. Indicate the following:
 - .1 Flexible connections.
 - .2 Duct access doors.
 - .3 Turning vanes.
 - .4 Instrument test ports.
 - .2 Submit WHMIS MSDS in accordance with Section 02 81 01 - Hazardous Materials. Indicate VOC's for adhesives and solvents during application and curing.
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- .3 Test Reports: submit certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties.
 - .1 Certification of ratings: catalogue or published ratings to be those obtained from tests carried out by manufacturer or independent testing agency signifying adherence to codes and standards.
- .4 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .5 Instructions: submit manufacturer's installation instructions.
- .6 Manufacturer's Field Reports: manufacturer's field reports specified.

1.5 CLOSEOUT SUBMITTALS

- .1 Submit maintenance and engineering data for incorporation into manual specified in Section 01 78 00 - Documents and samples to be submitted.

1.6 HEALTH AND SAFETY:

- .1 Do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety.

1.7 DELIVERY, STORAGE AND HANDLING

- .1 Waste Management and Disposal:
 - .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Management and disposal of construction / demolition waste.

Part 2 Products

2.1 GENERAL

- .1 Manufacture in accordance with SMACNA - HVAC Duct Construction Standards.

2.2 FLEXIBLE CONNECTIONS

- .1 Frame: galvanized sheet metal frame of 0.66 mm thick with fabric clenched by means of double locked seams.
- .2 Material :
 - .1 Fire resistant, self extinguishing, neoprene coated glass fabric, temperature rated at minus 40 degrees C to plus 90 degrees C, density of 1.3 kg/m².

2.3 ACCESS DOORS IN DUCTS

- .1 Non-Insulated Ducts: sandwich construction of same material as duct, one sheet metal thickness heavier, minimum 0.6 mm thick complete with sheet metal angle frame.

- .2 Insulated Ducts: sandwich construction of same material as duct, one sheet metal thickness heavier, minimum 0.6 mm thick complete with sheet metal angle frame and 25 mm thick rigid glass fibre insulation.
- .3 Gaskets: neoprene or foam rubber.
- .4 Hardware:
 - .1 Up to 300 mm: two sash locks complete with safety chain.
 - .2 301 to 450 mm: four sash locks complete with safety chain.
 - .3 451 to 1000 mm: piano hinge and minimum two sash locks.
 - .4 Doors over 1000 mm: piano hinge and two handles operable from both sides.
 - .5 Hold open devices.
 - .6 300 x 300 mm glass viewing panels.

2.4 TURNING VANES

- .1 24 gauge galvanized steel directional vanes, single thickness, 50 mm radius. Blades spaced 38 mm apart inside rails.

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 corresponding round duct standards.

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 INSTALLATION

- .1 Flexible Connections:
 - .1 Install in following locations:
 - .1 Inlets and outlets to supply air units 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 and Viewing Panels:
 - .1 Size:
 - .1 300 x 300 mm for inspection/servicing entry or as indicated on drawings.
 - .2 The hand holes will be refused.
 - .3 250 x 250 mm for viewing.
 - .4 As indicated.
 - .2 Locations:
 - .1 Fire and smoke dampers.
 - .2 Control dampers.
 - .3 Devices requiring maintenance.
 - .4 Required by code.
 - .5 Reheat coils.
 - .6 Elsewhere as indicated.
-

- .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 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 As indicated.
- .4 Turning vanes:
 - .1 Install in accordance with recommendations of SMACNA and as indicated.
 - .2 All elbows of square, rectangular or flat oval ducts which cannot be constructed with an inside radius of curvature of 1.5 shall be fitted with directional vanes.

3.3 FIELD QUALITY CONTROL

- .1 Manufacturer's Field Services:
 - .1 Require manufacturer of products, supplied under this Section, to review work involved in the handling, installation/application, protection and cleaning, of its product(s) and submit written reports, in acceptable format, to verify compliance of Work with Contract.

- .2 Manufacturer's Field Services: 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 Schedule site visits, to review Work, at stages listed:
 - .1 After delivery and storage of products and when preparatory Work, or other Work, on which the Work of this Section depends, is complete but before installation begins.
 - .2 Twice during progress of Work at 25% and 60% complete.
 - .3 Upon completion of the Work, after cleaning is carried out.
- .4 Obtain reports, within 3 days of review and submit, immediately to Departmental Representative.

3.4 CLEANING

- .1 Perform cleaning operations as specified in Section 01 74 11 - Cleaning and in accordance with manufacturer's recommendations.
- .2 Upon 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 SECTIONS**

- .1 The requirements of the section 23 05 00 - HVAC - General requirements for the results of work are an integral part of this section.
- .2 Section 01 33 00 - Documents and samples to be submitted.
- .3 Section 01 35 29.06 - Health and Safety.
- .4 Section 01 45 00 - Quality Control.
- .5 Section 01 74 21 - Management and disposal of construction / demolition waste.
- .6 Section 01 78 00 - Documents / Items to be submitted upon completion of work.
- .7 Section 01 91 13.13 – Commissioning plan.

1.2 REFERENCES

- .1 *American National Standards Institute/National Fire Protection Association (ANSI/NFPA)*
 - .1 ANSI/NFPA 90A-2002, *Standard for the Installation of Air Conditioning and Ventilating Systems*.
 - .2 NFPA 80 Standard for Fire Doors and Other Opening Protectives.
- .2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
- .3 Underwriters Laboratories of Canada (ULC)
 - .1 CAN4-S112-M1990, Fire Test of Fire Damper Assemblies.
 - .2 CAN4-S112.2-M84, Standard method of testing fire performance of fire dampers located in the ceilings.
 - .3 ULC-S505-1974, Fusible Links for Fire Protection Service.

1.3 SUBMITTALS

- .1 Product Data:
 - .1 Submit manufacturers' required technical data, specifications and documentation in accordance with Section 01 33 00 - Documents and samples to be submitted. Include product characteristics, performance criteria, and limitations.
 - .1 Submit two (2) copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 01 33 00 - Documents and samples to be submitted.
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- .2 Indicate the following:
 - .1 Fire-dampers.
 - .2 Smoke dampers.
 - .3 Operators.
 - .4 Fusible links.
 - .5 Design details of break-away joints.
- .2 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.
 - .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 Closeout Submittals:
 - .1 Provide maintenance records required and join them to the manual mentioned in Section 01 78 00 - Documents / Items to be submitted upon completion of work.

1.4 HEALTH AND SAFETY REQUIREMENTS

- .1 Apply necessary measures during construction in occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety.

1.5 MAINTENANCE

- .1 Extra Materials:
 - .1 Provide maintenance materials in accordance with Section 01 78 00 - Documents / Items to be submitted upon completion of work.
 - .2 Provide following:
 - .1 Six (6) fusible links of each type.

1.6 DELIVERY, STORAGE AND HANDLING

- .1 Packing, shipping, handling and unloading:
 - .1 Deliver, store and handle in accordance with Section 01 61 00 - General Product Requirements.
 - .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Waste Management and Disposal:
 - .1 Construction/Demolition Waste Management and Disposal: in accordance with Section 01 74 21 - Management and disposal of construction / demolition waste.

Part 2 Products**2.1 FIRE DAMPERS**

- .1 Fire dampers: arrangement Type A B C, listed and bear label of ULC and meet requirements of CFFM and ANSI/NFPA 90A and authorities having jurisdiction. Fire damper assembly fire tested in accordance with CAN4-S112.
- .2 Mild steel, factory fabricated for fire rating requirement to maintain integrity of fire wall and/or fire separation.
 - .1 Fire dampers: 1-1/2 hour fire rated unless otherwise indicated.
- .3 Fusible link actuated, weighted to close and lock in closed position when released or having negator-spring-closing operator for multi-leaf type or roll door type in horizontal position with vertical air flow.
- .4 Built mounting angles 40 mm x 40 mm x 3 mm, all around records of each side of partitions or walls Fire crossed
- .5 Equip fire dampers with steel sleeve or frame installed disruption ductwork or impair damper operation.
- .6 Equip sleeves or frames with perimeter mounting angles attached on both sides of wall or floor opening. Construct ductwork in fire-rated floor-ceiling or roof-ceiling assembly systems with air ducts that pierce ceiling to conform with ULC.
- .7 Design and construct dampers to not reduce duct or air transfer opening cross-sectional area.
- .8 Dampers shall be installed so that the centerline of the damper depth or thickness is located in the centerline of the wall, partition of floor slab depth or thickness.
- .9 Unless otherwise indicated, the installation details given in SMACNA Install Fire Damp HVAC and in manufacturer's instructions for fire dampers shall be followed.

2.2 SMOKE DAMPERS

- .1 Smoke Dampers: to be ULC or UL listed and labelled.
 - .2 Normally closed reverse action smoke vent (S/D-RASV): folding blade type, opening by gravity upon detection of smoke, and/or from remote alarm signalling device actuated by an electro thermal link as indicated. Two flexible stainless steel blades edge seals to provide required constant sealing pressure.
 - .3 Normally open smoke/seal (S/D-SSSD): folding blade type, closing when actuated by means of electro thermal link and/or from remote alarm signalling device. Blade edge seals of flexible stainless steel to provide required constant sealing pressure. Provide stainless steel negator springs with locking devices to ensure positive closure for units mounted horizontally in vertical ducts.
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- .4 Motorized (S/D-M): folding blade type, normally open with power on. When power is interrupted damper shall close automatically. Both damper and damper operator shall be ULC listed and labelled.
- .5 Electro thermal link (S/D-ETL): dual responsive fusible link which melts when subjected to local heat of 74 degrees C and from external electrical impulse of low power and short duration; ULC or UL listed and labelled.

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 in accordance with ANSI/NFPA 90A and in accordance with conditions of ULC listing.
- .2 Maintain integrity of fire separation.
- .3 After completion and prior to concealment, obtain approvals of complete installation from authority having jurisdiction.
- .4 Install access door adjacent to each damper. See Section 23 33 00 - Air Duct Accessories. Each access door must have a label with the identification "Registre Coupe-Feu".
- .5 Coordinate with fire damper installer
- .6 Ensure access doors/panels, fusible links, damper operators are easily observed and accessible.
- .7 Install break-away joints of approved design on each side of fire separation.
- .8 Tests to be performed as per specifications of section 01 91 13.13 – Commissioning plan.

3.3 ADDITIONAL INSTRUCTIONS FOR COMMISSIONING

- .1 Fire dampers: ULC listed and labeled; fire performance rated to CAN4-S112.2.
- .2 Dampers made of sheet steel at least 1.5 mm thick, with 1.6 mm thick ULC approved asbestos-free insulation and hinged on hinges and pins protected against rust.
- .3 Valves of the normally open type, closing under the action of a fusible link conforming to ULC-5505 when the temperature reaches 74°C or the indicated value.
- .4 Fire or smoke damper
 - .1 Subcontractor shall submit an installation report for each fire damper in accordance with the manufacturer's recommendations, the requirements of the contract documents, NFPA80 and the manufacturer's installation and operation manual. Upon receipt of the report and completion of the work, the Subcontractor shall perform the test list required in NFPA80 for each fire damper in front of the Commissioning Agent.

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- .1 Upon completion of fire damper installation, an operational test shall be performed.
 - .2 Damper shall be fully closed from the open position.
 - .3 When damper is equipped with smoke detection, a test shall be performed by activating the detector in accordance with NFPA72.
 - .4 In the case of a dynamic component, verify/confirm that the component corresponds to the velocity rating of the damper listing.
 - .5 Ensure that there is no obstruction in the movement of the damper.
 - .6 Ensure that there is full access to the fire damper.
 - .7 Fuse operating temperature shall be in accordance with NFPA 90A, standard for installation of air-conditioning and ventilation systems, and ANSI/UL 33, standard for heat responsive links for fire-protection, temperature, classifications and notes.
 - .8 Upon completion of tests, perform a visual inspection to ensure that there are no obstructions.
 - .9 All tests shall be documented, indicating the location, date of inspection, inspector's name and deficiencies. The documentation shall include space to explain when and how deficiencies were corrected.
 - .10 The Subcontractor shall provide stickers on the equipment to be signed certifying that the verification was performed in the presence of the Contractor's Commissioning Agent and the Subcontractor.
- .5 Combination fire and smoke shutter
- .1 Subcontractor shall submit an installation report for each combination fire and smoke control damper in accordance with the manufacturer's recommendations, the requirements of the contract documents, NFPA80 and the manufacturer's installation and operation manual. Upon receipt of the report and completion of the work, the Subcontractor shall perform the test list required in NFPA80 for each fire damper in front of the Commissioning Agent.
 - .1 Upon completion of the installation of the combined fire and smoke dampers, an operational test shall be performed.
 - .2 The test shall determine that the system has been installed and is functioning as intended.
 - .3 The function test must be performed when the ventilation unit is in normal mode and when the static pressure is at the set point.
 - .4 Ensure that there is no obstruction in the movement of the shutter.
 - .5 Ensure that there is full access to the damper.
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- .6 The combined fire and smoke damper shall meet the test requirements contained in Chapter 6 of NFPA 105, Standard for smoke door assemblies and other opening protectors.
- .7 Upon completion of the tests, perform a visual inspection to ensure there are no obstructions.
- .8 All tests shall be documented, indicating the location, date of inspection, inspector's name and deficiencies. The documentation shall include space to explain when and how deficiencies were corrected.
- .9 The Subcontractor shall provide stickers on the equipment to be signed certifying that the verification has been completed in the presence of the Contractor's Commissioning Agent and the Subcontractor.

3.4 CLEANING

- .1 Proceed in accordance with Section 01 74 11 - Cleaning.
- .2 Upon completion and verification of performance of installation, evacuate the site materials / equipment surplus, waste, tools and equipment.

END OF SECTION

Part 1 GENERAL**1.1 RELATED SECTIONS**

- .1 The requirements of Section 23 05 00 – Common Work Results for HVAC are an integral part of this section.
- .2 Section 01 33 00 - Documents and samples to be submitted.
- .3 Section 01 35 29.06 - Health and Safety.
- .4 Section 01 45 00 - Quality Control.
- .5 Section 01 74 21 - Management and disposal of construction / demolition waste.
- .6 Section 01 78 00 - Documents / Items to be submitted upon completion of work.

1.2 REFERENCES

- .1 Air Conditioning and Mechanical Contractors (AMCA)
 - .1 AMCA Publication 99-2003, Standards Handbook.
 - .2 AMCA 300-1996, Reverberant Room Method for Sound Testing of Fans.
 - .3 AMCA 301-1990, Methods for Calculating Fan Sound Ratings from Laboratory Test Data.
- .2 American National Standards Institute (ANSI)/American Society of Mechanical Engineers (ASME)
 - .1 ANSI/AMCA 210-1999, Laboratory Methods of Testing Fans for Aerodynamic Performance Rating.
- .3 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB 1.181-99, Ready-Mixed Organic Zinc-Rich Coating.
- .4 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).

1.3 SYSTEM DESCRIPTION

- .1 Performance Requirements
 - .1 Catalogued or published ratings for manufactured items: obtained from tests carried out by manufacturer or those ordered by manufacturer from independent testing agency signifying adherence to codes and standards in force.
 - .2 Capacity: flow rate, total static pressure, bhp W, efficiency, revolutions per minute, power, model, size, sound power data, and as indicated on schedule.
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- .3 Fans: statically and dynamically balanced, constructed in conformity with AMCA 99.
- .4 Sound ratings: comply with AMCA 301, tested to AMCA 300. Supply unit with AMCA certified sound rating seal.
- .5 Performance ratings: based on tests performed in accordance with ANSI/AMCA 210 and ASHRAE 51-99. Supply unit with AMCA certified rating seal, except for propeller fans smaller than 300 mm diameter.

1.4 SUBMITTALS

- .1 Product Data
 - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 – Documents and samples to be submitted. Include product characteristics, performance criteria, and limitations.
 - .1 Submit two (2) copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 01 33 00 – Documents and samples to be submitted.
 - .2 Shop Drawings
 - .1 Submit shop drawings and product data in accordance with Section 01 33 00 – Documents and samples to be submitted.
 - .3 Provide:
 - .1 Fan performance curves showing point of operation, bhp kW and efficiency.
 - .2 Sound rating data at point of operation.
 - .4 Indicate:
 - .1 Motors, sheaves, bearings, shaft details;
 - .2 Minimum performance achievable with variable speed controllers.
 - .5 Quality Assurance Submittals: submit following in accordance with Section 01 33 00 – Documents and samples to be submitted.
 - .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.
 - .1 DCC Representative to make available one (1) copy of installation instructions prepared by the system supplier to intended personnel.
 - .6 Closeout Submittals:
 - .1 Provide operation and maintenance data for incorporation into manual specified in Section 01 78 00 – Documents / Items to be submitted upon completion of work.
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- .7 All documentation required to obtain the Enhanced Commissioning Credit. Refer to the following sections :

- .1 01 91 13 – General commissioning (CX) requirements
- .2 01 91 13.13 – Commissioning plan
- .3 01 91 31 – Commissioning (CX) plan
- .4 01 91 33 – Commissioning forms
- .5 01 91 41 – Commissioning training

1.5 QUALITY ASSURANCE

- .1 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety.

1.6 MAINTENANCE

- .1 Extra Materials
- .1 Provide maintenance materials in accordance with Section 01 78 00 – Documents / Items to be submitted upon completion of work.
 - .2 Furnish:
 - .1 List of individual manufacturer's recommended spare parts for equipment, including bearings and seals.
 - .2 Address of suppliers.
 - .3 List of specialized tools necessary for adjusting, repairing or replacing.

1.7 DELIVERY, STORAGE AND HANDLING

- .1 Packing, shipping, handing and unloading:
- .1 Deliver, store and handle in accordance with Section 01 61 00 – General Product Requirements.
 - .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Waste Management and Disposal
- .1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Management and disposal of construction / demolition waste.

Part 2 Products

2.1 FANS – GENERAL

- .1 Motors
- .1 In accordance with Section 12 05 01 – Common Work Results For Mechanical and supplemented as specified herein.
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- .2 Motors selected based on variable speed drive applications, 50-hp motors and up must be in accordance with NEMA MG1, part 30.
 - .3 Motors to be high efficiency and surpasses CAN/CSA-C390.
 - .4 Factory installed motors.
 - .5 Rating as indicated.
 - .2 Accessories and hardware: fan inlet and/or outlet safety screens as indicated in specifications, inlet or outlet dampers and vanes and as indicated.
 - .3 Bearings: air handling quality, heavy duty, split pillow-block, flange mounted grease lubricated ball or roller self-aligning type with oil retaining, dust excluding seals and a certified minimum rated life of 200 000 h to AFBMA L-50 (AntiFriction Bearing Manufacturers Association). Characteristics and specifications of bearings are to be based on fan maximum speed and capacity as illustrated in catalogue data. Bearing supports are to be single or two-row cylindrical roller bearings. Supports must be secured to fan base.
 - .4 Factory primed before assembly in colour standard to manufacturer.
 - .5 Scroll casing drains: as indicated.
 - .6 Finish on fume hood exhaust fans:
 - .1 As required, wheel and all fan surfaces in contact with exhaust air must be treated with an anticorrosive coating composed of phenolic epoxy, a compound resulting from the reaction between a phenol and formaldehyde under heat reaction conditions. Two (2) coats are required.
 - .2 Surface preparation:
 - .1 General
 - .1 Before proceeding with painting, all surfaces must be free of humidity and meticulously cleaned of all matter that could lead to premature breakdown of paint. Welding spatters must be removed. The method for surface preparation must be compatible with primer coat, as per the following method:
 - .2 Commercial blast cleaning (SSPC-SP6): following blast cleaning, the surface must be free of dirt, mill scale, welding flux, or any other foreign matter. Rust must be removed but tightly adherent mill scale may remain on the surface, if not able to be lifted with a metal brush.
 - .3 Prior to blast cleaning, oil and similar substances must be cleaned with solvent as per SSPC SP-1.
 - .2 Abrasive blasting:
 - .1 Abrasive blasting to be metal grain or approved non-metal grain type, to produce abrasively blasted surface as per specified standards. Abrasive material not to be reused. Blasting particle size to produce an Anchor Pattern Profile for a profile height of between 30 and 100 microns.
 - .2 Abrasives must be dry, clean and free of all contaminants.
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- .7 Bearing lubrication systems plus extension lubrication tubes where bearings are not easily accessible.
- .8 Vibration isolation: to Section 23 05 48 – Vibration and Seismic Control for HVAC Piping and Equipment.
- .9 Flexible connections: to Section 23 33 00 – Air Duct Accessories.

2.2 CENTRIFUGAL FANS (DWDI, SWSI)

- .1 Fan wheels:
 - .1 Welded steel or aluminum construction, as indicated.
 - .2 Maximum operating speed not more than 40% of first critical speed.
 - .3 Wheels equipped with blades as indicated.
- .2 Housings
 - .1 Volute with inlet cones, fabricated steel for wheels 300 mm or greater; aluminum for smaller wheels, braced, and with welded supports.
 - .2 For horizontally and vertically split housings provide flanges on each section for bolting together, with gaskets of non-oxidizing non-flammable material.
 - .3 Provide bolted latched airtight access doors with handles.
- .3 Variable volume control devices
 - .1 Mounted by fan manufacturer.
 - .2 Adjustable inlet vanes: operated from a centre mechanism linked to each damper vane. Support each vane at ends in bronze bearings. On DWDI fans interconnect vanes to operate in unison. Provide locking devices for manual operation.
 - .3 Variable speed drives: refer to section.
- .4 Product : See the plans.

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 FAN INSTALLATION

- .1 Install fans as indicated, complete with resilient mountings specified in Section 23 05 48 – Vibration and Seismic Control for HVAC and Piping Equipment, flexible electrical leads and flexible connections in accordance with Section 23 33 00 – Air Duct Accessories.
- .2 Install flexible connections on fan inlet and discharge ductwork. Ensure metal bands of connectors are parallel with minimum flex between ductwork and fan while running. Flexible connections must not be under tension when fan is operating.
- .3 Provide sheaves and belts required for final air balance.

.4 Bearings and extension tubes to be easily accessible.

.5 Access doors and access panels to be easily accessible.

3.3 ANCHOR BOLTS AND MOUNTING TEMPLATES

.1 Properly sized anchor bolts are to be used to seismically restrain (speed and acceleration) the units as specified in the section.

3.4 CLEANING

.1 Proceed in accordance with Section 01 74 11 – Cleaning.

.2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish tools and equipment.

3.5 STARTING UP AND COMMISSIONING THE DEVICES

.1 Manufacturer shall approve installation and supervise start-up of fans.

.2 The appliance manufacturer shall certify the performance of the installed fans.

END OF SECTION

Part 1 GENERAL**1.1 SUMMARY****.1 Related Sections**

- .1 The requirements of the section 23 05 00 – Common Work Results for HVAC are integral parts of this section.
- .2 Section 01 33 00 - Documents and samples to be submitted.
- .3 Section 01 35 29.06 - Health and Safety.
- .4 Section 01 45 00 - Quality Control.
- .5 Section 01 74 21 - Management and disposal of construction / demolition waste.
- .6 Section 01 78 00 - - Documents / Items to be submitted upon completion of work.

1.2 SYSTEM DESCRIPTION**.1 Performance Requirements**

- .1 Catalogued or published ratings for manufactured items: obtained from tests carried out by manufacturer or those ordered by manufacturer from independent testing agency signifying adherence to codes and standards in force.

1.3 SUBMITTALS**.1 Product Data:**

- .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 – Documents and samples to be submitted. Include product characteristics, performance criteria, and limitations.
 - .1 Submit two (2) copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 01 33 00 – Documents and samples to be submitted.
- .2 Product data must specify:
 - .1 capacity;
 - .2 throw and terminal velocity;
 - .3 noise criteria;
 - .4 pressure drop;
 - .5 neck velocity.

- .2 Quality assurance submittals: submit following in accordance with Section 01 33 00 – Documents and samples to be submitted.
 - .1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
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.2 Instructions: submit manufacturer's installation instructions.

.1 DCC Representative to make available one (1) copy of installation instructions prepared by the system supplier to intended personnel.

1.4 QUALITY ASSURANCE

.1 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Packing, shipping, handling and unloading

.1 Deliver, store and handle materials in accordance with Section 01 61 00 – General Product Requirements.

.2 Deliver, store and handle materials in accordance with manufacturer's written instructions.

.2 Waste Management and Disposal

.1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Management and disposal of construction / demolition waste.

1.6 RELIABILITY OF TECHNICAL DATA

.1 Catalogued or published ratings for manufactured items: obtained from tests carried out by manufacturer or those ordered by manufacturer from independent testing agency signifying adherence to codes and standards in force.

1.7 MAINTENANCE

.1 Extra materials:

.1 Provide maintenance materials in accordance with Section 01 78 00 – Documents / Items to be submitted upon completion of work.

.2 Provide the following:

.1 keys for volume control adjustment;

.2 keys for air flow pattern adjustment.

Part 2 Products

2.1 GENERAL

.1 To meet capacity, pressure drop, terminal velocity, throw, noise level, and neck velocity as indicated.

.2 Grilles, registers and diffusers passing through fire-rated partitions to be equipped with steel sleeves secured to frame in accordance with NFPA 90A.

2.2 GRILLES AND DIFFUSERS

- .1 Specified products: See in plans.

2.3 MANUFACTURED UNITS

- .1 Grilles, registers and diffusers of same generic type to be product of one manufacturer.

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 Install grilles, registers and diffusers in accordance with manufacturer's instructions.
- .2 Provide and install all angle irons and steel fasteners necessary so that the weight of type 'C' and 'L' grilles and diffusers is not supported by the ceiling.
- .3 Install with flat-head screws in countersunk holes where fastenings are visible.
- .4 Plan for all additional connections, transitional elements and suspended T ceilings necessary for installation and connection of grilles and diffusers. Connections to be both robust and sealtight.
- .5 Coordinate the installation of grilles and diffusers with the work of other subtrades, in particular those involved in architectural finishes and sealing details.
- .6 In gymnasiums and other similar rooms, use bolts to secure equipment in place.
- .7 In gymnasiums and other similar rooms, in addition to locations indicated, provide grilles, registers and diffusers with a concealed safety chain.

3.3 CLEANING

- .1 Proceed in accordance with Section 01 74 11 – Cleaning.
- .2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

3.4 START-UP

- .1 Start-up of equipment to be performed under supervision of manufacturer's representative.

END OF SECTION

Part 1 General**1.1 SUMMARY****.1 Related Sections**

- .1 The requirements of the section 23 05 00 - HVAC - General Requirements for Work Results form an integral part of this section.
- .2 Section 01 33 00 - Documents and Samples to be Submitted.
- .3 Section 01 35 29.06 - Health and Safety.
- .4 Section 01 45 00 - Quality Control.
- .5 Section 01 74 21 - Management and disposal of construction / demolition waste.
- .6 Section 01 78 00 - Documents/Elements to be submitted upon completion.

1.2 SYSTEM DESCRIPTION**.1 Performance Requirements**

- .1 Technical data from manufacturers' catalogs and literature shall be reliable data based on test results from tests performed by the manufacturers themselves or by independent laboratories on their behalf, certifying compliance with the requirements of applicable codes and standards.

1.3 DOCUMENTS/SAMPLES TO BE SUBMITTED**.1 Technical Data Sheets**

- .1 Submit the required data sheets and manufacturers' product specifications and documentation as per section 01 33 00 - Documents and samples to be submitted. Specify product characteristics, performance criteria and constraints.
 - .1 Submit two (2) copies of the Material Safety Data Sheets (MSDS) required under the Workplace Hazardous Materials Information System (WHMIS), which must comply with WHMIS as per Section 01 33 00 - Documents and samples to be submitted.
- .2 The MSDSs shall specify the following :
 - .1 Construction specifications.
 - .2 Material types;
 - .3 Pressure drop;

.2 Samples

- .1 Submit the required samples in accordance with section 01 33 00 - Documents and Samples to be Submitted.

.3 Quality Assurance: Submit the following documents in accordance with section 01 33 00 Submitting Documents and Samples.

- .1 Certificates: Submit documents signed by the manufacturer certifying that the products, materials and equipment meet the physical and performance requirements.
- .2 Instructions: Submit installation instructions provided by the manufacturer.
 - .1 The Departmental Representative will make one (1) copy of the installation instructions prepared by the System Provider available to affected personnel.

1.4 HEALTH AND SAFETY

- .1 Take the necessary health and safety measures in construction in accordance with Section 01 35 29.06 - Health and Safety.

1.5 TRANSPORTATION, STORAGE AND HANDLING

- .1 Packing, shipping, handling and unloading
 - .1 Transport, store and handle materials and equipment in accordance with Section 01 61 00 - General Product Requirements.
 - .2 Transport and store materials and equipment in accordance with the manufacturer's written instructions.
- .2 Waste Management and Disposal
 - .1 Construction/Demolition Waste Management and Disposal: in accordance with Section 01 74 21 - Management and disposal of construction / demolition waste.
 - .2 as per Section 01 74 21 - Management and disposal of construction / demolition waste.

1.6 RELIABILITY OF TECHNICAL DATA

- .1 Data from manufacturers' catalogs and documentation shall be reliable data, confirmed by tests performed by the manufacturers themselves or by independent laboratories on their behalf, certifying compliance with the requirements of applicable codes and standards.

Part 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

- .1 Technical data from manufacturers' catalogs and literature shall be reliable data based on test results from tests performed by the manufacturers themselves or by independent laboratories on their behalf, certifying compliance with the requirements of applicable codes and standards.

2.2 GRAVITY OPERATED FRESH AIR INTAKES AND BALANCING VENTS FOR INSTALLATION ON ROOFS

- .1 Construction: Factory made, galvanized steel components
 - .1 Bird screen: incorporated, made of galvanized steel wire of 2.7 mm diameter, with 12 mm mesh.

- .2 Backflow prevention dampers (when prescribed): with horizontally mounted blades.
- .3 Maximum speed at the shrinkage point 3.3 m/s.
- .4 Maximum pressure drop across the element: 15 Pa static pressure discharge side.
- .5 Maximum velocity in the damper area: 1.5 m/s.
- .6 Shape: as indicated.

Part 3 PERFORMANCE

3.1 INSPECTION

- .1 Condition Verification: Prior to installing louvers, air intakes and other vents, ensure that the condition of surfaces/supports previously installed under other sections or contracts is acceptable and allows the work to be performed in accordance with the Manufacturer's written instructions.
 - .1 Visually inspect surfaces/supports in the presence of the Departmental Representative.
 - .2 Immediately inform the Departmental Representative of any unacceptable conditions found.
 - .3 Begin installation work only after unacceptable conditions have been corrected.

3.2 INSTALLATION

- .1 Install louvers, air intakes and other vents in accordance with the manufacturer's recommendations and those of SMACNA.
- .2 Reinforce and braced as indicated.
- .3 Securely fasten components in openings provided for this purpose. Caulk to ensure a good seal.

3.3 CLEANING

- .1 Clean-up during the course of the work: Perform cleaning as per Section 01 74 11 - Cleaning.
 - .1 Leave the premises clean at the end of each work day.
 - .2 Final Clean-up: Remove excess materials/equipment, waste, tools and equipment from the job site as per 01 74 00 - Cleaning.
 - .3 Waste Management: Sort waste for recycling.

END OF SECTION

Part 1 GENERAL**1.1 SUMMARY**

- .1 Related Sections:
 - .1 The requirements of section 23 05 00 – Common Work Results for HVAC are an integral part of this section.
 - .2 Section 01 33 00 - Documents and samples to be submitted.
 - .3 Section 01 35 29.06 - Health and Safety.
 - .4 Section 01 45 00 - Quality Control.
 - .5 Section 01 74 19 - Waste Management and Disposal.
 - .6 Section 01 78 00 - Documents / Items to be submitted upon completion of work.

1.2 REFERENCES

- .1 American National Standards Institute/National Fire Prevention Association (ANSI/NFPA).
 - .1 ANSI/NFPA 96-04, Ventilation Control and Fire Protection of Commercial Cooking Operations.
 - .2 American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE).
 - .1 ASHRAE 52.1-1992, Gravimetric and Dust Spot for Testing Air-Cleaning Devices Used in Ventilation for Removing Particulate Matter (ANSI Approved).
 - .3 Canadian General Standards Board (CGSB):
 - .1 CAN/CGSB-115.10, Disposable Air Filters for the Removal of Particulate Matter from Ventilating Systems.
 - .2 CAN/CGSB-115.11, Filters, Air, High Efficiency, Disposable, Bag Type.
 - .3 CAN/CGSB-115.12, Filters, Air, Medium Efficiency, Disposable, Bag Type.
 - .4 CAN/CGSB-115.13, Filter Media, Automatic Roll.
 - .5 CAN/CGSB-115.14, High Efficiency Cartridge Type Supported Air Filters for the Removal of Particulate Matter from Ventilating Systems.
 - .6 CAN/CGSB-115.15, High Efficiency Rigid Type Air Filters for Removal of Particulate Matter from Ventilating Systems.
 - .7 CAN/CGSB-115.16, Activated Carbon for Odor Removal from Ventilating Systems.
 - .8 CAN/CGSB-115.18, Filter, Air, Extended Area Panel Type, Medium Efficiency.
 - .9 CAN/CGSB-115.20, Polarized Media Air Filter.
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- .4 Health Canada/Workplace Hazardous Materials Information System (WHMIS):
 - .1 Material Safety Data Sheets (MSDS).
- .5 Underwriters' Laboratories of Canada (ULC)
 - .1 ULC-S111, Standard Method of Fire Tests for Air Filter Units.
 - .2 ULC-S649, Exhaust Hoods and Related Controls for Commercial and Institutional Kitchens.

1.3 SUBMITTALS

- .1 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 – Documents and samples to be submitted. Include product characteristics, performance criteria, and limitations.
 - .1 Submit two (2) copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 01 33 00 – Documents and samples to be submitted.
- .2 Shop Drawings:
 - .1 Submit shop drawings in accordance with Section 01 33 00 – Documents and samples to be submitted.
- .3 Quality assurance submittals: submit following in accordance with Section 01 33 00 – Documents and samples to be submitted.
 - .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.
 - .1 DCC Representative to make available one (1) copy of installation instructions prepared by the system supplier to intended personnel.
- .4 Closeout Submittals:
 - .1 Provide maintenance data for incorporation into manual specified in Section 01 78 00 – Documents / Items to be submitted upon completion of work.

1.4 QUALITY ASSURANCE

- .1 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Packing, shipping, handling and unloading:
 - .1 Deliver, store and handle in accordance with Section 01 61 00 – General Product Requirements.

- .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.

- .2 Waste Management and Disposal

- .1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Management and disposal of construction / demolition waste.

1.6 MAINTENANCE

- .1 Extra Materials:

- .1 Provide maintenance materials in accordance with Section 01 78 00 – Documents / Items to be submitted upon completion of work.
 - .2 Furnish list of individual manufacturer's recommended spare parts for equipment such as frames and filters, addresses of suppliers, list of specialized tools necessary for adjusting, repairing or replacing for inclusion in operating manual.
 - .3 Spare filters: in addition to filters installed immediately prior to acceptance by DCC Representative, supply one (1) complete set of filters for each filter unit or filter bank in accordance with Section 01 78 00 – Documents / Items to be submitted upon completion of work.

Part 2 Products

2.1 GENERAL

- .1 Media: suitable for air at 100% RH and air temperatures between -40 and 50°C.
- .2 Number of units, size as recommended by manufacturer and thickness of panels, overall dimensions of filter bank, configuration and capacity: as indicated.
- .3 Pressure drop when clean and dirty, sizes and thickness: as indicated on schedule.

2.2 HOLDING FRAME

- .1 Frames: Filter housing shall be constructed of minimum 16-gauge SS304, rigid "T" section, with sealing gaskets between frames and internal walls and fastener attachments to keep filters in place.
 - .2 Frames must be secured to filter pack and adequately reinforced to additional galvanized steel components as necessary. Filter fastener attachments must be made of stainless steel.
 - .3 Oversized copper differential pressure orifice plate.
 - .4 Seals: to ensure leakproof operation.
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2.3 ACCESSORIES

- .1 Blank-off plates: as required, to fit all openings and of same material as holding frames.
- .2 Factory-installed gauge, Dwyer Magnehelic series 2000, accuracy within $\pm 2\%$, capacity two times maximum filter pressure drop.
- .3 Access and servicing: through doors/panels on each side and/or from upstream face of filter bank.

2.4 CARTRIDGE TYPE FILTERS, 30–35% EFFICIENCY

- .1 Media: pre-moulded fibrous glass, disposable, synthetic material cartridge.
- .2 Holding frame: galvanized steel with bracing.
- .3 Media support: welded wire grid.
- .4 Performance
 - .1 Average atmospheric dust spot efficiency to ASHRAE 52.1.
 - .2 Average dust holding capacity to ASHRAE 52.1.
- .5 Fire rated: to ULC-S111.

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 - GENERAL

- .1 Install in accordance with manufacturer's recommendations and with adequate space for access, maintenance and replacement.

3.3 REPLACEMENT MEDIA

- .1 Replace all media with new upon acceptance.
- .2 Filter media to be new and clean, as indicated by pressure gauge, at time of acceptance.

3.4 FILTER GAUGES

- .1 Install filter gauge type as indicated across each filter bank (pre-filter and final filter) in approved and easily readable location.
- .2 Mark each filter gauge with value of pressure drop for clean condition and manufacturer's recommended replacement (dirty) value.

3.5 CLEANING

- .1 Proceed in accordance with Section 01 74 11 – Cleaning.
- .2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

Part 1 General**1.1 SUMMARY****.1 Related Requirements**

.1 Section 25 05 01 – General requirements.

1.2 DEFINITIONS

.1 For additional acronyms and definitions refer to Section 25 05 01 - EMCS: General Requirements.

.2 AEL: ratio between total test periods less any system downtime accumulated within that period and test period.

.3 Downtime: results whenever EMCS is unable to fulfill required functions due to malfunction of equipment defined under responsibility of EMCS contractor. Downtime is measured by duration, in time, between time that Contractor is notified of failure and time system is restored to proper operating condition. Downtime not to include following:

.1 Outage of main power supply in excess of back-up power sources, provided that:

.1 Automatic initiation of back-up was accomplished.

.2 Automatic shut-down and re-start of components was as specified.

.2 Failure of communications link, provided that:

.1 Controller automatically and correctly operated in stand-alone mode.

.2 Failure was not due to failure of any specified EMCS equipment.

.3 Functional failure resulting from individual sensor inputs or output devices, provided that:

.1 System recorded said fault.

.2 Equipment defaulted to fail-safe mode.

.3 AEL of total of all input sensors and output devices is at least 99 % during test period.

1.3 DESIGN REQUIREMENTS

.1 Confirm with Departmental Representative that Design Criteria and Design Intents are still applicable.

.2 Commissioning personnel to be fully aware of and qualified to interpret Design Criteria and Design Intents.

.3 The new controller must be compatible with the existing Reliable Controls control system.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submittals in accordance with Section 01 33 00 - Documents and samples to be submitted.

- .2 Final Report: submit report to Departmental Representative.
 - .1 Include measurements, final settings and certified test results.
 - .2 Bear signature of commissioning technician and supervisor
 - .3 Report format to be approved by Departmental Representative before commissioning is started.
 - .4 Revise "as-built" documentation, commissioning reports to reflect changes, adjustments and modifications to EMCS as set during commissioning and submit to Departmental Representative in accordance with Section 01 78 00 - Documents / Items to be submitted upon completion of work.
 - .5 Recommend additional changes and/or modifications deemed advisable in order to improve performance, environmental conditions or energy consumption.

1.5 CLOSEOUT SUBMITTALS

- .1 Provide documentation, O&M Manuals, and training of O&M personnel for review of Departmental Representative before interim acceptance in accordance with Section 01 78 00 - Documents / Items to be submitted upon completion of work.

1.6 COMMISSIONING

- .1 Do commissioning in accordance with Section 01 91 13 - Requirements.
- .2 Carry out commissioning under direction of Departmental Representative and with the commissioning manager in attendance.
- .3 Inform, and obtain approval from, Departmental Representative in writing at least 14 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.
- .4 Correct deficiencies, re-test in presence of Departmental Representative until satisfactory performance is obtained.
- .5 Acceptance of tests will not relieve Contractor from responsibility for ensuring that complete systems meet every requirement of Contract.
- .6 Load system with project software.
- .7 Perform tests as required.

1.7 COMPLETION OF COMMISSIONING

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

1.8 ISSUANCE OF FINAL CERTIFICATE OF COMPLETION

- .1 Final Certificate of Completion will not be issued until receipt of written approval indicating successful completion of specified commissioning activities including receipt of commissioning documentation.

Part 2 Products**2.1 EQUIPMENT**

- .1 Provide sufficient instrumentation to verify and commission the installed system. Provide two-way radios.
- .2 Instrumentation accuracy tolerances: higher order of magnitude than equipment or system being tested.
- .3 Independent testing laboratory to certify test equipment as accurate to within approved tolerances no more than 2 months prior to tests.
- .4 Locations to be approved, readily accessible and readable.
- .5 Application: to conform to normal industry standards.

Part 3 Execution**3.1 PROCEDURES**

- .1 Test each system independently and then in unison with other related systems.
- .2 Commission each system using procedures prescribed by the Commissioning Manager.
- .3 Commission integrated systems using procedures prescribed by Commissioning Manager.
- .4 Debug system software.
- .5 Optimize operation and performance of systems by fine-tuning PID values and modifying CDLs as required.

3.2 FIELD QUALITY CONTROL

- .1 Pre-Installation Testing.
 - .1 General: consists of field tests of equipment just prior to installation.
 - .2 Testing may be on site or at Contractor's premises as approved by Departmental Representative.
 - .3 Configure major components to be tested in same architecture as designed system. Include BECC equipment and 2 sets of Building Controller's including MCU's, LCU's, and TCU's.
 - .4 Equip each Building Controller with sensor and controlled device of each type (AI, AO, DI, DO).
-

- .5 Additional instruments to include:
 - .1 DP switches used for dirty filter indication and fan status.
- .6 In addition to test equipment, provide inclined manometer, digital micro-manometer, milli-amp meter, source of air pressure infinitely adjustable between 0 and 500 Pa, to hold steady at any setting and with direct output to milli-amp meter at source.
- .7 After setting, test zero and span in 10% increments through entire range while both increasing and decreasing pressure.
- .8 Departmental Representative to mark instruments tracking within 0.5% in both directions as "approved for installation".
- .9 Transmitters above 0.5% error will be rejected.
- .10 DP switches to open and close within 2 % of setpoint.
- .2 Completion Testing.
 - .1 General: test after installation of each part of system and after completion of mechanical and electrical hook-ups, to verify correct installation and functioning.
 - .2 Include following activities:
 - .1 Test and calibrate field hardware including stand-alone capability of each controller.
 - .2 Verify each A-to-D convertor.
 - .3 Test and calibrate each AI using calibrated digital instruments.
 - .4 Test each DI to ensure proper settings and switching contacts.
 - .5 Test each DO to ensure proper operation and lag time.
 - .6 Test each AO to ensure proper operation of controlled devices. Verify tight closure and signals.
 - .7 Test operating software.
 - .8 Test application software and provide samples of logs and commands.
 - .9 Verify each CDL including energy optimization programs.
 - .10 Debug software.
 - .11 Blow out flow measuring and static pressure stations with high pressure air at 700 kPa.
 - .12 Provide point verification list in table format including point identifier, point identifier expansion, point type and address, low and high limits and engineering units. Include space on commissioning technician and Departmental Representative. This document will be used in final startup testing.
- .3 Final Startup Testing: Upon satisfactory completion of tests, perform point-by-point test of entire system under direction of Departmental Representative and PWGSC Commissioning Manager and provide:
 - .1 2 technical personnel capable of re-calibrating field hardware and modifying software.
 - .2 Detailed daily schedule showing items to be tested and personnel available.
 - .3 Departmental Representative's acceptance signature to be on executive and applications programs.
 - .4 Commissioning to commence during final startup testing.
 - .5 O&M personnel to assist in commissioning procedures as part of training.

- .6 Commissioning to be supervised by qualified supervisory personnel and Departmental Representative.
 - .7 Commission systems considered as life safety systems before affected parts of the facility are occupied.
 - .8 Operate systems as long as necessary to commission entire project.
 - .9 Monitor progress and keep detailed records of activities and results.
- .4 Final Operational Testing: to demonstrate that EMCS functions in accordance with contract requirements.
- .1 Prior to beginning of 30 day test demonstrate that operating parameters (setpoints, alarm limits, operating control software, sequences of operation, trends, graphics and CDL's) have been implemented to ensure proper operation and operator notification in event of off-normal operation.
 - .1 Repetitive alarm conditions to be resolved to minimize reporting of nuisance conditions.
 - .2 Test to last at least 30 consecutive 24 hour days.
 - .3 Tests to include:
 - .1 Demonstration of correct operation of monitored and controlled points.
 - .2 Operation and capabilities of sequences, reports, special control algorithms, diagnostics, software.
 - .4 System will be accepted when:
 - .1 EMCS equipment operates to meet overall performance requirements. Downtime as defined in this Section must not exceed allowable time calculated for this site.
 - .2 Requirements of Contract have been met.
 - .5 Correct defects when they occur and before resuming tests.
- .5 Commissioning Manager and Departmental Representative to verify reported results.

3.3 ADJUSTING

- .1 Final adjusting: upon completion of commissioning as reviewed by Departmental Representative, set and lock devices in final position and permanently mark settings.

3.4 DEMONSTRATION

- .1 Demonstrate to Commissioning Manager and to Departmental Representative operation of systems including sequence of operations in regular and emergency modes, under normal and emergency conditions, start-up, shut-down interlocks and lock-outs in accordance with Section 01 79 00 - Demonstration and Training.

END OF SECTION

Part 1 General**1.1 SUMMARY**

- .1 Related Requirements
 - .1 Section 25 05 01 – EMCS : General requirement.

1.2 DEFINITIONS

- .1 CDL - Control Description Logic.
- .2 For additional acronyms and definitions refer to Section 25 05 01 - EMCS: General Requirements.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00 - Documents and samples to be submitted, supplemented and modified by requirements of this Section.
- .2 Submit training proposal complete with hour-by-hour schedule including brief overview of content of each segment to Departmental Representative, 30 days prior to anticipated date of beginning of training.
 - .1 List name of trainer, and type of visual and audio aids to be used.
 - .2 Show co-ordinated interface with other EMCS mechanical and electrical training programs.
 - .3 Submit reports within one week after completion of training program that training has been satisfactorily completed.

1.4 QUALITY ASSURANCE

- .1 Provide competent instructors thoroughly familiar with aspects of EMCS installed in facility.
- .2 Departmental Representative reserves right to approve instructors.

1.5 INSTRUCTIONS

- .1 Provide instruction to designated personnel in adjustment, operation, maintenance and pertinent safety requirements of EMCS installed.
- .2 Training to be project-specific.

1.6 TIME FOR TRAINING

- .1 Number of days of instruction to be as specified in this section (1 day = 8 hours including two 15 minute breaks and excluding lunch time).

1.7 TRAINING MATERIALS

- .1 Provide equipment, visual and audio aids, and materials for classroom training.
-

- .2 Supply manual for each trainee, describing in detail data included in each training program.
 - .1 Review contents of manual in detail to explain aspects of operation and maintenance (O&M).

1.8 TRAINING PROGRAM

- .1 To be in one session.
- .2 Training for a period of two hours to begin two weeks after acceptance of the system at time mutually agreeable to Contractor, Departmental Representative and PWGSC Commissioning Manager.
 - .1 Train O&M personnel, maintenance personnel and programmers in functional operations and procedures to be employed for system operation.

1.9 ADDITIONAL TRAINING

- .1 List courses offered by name, duration and approximate cost per person per week. Note courses recommended for training supervisory personnel.

1.10 MONITORING OF TRAINING

- .1 Departmental Representative to monitor training program and may modify schedule and content.

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 SUMMARY**

- .1 Related Requirements
 - .1 The drawings and general provisions of the contract, including the “Conditions générales” (general clauses) and “Conditions supplémentaires” (additional clauses), as well as the sections of Division 01, apply to this section.

1.2 REFERENCES

- .1 American National Standards Institute (ANSI)/The Instrumentation, Systems and Automation Society (ISA).
 - .1 ANSI/ISA 5.5-1985, Graphic Symbols for Process Displays.
- .2 American National Standards Institute (ANSI)/ Institute of Electrical and Electronics Engineers (IEEE).
 - .1 ANSI/IEEE 260.1-1993, American National Standard Letter Symbols Units of Measurement (SI Units, Customary Inch-Pound Units, and Certain Other Units).
- .3 American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE).
 - .1 ASHRAE STD 135-R2001, BACNET - Data Communication Protocol for Building Automation and Control Network.
- .4 Canadian Standards Association (CSA International).
 - .1 CAN/CSA-Z234.1-89(R1995), Canadian Metric Practice Guide.
- .5 Consumer Electronics Association (CEA).
 - .1 CEA-709.1-B-2002, Control Network Protocol Specification.
- .6 Department of Justice Canada (Jus).
 - .1 Canadian Environmental Assessment Act (CEAA), 1995, c. 37.
 - .2 Canadian Environmental Protection Act (CEPA), 1999, c. 33.
- .7 Electrical and Electronic Manufacturers Association (EEMAC).
 - .1 EEMAC 2Y-1-1958, Light Gray Colour for Indoor Switch Gear.
- .8 Health Canada/Workplace Hazardous Materials Information System (WHMIS).
 - .1 Material Safety Data Sheets (MSDS).
- .9 Transport Canada (TC).
 - .1 Transportation of Dangerous Goods Act (TDGA), 1992, c. 34.

1.3 ACRONYMS AND ABBREVIATIONS

- .1 Acronyms used in EMCS:
 - .1 AEL - Average Effectiveness Level.
 - .2 AI - Analog Input.
 - .3 AIT - Agreement on International Trade.
-

- .4 AO - Analog Output.
- .5 BACnet - Building Automation and Control Network.
- .6 BC(s) - Building Controller(s).
- .7 BECC - Building Environmental Control Center.
- .8 CAD - Computer Aided Design.
- .9 CDL - Control Description Logic.
- .10 CDS - Control Design Schematic.
- .11 COSV - Change of State or Value.
- .12 CPU - Central Processing Unit.
- .13 DI - Digital Input.
- .14 DO - Digital Output.
- .15 DP - Differential Pressure.
- .16 ECU - Equipment Control Unit.
- .17 EMCS - Energy Monitoring and Control System.
- .18 HVAC - Heating, Ventilation, Air Conditioning.
- .19 IDE - Interface Device Equipment.
- .20 I/O - Input/Output.
- .21 ISA - Industry Standard Architecture.
- .22 LAN - Local Area Network.
- .23 LCU - Local Control Unit.
- .24 MCU - Master Control Unit.
- .25 NAFTA - North American Free Trade Agreement.
- .26 NC - Normally Closed.
- .27 NO - Normally Open.
- .28 OS - Operating System.
- .29 O&M - Operation and Maintenance.
- .30 OWS - Operator Work Station.
- .31 PC - Personal Computer.
- .32 PCI - Peripheral Control Interface.
- .33 PCMCIA - Personal Computer Micro-Card Interface Adapter.
- .34 PID - Proportional, Integral and Derivative.
- .35 RAM - Random Access Memory.
- .36 SP - Static Pressure.
- .37 ROM - Read Only Memory.
- .38 TCU - Terminal Control Unit.
- .39 USB - Universal Serial Bus.
- .40 UPS - Uninterruptible Power Supply.
- .41 VAV - Variable Air Volume.

1.4 DEFINITIONS

- .1 Point: may be logical or physical.
 - .1 Logical points: values calculated by system such as setpoints, totals, counts, derived corrections and may include, but not limited to result of and statements in CDL's.

- .2 Physical points: inputs or outputs which have hardware wired to controllers which are measuring physical properties, or providing status conditions of contacts or relays which provide interaction with related equipment (stop, start) and valve or damper actuators.
- .2 Point Name: composed of two parts, point identifier and point expansion.
 - .1 Point identifier: comprised of three descriptors, "area" descriptor, "system" descriptor and "point" descriptor, for which database to provide 25 character field for each point identifier. "System" is system that point is located on.
 - .1 Area descriptor: building or part of building where point is located.
 - .2 System descriptor: system that point is located on.
 - .3 Point descriptor: physical or logical point description. For point identifier "area", "system" and "point" will be shortforms or acronyms. Database must provide 25 character field for each point identifier.
 - .2 Point expansion: comprised of three fields, one for each descriptor. Expanded form of shortform or acronym used in "area", "system" and "point" descriptors is placed into appropriate point expansion field. Database must provide 32 character field for each point expansion.
 - .3 Bilingual systems to include additional point identifier expansion fields of equal capacity for each point name for second language.
 - .1 System to support use of numbers and readable characters including blanks, periods or underscores to enhance user readability for each of the above strings.
- .3 Point Object Type: points fall into following object types:
 - .1 AI (analog input).
 - .2 AO (analog output).
 - .3 DI (digital input).
 - .4 DO (digital output).
 - .5 Pulse inputs.
- .4 Symbols and engineering unit abbreviations utilized in displays: to ANSI/ISA S5.5.
 - .1 Printouts: to ANSI/IEEE 260.1.
 - .2 Refer also to Section 25 05 54 - EMCS: Identification.

1.5 SYSTEM DESCRIPTION

- .1 Work covered by sections referred to above consists of an extension of the fully operational existing Reliable Controls EMCS, including, but not limited to, following:
 - .1 Building Controllers.
 - .2 Control devices as listed in I/O point summary tables.
 - .3 OWS(s).
 - .4 Data communications equipment necessary to effect EMCS data transmission system.
 - .5 Field control devices.
 - .6 Hardware complete with full documentation.
 - .7 Complete operating and maintenance manuals.
 - .8 Training of personnel.
 - .9 Acceptance tests, technical support during commissioning, full documentation.
 - .10 Wiring interface co-ordination of equipment supplied by others.
 - .11 Miscellaneous work as specified in these sections and as indicated.

- .3 Design Requirements:
 - .1 Design and provide conduit and wiring linking elements of system.
 - .2 Supply sufficient programmable controllers of types to meet project requirements. Quantity and points contents as reviewed by Departmental Representative prior to installation.
 - .3 Location of controllers as reviewed by Departmental Representative prior to installation.
 - .4 Provide utility power to EMCS and emergency power to EMCS as indicated.
 - .5 Metric references: in accordance with CAN/CSA Z234.1.
- .4 Language Operating Requirements:
 - .1 Provide French operator selectable access codes.
 - .2 Use non-linguistic symbols for displays on graphic terminals wherever possible. Other information to be in French.
 - .4 System manager software: include in French system definition point database, additions, deletions or modifications, control loop statements, use of high level programming languages, report generator utility and other OS utilities used for maintaining optimal operating efficiency.

1.6 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Make submittals in accordance with Section 01 33 00 - Documents and samples to be submitted.
- .2 Quality Control:
 - .1 Provide equipment and material from manufacturer's regular production, CSA certified, manufactured to standard quoted plus additional specified requirements.
 - .2 Where CSA certified equipment is not available submit such equipment to inspection authorities for special inspection and approval before delivery to site.
 - .3 In lieu of such evidence, submit certificate from testing organization, approved by Departmental Representative, certifying that item was tested in accordance with their test methods and that item conforms to their standard/code.
 - .4 For materials whose compliance with organizational standards/codes/specifications is not regulated by organization using its own listing or label as proof of compliance, furnish certificate stating that material complies with applicable referenced standard or specification.
 - .5 Permits and fees: in accordance with general conditions of contract.
 - .6 Submit certificate of acceptance from authority having jurisdiction to Departmental Representative
 - .7 Existing devices intended for re-use: submit test report.

1.7 QUALITY ASSURANCE

- .1 Have local office within 50 km of project staffed by trained personnel capable of providing instruction, routine maintenance and emergency service on systems,
- .2 Provide record of successful previous installations submitting tender showing experience with similar installations utilizing computer-based systems.
- .3 Have access to local supplies of essential parts and provide 7 year guarantee of availability of spare parts after obsolescence.
- .4 Ensure qualified supervisory personnel continuously direct and monitor Work and attend site meetings.

- .5 Health and Safety:
 - .1 Do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety.

1.8 DELIVERY, STORAGE AND HANDLING

- .1 Material Delivery Schedule: provide Departmental Representative with schedule within 2 weeks after award of Contract.
- .2 Waste Management and Disposal:
 - .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Management and disposal of construction / demolition waste.
 - .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.
 - .4 Separate for reuse and recycling and place in designated containers Steel, Metal, Plastic waste in accordance with Waste Management Plan.
 - .5 Place materials defined as hazardous or toxic in designated containers.
 - .6 Handle and dispose of hazardous materials in accordance with Regional, regulations.
 - .7 Label location of salvaged material's storage areas and provide barriers and security devices.
 - .8 Ensure emptied containers are sealed and stored safely.
 - .9 Divert unused metal materials from landfill to metal recycling facility as approved by Departmental Representative.
 - .10 Fold up metal and plastic banding, flatten and place in designated area for recycling.

Part 2 Products

2.1 ADAPTORS

- .1 Provide adaptors between metric and imperial components.

Part 3 Execution

3.1 MANUFACTURER'S RECOMMENDATIONS

- .1 Installation: to manufacturer's recommendations.

3.2 PAINTING

- .1 Painting: in accordance with Section 09 91 23- Interior and Exterior Painting, supplemented as follows:
 - .1 Clean and touch up marred or scratched surfaces of factory finished equipment to match original finish.
 - .2 Restore to new condition, finished surfaces too extensively damaged to be primed and touched up to make good.
 - .3 Clean and prime exposed hangers, racks, fastenings, and other support components.
 - .4 Paint unfinished equipment installed indoors to EEMAC 2Y-1.

END OF SECTION

Part 1 General**1.01 DEFINITIONS**

- .1 BECC - Building Environmental Control Centre.
- .2 OWS - Operator Work Station.
- .3 For additional acryonyms and definitions refer to Section 25 05 01 - EMCS: General Requirements.

1.02 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submittals in accordance with Section 01 78 00 - Documents / Items to be submitted upon completion of work, supplemented and modified by requirements of this Section.
- .2 Submit Record Documents Operation and Maintenance Manual to Departmental Representative in English and French.
- .3 Provide soft copies and hard copies in hard-back, 50 mm 3 ring, D-ring binders.
 - .1 Binders to be 2/3 maximum full.
 - .2 Provide index to full volume in each binder.
 - .3 Identify contents of each manual on cover and spine.
 - .4 Provide Table of Contents in each manual.
 - .5 Assemble each manual to conform to Table of Contents with tab sheets placed before instructions covering subject.

1.03 AS-BUILTS

- .1 Provide 1 copy of detailed shop drawings generated in Section and include:
 - .1 Changes to Contract Documents as well as addenda and contract extras.
 - .2 Changes to interface wiring.
 - .3 Routing of conduit, wiring and control air lines associated with EMCS installation.
 - .4 Locations of obscure devices to be indicated on drawings.
 - .5 Listing of alarm messages.
 - .6 Panel/circuit breaker number for sources of normal/emergency power.
 - .7 Names, addresses, telephone numbers of each sub-contractor having installed equipment, local representative for each item of equipment, each system.
 - .8 Test procedures and reports: provide records of start-up procedures, test procedures, checkout tests and final commissioning reports as specified in Section 25 01 11 - EMCS: Start-up, Verification and Commissioning.
 - .9 Basic system design and full documentation on system configuration.
- .2 Submit for final review by Consultant.
- .3 Provide before acceptance 4 Hard and 1 soft copy incorporating changes made during final review.

1.04 O&M MANUALS

- .1 Custom design O&M Manuals (both hard and soft copy) to contain material pertinent to this project only, and to provide full and complete coverage of subjects referred to in this Section.
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- .2 Provide 2 complete sets of hard and soft copies prior to system or equipment tests
 - .3 Include complete coverage in concise language, readily understood by operating personnel using common terminology of functional and operational requirements of system. Do not presume knowledge of computers, electronics or in-depth control theory.
 - .4 Functional description to include:
 - .1 Functional description of theory of operation.
 - .2 Design philosophy.
 - .3 Specific functions of design philosophy and system.
 - .4 Full details of data communications, including data types and formats, data processing and disposition data link components, interfaces and operator tests or self-test of data link integrity.
 - .5 Explicit description of hardware and software functions, interfaces and requirements for components in functions and operating modes.
 - .6 Description of person-machine interactions required to supplement system description, known or established constraints on system operation, operating procedures currently implemented for implementation in automatic mode.
 - .5 System operation to include:
 - .1 Complete step-by-step procedures for operation of system including required actions at each OWS.
 - .2 Operation of computer peripherals, input and output formats.
 - .3 Emergency, alarm and failure recovery.
 - .4 Step-by-step instructions for start-up, back-up equipment operation, execution of systems functions and operating modes, including key strokes for each command so that operator need only refer to these pages for keystroke entries required to call up display or to input command.
 - .6 Software to include:
 - .1 Documentation of theory, design, interface requirements, functions, including test and verification procedures.
 - .2 Detailed descriptions of program requirements and capabilities.
 - .3 Data necessary to permit modification, relocation, reprogramming and to permit [new and existing, software modules to respond to changing system functional requirements without disrupting normal operation.
 - .4 Software modules, fully annotated source code listings, error free object code files ready for loading via peripheral device
 - .5 Complete program cross reference plus linking requirements, data exchange requirements, necessary subroutine lists, data file requirements, other information necessary for proper loading, integration, interfacing, program execution.
 - .6 Software for each Controller and single section referencing Controller common parameters and functions.
 - .7 Maintenance: document maintenance procedures including inspection, periodic preventive maintenance, fault diagnosis, repair or replacement of defective components, including calibration, maintenance, repair of sensors, transmitters, transducers, controller and interface firmware's, plus diagnostics and repair/replacement of system hardware.
 - .8 System configuration document:
 - .1 Provisions and procedures for planning, implementing and recording hardware and software modifications required during operating lifetime of system.
-

- .2 Information to ensure co-ordination of hardware and software changes, data link or message format/content changes, sensor or control changes in event that system modifications are required.
- .9 Programmer control panel documentation: provide where panels are independently interfaced with BECC, including interfacing schematics, signal identification, timing diagrams, fully commented source listing of applicable driver/handler.

Part 2 Products**2.01 NOT USED**

- .1 Not Used.

Part 3 Execution**3.01 NOT USED**

- .1 Not Used.

END OF SECTION

Part 1 General**1.01 SUMMARY**

- .1 Related Requirements
 - .1 Section 25 05 01 - EMCS: General Requirements.

1.02 REFERENCES

- .1 Canadian Standards Association (CSA International).
 - .1 CSA C22.1-02, The Canadian Electrical Code, Part I (19th Edition), Safety Standard for Electrical Installations.

1.03 DEFINITIONS

- .1 For acronyms and definitions refer to Section 25 05 01 - EMCS: General Requirements.

1.04 SYSTEM DESCRIPTION

- .1 Language Operating Requirements: provide identification for control items in French.
- .2 All identifications must meet the standards of Laval University.

1.05 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00 - Documents and samples to be submitted supplemented and modified by requirements of this Section.
- .2 Submit to Departmental Representative for approval if asked samples of nameplates, identification tags and list of proposed wording.

Part 2 Products**2.01 NAMEPLATES FOR PANELS**

- .1 Identify by Plastic laminate, 3 mm thick Melamine, matt white finish, 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.

2.02 NAMEPLATES FOR FIELD DEVICES

- .1 Identify by plastic encased cards attached by chain.
 - .2 Sizes: 50 x 100 mm minimum.
-

- .3 Lettering: minimum 5 mm high produced from laser printer in black.
- .4 Data to include: point name and point address.
- .5 Companion cabinet: identify interior components using plastic enclosed cards with point name and point address.

2.03 NAMEPLATES FOR ROOM SENSORS

- .1 Identify by stick-on labels using point identifier.
- .2 Location: as directed by Departmental Representative.
- .3 Letter size: to suit, clearly legible.

2.04 WARNING SIGNS

- .1 Equipment including motors, starters under remote automatic control: supply and install orange coloured signs warning of automatic starting under control of EMCS.
- .2 Sign to read: "Caution: This equipment is under automatic remote control of EMCS" as reviewed by Departmental Representative's.

2.05 WIRING

- .1 Supply and install numbered tape markings on wiring at panels, junction boxes, splitters, cabinets and outlet boxes.
- .2 Colour coding: to CSA C22.1. Use colour coded wiring in communications cables, matched throughout system.
- .3 Power wiring: identify circuit breaker panel/circuit breaker number inside each EMCS panel.

2.06 CONDUIT

- .1 Colour code EMCS conduit.
- .2 Pre-paint box covers and conduit fittings.
- .3 Coding: use fluorescent orange paint.

Part 3 Execution

3.01 NAMEPLATES AND LABELS

- .1 Ensure that manufacturer's nameplates, CSA labels and identification nameplates are visible and legible at all times.

3.02 EXISTING PANELS

- .1 Correct existing nameplates and legends to reflect changes made during Work.

END OF SECTION

Part 1 General**1.01 REFERENCES**

- .1 American National Standards Institute (ANSI)
 - .1 ANSI/ASME B16.22-2013, Wrought Copper and Copper Alloy Solder Joint Pressures Fittings.
 - .2 ANSI C2-1990, National Electrical Safety Code.
 - .3 ANSI/NFPA 70-1990, National Electrical Code.
- .2 CSA Group
 - .1 CSA C22.1-12,
 - .2 CAN/CSA-C22.3 No. 7-10, Underground Systems.
 - .3 CSA C22.2 No. 45.1-07(R2012), Electrical Rigid Metal Conduit.
 - .4 CSA C22.2 No. 56-13, Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit.
 - .5 CSA C22.2 No. 83-M1985(R2013), Electrical Metallic Tubing.
 - .6 CAN/CSA-C22.3 No. 1-10, Overhead Systems.

1.02 SYSTEM DESCRIPTION

- .1 Electrical:
 - .1 Provide power wiring from existing power panels to EMCS field panels. Circuits to be for exclusive use of EMCS equipment. Panel breakers to be identified on panel legends tagged and locks applied to breaker switches.
 - .2 Hard wiring between field control devices and EMCS field panels.
 - .3 Communication wiring between EMCS field panels and OWS's including main control centre BECC.
 - .4 Modify existing starters to provide for EMCS as indicated in I/O Summaries and as indicated.
 - .5 Refer to wiring diagrams included as part of flow diagrams. Trace existing control wiring installation and provide updated wiring schematics including additions and/or deletions to control circuits for approval by engineer before commencing work.
- .2 Mechanical:
 - .1 Pipe Taps Required For EMCS equipment will be supplied and installed by Division 23.
 - .2 Wells and Control Valves Shall Be Supplied by EMCS Contractor and Installed by Division 23.
 - .3 Installation of air flow stations, dampers, and other devices requiring sheet metal trades to be mounted by Division 23. Costs to be carried by designated trade.
- .3 Structural:
 - .1 Special steelwork as required for installation of work.

1.03 PERSONNEL QUALIFICATIONS

- .1 Qualified supervisory personnel to:
 - .1 Continuously direct and monitor all work.
 - .2 Attend site meetings.

1.04 EXISTING CONDITIONS

- .1 Cutting and Patching: refer to supplemented information as specified herein.
- .2 Repair all surfaces damaged during execution of work.
- .3 Turn over to Departmental Representative existing materials removed from work not identified for re-use.

Part 2 Products**2.01 WIRING**

- .1 As per requirements of Division 26.
- .2 For 70V and above copper conductor with chemically cross-linked thermosetting polyethylene insulation rated RW90 and 600V. Colour code to CSA 22.1.
- .3 For wiring under 70 volts use FT6 rated wiring where wiring is not run in conduit. All other cases use FT4 wiring.
- .4 Sizes:
 - .1 120V Power supply: to match or exceed breaker, size #12 minimum.
 - .2 Wiring for safeties/interlocks for starters, motor control centres, to be stranded, #14 minimum.
 - .3 Field wiring to digital device: #18 AWG 20 AWG stranded twisted pair.
 - .4 Analog input and output: shielded #18 minimum solid copper #20 minimum stranded twisted pair. Wiring must be continuous without joints.
 - .5 More than 4 conductors: #22 minimum solid copper.
- .5 Terminations:
 - .1 Terminate wires with screw terminal type connectors suitable for wire size, and number of terminations.

2.02 CONDUIT

- .1 As per requirements of Division 26.
- .2 Electrical metallic tubing to CSA C22.2 No. 83. Flexible and liquid tight flexible metal conduit to CSA C22.2 No. 56. Rigid steel threaded conduit to CSA C22.2 No. 45.1.
- .3 Junction and pull boxes: welded steel.
 - .1 Surface mounting cast FS: screw-on flat covers.
 - .2 Flush mounting: covers with 25 mm minimum extension all round.
- .4 Cabinets: sheet steel, for surface mounting, with hinged door, latch lock, 2 keys, complete with perforated metal mounting backboard. Panels to be keyed alike for similar functions and or entire contract as approved.
- .5 Outlet boxes: 100 mm minimum, square.

- .6 Conduit boxes, fittings:
 - .1 Bushings and connectors: with nylon insulated throats.
 - .2 With push pennies to prevent entry of foreign materials.
- .7 Fittings for rigid conduit:
 - .1 Couplings and fittings: threaded type steel.
 - .2 Double locknuts and insulated bushings: use on sheet metal boxes.
 - .3 Use factory "ells" where 90 degree bends required for 25 mm and larger conduits.
- .8 Fittings for thin wall conduit:
 - .1 Connectors and couplings: steel, set screw type.

2.03 WIRING DEVICES, COVER PLATES

- .1 Conform to CSA.
- .2 Receptacles:
 - .1 Duplex: CSA type 5-15R.
 - .2 Single: CSA type 5-15R.
 - .3 Cover plates and blank plates: finish to match other plates in area.

2.04 STARTERS, CONTROL DEVICES

- .1 Across-the-line magnetic starters:
 - .1 Enclosures: CSA Type 1, except where otherwise specified.
 - .2 Size, type and rating: to suit motors.
- .2 Starter diagrams:
 - .1 Provide copy of wiring and schematic diagrams - mount one copy in each starter with additional copies for operation and maintenance manual.
- .3 Auxiliary Control Devices:
 - .1 Control transformers: 60 Hz, primary voltage to suit supply, 120 V single phase secondary, VA rating to suit load plus 20% margin.
 - .2 Auxiliary contacts: one "Normally Open" and one "Normally Closed" spare auxiliary contact in addition to maintained auxiliary contacts as indicated.
 - .3 Hand-Off-Automatic switch: heavy duty type, knob lever operator.
 - .4 Double voltage relays: with barrier to separate relay contacts from operating magnet. Operating coil voltage and contact rating as indicated.
- .4 Finish for starters:
 - .1 Exterior: in accordance with Section 26 05 00 - Common Work Results for Electrical.
 - .2 Interior: white.

2.05 SUPPORTS FOR CONDUIT, FASTENINGS, EQUIPMENT

- .1 Solid masonry, tile and plastic surfaces: lead anchors or nylon shields.
 - .1 Hollow masonry walls, suspended drywall ceilings: toggle bolts.
- .2 Exposed conduits or cables:
 - .1 50 mm diameter and smaller: one-hole steel straps.
 - .2 Larger than 50 mm diameter: two-hole steel straps.

- .3 Suspended support systems:
 - .1 Individual cable or conduit runs: support with 6 mm diameter threaded rods and support clips.
 - .2 Two or more suspended cables or conduits: support channels supported by 6 mm diameter threaded rod hangers.

Part 3 Execution

3.01 INSTALLATION

- .1 Install equipment, components so that manufacturer's and CSA labels are visible and legible after commissioning is complete.

3.02 MECHANICAL PIPING

- .1 Install piping straight, parallel and close to building structure with required grades for drainage and venting.
- .2 Ream ends of pipes before assembly.
- .3 Copper tubing not to come into contact with dissimilar metal.
- .4 Use non-corrosive lubricant or Teflon tape on male screwed threads.
- .5 Clean ends of pipes, tubing and recesses of fittings to be brazed or soldered. Assemble joints without binding.
- .6 Install di-electric couplings where dissimilar metals joined.
- .7 Sleeves:
 - .1 Installation:
 - .1 Concrete, masonry walls, concrete floors on grade: terminate flush with finished surface.
 - .2 Other floors: terminate 25 mm above finished floor.
 - .3 Before installation, paint exposed exterior surfaces with heavy application of zinc-rich paint.
 - .2 Caulking:
 - .1 Foundation walls and below grade floors: fire retardant, waterproof non-hardening mastic.
 - .2 Elsewhere: provide space for fire stopping by Section 07 84 00 - Fire Protection. Maintain fire rating integrity.
 - .3 Sleeves installed for future use: fill with lime plaster or other easily removable filler.
 - .4 Ensure no contact between copper pipe or tube and sleeve.
- .8 Pressure tests:
 - .1 Pressure test all piping systems modified under this contract to 1 1/2 times maximum working pressure or 860 kPa (whichever is greater) for 4 hours without loss of pressure. Test all piping systems modified under this contract by means of visual inspection of each connection.
 - .2 Isolate equipment, components, not designed to withstand test pressure.
- .9 Introduce system pressure carefully into new piping.

3.03 SUPPORTS

- .1 Install special supports as required and as indicated.

3.04 ELECTRICAL GENERAL

- .1 Do complete installation in accordance with requirements of:
 - .1 Division 26, this specification.
 - .2 CSA 22.1 Canadian Electrical Code.
 - .3 ANSI/NFPA 70.
 - .4 ANSI C2.
- .2 Fully enclose or properly guard electrical wiring, terminal blocks, high voltage above 70 V contacts and mark to prevent accidental injury.
- .3 Do underground installation to CAN/CSA-C22.3 No.7, except where otherwise specified.
- .4 Conform to manufacturer's recommendations for storage, handling and installation.
- .5 Check factory connections and joints. Tighten where necessary to ensure continuity.
- .6 Install electrical equipment between 1000 and 2000 mm above finished floor wherever possible and adjacent to related equipment.
- .7 Protect exposed live equipment such as panel, mains, outlet wiring during construction for personnel safety.
- .8 Shield and mark live parts "LIVE 120 VOLTS" or other appropriate voltage.
- .9 Install conduits, and sleeves prior to pouring of concrete.
- .10 Holes through exterior wall and roofs: flash and make weatherproof.
- .11 Make necessary arrangements for cutting of chases, drilling holes and other structural work required to install electrical conduit, cable, pull boxes, outlet boxes.
- .12 Install cables, conduits and fittings which are to be embedded or plastered over, neatly and closely to building structure to minimize furring.

3.05 CONDUIT SYSTEM

- .1 Communication wiring shall be installed in conduit. Provide complete conduit system to link Building Controllers to BECC. Conduit sizes to suit wiring requirements and to allow for future expansion capabilities specified for systems. Maximum conduit fill not to exceed 40%. Design drawings do not show conduit layout.
 - .2 Install conduits parallel or perpendicular to building lines, to conserve headroom and to minimize interference.
 - .3 Do not run exposed conduits in normally occupied spaces unless otherwise indicated or unless impossible to do otherwise. Obtain approval from Departmental Representative/DCC Representative/Consultant before starting such work. Provide complete conduit system to link field panels and devices with main control centre. Conduit size to match conductors plus future expansion capabilities as specified.
-

- .4 Locate conduits at least 150 mm from parallel steam or hot water pipes and at least 50 mm at crossovers.
- .5 Bend conduit so that diameter is reduced by less than 1/10th original diameter.
- .6 Field thread on rigid conduit to be of sufficient length to draw conduits up tight.
- .7 Limit conduit length between pull boxes to less than 30 m.
- .8 Use conduit outlet boxes for conduit up to 32 mm diameter and pull boxes for larger sizes.
- .9 Fastenings and supports for conduits, cables, and equipment:
 - .1 Provide metal brackets, frames, hangers, clamps and related types of support structures as indicated and as required to support cable and conduit runs.
 - .2 Provide adequate support for raceways and cables, sloped vertically to equipment.
 - .3 Use supports or equipment installed by other trades for conduit, cable and raceway supports only after written approval from Departmental RepresentativeDCC RepresentativeConsultant.
- .10 Install polypropylene fish cord in empty conduits for future use.
- .11 Where conduits become blocked, remove and replace blocked sections.
- .12 Pass conduits through structural members only after receipt of Departmental Representative'sDCC Representative'sConsul tant's written approval.
- .13 Conduits may be run in flanged portion of structural steel.
- .14 Group conduits wherever possible on suspended or surface channels.
- .15 Pull boxes:
 - .1 Install in inconspicuous but accessible locations.
 - .2 Support boxes independently of connecting conduits.
 - .3 Fill boxes with paper or foam to prevent entry of construction material.
 - .4 Provide correct size of openings. Reducing washers not permitted.
 - .5 Mark location of pull boxes on record drawings.
 - .6 Identify AC power junction boxes, by panel and circuit breaker.
- .16 Install bonding conductor for 120 volt and above in conduit.

3.06 WIRING

- .1 Install multiple wiring in ducts simultaneously.
- .2 Do not pull spliced wiring inside conduits or ducts.
- .3 Use CSA certified lubricants of type compatible with insulation to reduce pulling tension.
- .4 Tests: use only qualified personnel. Demonstrate that:
 - .1 Circuits are continuous, free from shorts, unspecified grounds.
 - .2 Resistance to ground of all circuits is greater than 50 Megohms.
- .5 Provide Departmental Representative with test results showing locations, circuits, results of tests.

- .6 Remove insulation carefully from ends of conductors and install to manufacturer's recommendations. Accommodate all strands in lugs. Where insulation is stripped in excess, neatly tape so that only lug remains exposed.
- .7 Wiring in main junction boxes and pull boxes to terminate on terminal blocks only, clearly and permanently identified. Junctions or splices not permitted for sensing or control signal covering wiring.
- .8 Do not allow wiring to come into direct physical contact with compression screw.
- .9 Install ALL strands of conductor in lugs of components. Strip insulation only to extent necessary for installation.

3.07 WIRING DEVICES, COVER PLATES

- .1 Receptacles:
 - .1 Install vertically in gang type outlet box when more than one receptacle is required in one location.
- .2 Cover plates:
 - .1 Install suitable common cover plate where wiring devices are grouped.
 - .2 Use flush type cover plates only on flush type outlet boxes.

3.08 STARTERS, CONTROL DEVICES

- .1 Install and make power and control connections as indicated.
- .2 Install correct over-current devices.
- .3 Identify each wire, terminal for external connections with permanent number marking identical to diagram.
- .4 Performance Verification:
 - .1 Operate switches and controls to verify functioning.
 - .2 Perform start and stop sequences of contactors and relays.
 - .3 Check that interlock sequences, with other separate related starters, equipment and auxiliary control devices, operate as specified.

3.09 GROUNDING

- .1 Install complete, permanent, continuous grounding system for equipment, including conductors, connectors and accessories.
- .2 Install separate grounding conductors in conduit within building.
- .3 Install ground wire in all PVC ducts and in tunnel conduit systems.
- .4 Tests: perform ground continuity and resistance tests, using approved method appropriate to site conditions.

3.10 TESTS

- .1 General:
 - .1 Perform following tests in addition to tests specified Section 25 08 20 - EMCS: Warranty and Maintenance.

- .2 Give 14 days written notice of intention to test.
- .3 Conduct in presence of Departmental Representative and authority having jurisdiction.
- .4 Conceal work only after tests satisfactorily completed.
- .5 Report results of tests to Departmental Representative in writing.
- .6 Preliminary tests:
 - .1 Conduct as directed to verify compliance with specified requirements.
 - .2 Make needed changes, adjustments, replacements.
 - .3 Insulation resistance tests:
 - .1 Megger all circuits, feeders, equipment for 120 - 600V with 1000V instrument. Resistance to ground to be more than required by Code before energizing.
 - .2 Test insulation between conductors and ground, efficiency of grounding system to satisfaction of Departmental Representative and authority having jurisdiction.

3.13 IDENTIFICATION

- .1 Refer to Section 25 05 54 - EMCS: Identification.

END OF SECTION

Part 1 General**1.01 SUMMARY**

- .1 Related Requirements
 - .1 Section 25 05 01 - EMCS: General Requirements.
- .2 References.
 - .1 Canada Labour Code (R.S. 1985, c. L-2)/Part I - Industrial Relations.
 - .2 Canadian Standards Association (CSA International).
 - .1 CSA Z204-94(R1999), Guidelines for Managing Indoor Air Quality in Office Buildings.

1.02 DEFINITIONS

- .1 BC(s) - Building Controller(s).
- .2 OWS - Operator Work Station.
- .3 For additional acronyms and definitions refer to Section 25 05 01 - EMCS: General Requirements.

1.03 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00 - Documents and samples to be submitted.
- .2 Submit detailed preventative maintenance schedule for system components to Departmental Representative.
- .3 Submit detailed inspection reports to Departmental Representative.
- .4 Submit dated, maintenance task lists to Departmental Representative and include the following sensor and output point detail, as proof of system verification:
 - .1 Point name and location.
 - .2 Device type and range.
 - .3 Measured value.
 - .4 System displayed value.
 - .5 Calibration detail
 - .6 Indication if adjustment required,
 - .7 Other action taken or recommended.
- .5 Submit network analysis report showing results with detailed recommendations to correct problems found.
- .6 Records and logs: in accordance with Section 01 78 00 - Documents / Items to be submitted upon completion of work.
 - .1 Maintain records and logs of each maintenance task on site.
 - .2 Organize cumulative records for each major component and for entire EMCS chronologically.
 - .3 Submit records to Departmental Representative, after inspection indicating that planned and systematic maintenance have been accomplished.

- .7 Revise and submit to Departmental Representative in accordance with Section 01 78 00 - Documents / Items to be submitted upon completion of work "As-built drawings" documentation and commissioning reports to reflect changes, adjustments and modifications to EMCS made during warranty period.

1.04 MAINTENANCE SERVICE DURING WARRANTY PERIOD

- .1 Provide services, materials, and equipment to maintain EMCS for specified warranty period. Provide detailed preventative maintenance schedule for system components as described in Submittal article.
- .2 Emergency Service Calls:
 - .1 Initiate service calls when EMCS is not functioning correctly.
 - .2 Qualified control personnel to be available during warranty period to provide service to "CRITICAL" components whenever required at no extra cost.
 - .3 Furnish Departmental Representative with telephone number where service personnel may be reached at any time.
 - .4 Service personnel to be on site ready to service EMCS within 2 hours after receiving request for service.
 - .5 Perform Work continuously until EMCS restored to reliable operating condition.
- .3 Operation: foregoing and other servicing to provide proper sequencing of equipment and satisfactory operation of EMCS based on original design conditions and as recommended by manufacturer.
- .4 Work requests: record each service call request, when received separately on approved form and include:
 - .1 Serial number identifying component involved.
 - .2 Location, date and time call received.
 - .3 Nature of trouble.
 - .4 Names of personnel assigned.
 - .5 Instructions of work to be done.
 - .6 Amount and nature of materials used.
 - .7 Time and date work started.
 - .8 Time and date of completion.
- .5 Provide system modifications in writing.
 - .1 No system modification, including operating parameters and control settings, to be made without prior written approval of Departmental Representative.

Part 2 Products

2.01 NOT USED

- .1 Not Used.

Part 3 Execution**3.01 FIELD QUALITY CONTROL**

- .1 Perform as minimum (3) three minor inspections and one major inspection (more often if required by manufacturer) per year. Provide detailed written report to Departmental Representative as described in Submittal article.
 - .2 Perform inspections during regular working hours, 0800 to 1630 h, Monday through Friday, excluding statutory holidays.
 - .3 Following inspections are minimum requirements and should not be interpreted to mean satisfactory performance:
 - .1 Perform calibrations using test equipment having traceable, certifiable accuracy at minimum 50% greater than accuracy of system displaying or logging value.
 - .2 Check and Calibrate each field input/output device in accordance with Canada Labour Code - Part I and CSA Z204.
 - .3 Provide dated, maintenance task lists, as described in Submittal article, as proof of execution of complete system verification.
 - .4 Minor inspections to include, but not limited to:
 - .1 Perform visual, operational checks to BC's, peripheral equipment, interface equipment and other panels.
 - .2 Check equipment cooling fans as required.
 - .3 Visually check for mechanical faults, air leaks and proper pressure settings on pneumatic components.
 - .4 Review system performance with Departmental Representative to discuss suggested or required changes.
 - .5 Major inspections to include, but not limited to:
 - .1 Minor inspection.
 - .2 Clean OWS(s) peripheral equipment, BC(s), interface and other panels, micro-processor interior and exterior surfaces.
 - .3 Check signal, voltage and system isolation of BC(s), peripherals, interface and other panels.
 - .4 Verify calibration/accuracy of each input and output device and recalibrate or replace as required.
 - .5 Provide mechanical adjustments, and necessary maintenance on printers.
 - .6 Run system software diagnostics as required.
 - .7 Install software and firmware enhancements to ensure components are operating at most current revision for maximum capability and reliability.
 - .1 Perform network analysis and provide report as described in Submittal article.
 - .6 Rectify deficiencies revealed by maintenance inspections and environmental checks.
 - .7 Continue system debugging and optimization.
-

- .8 Testing/verification of occupancy and seasonal-sensitive systems to take place during four (4) consecutive seasons, after facility has been accepted, taken over and fully occupied.
- .1 Test weather-sensitive systems twice: first at near winter design conditions and secondly under near summer design conditions.

END OF SECTION

Part 1 General**1.01 SUMMARY**

- .1 Related Requirements
 - .1 Section 25 05 01 - EMCS: General Requirements.

1.02 REFERENCES

- .1 American Society of Heating, Refrigeration and Air-Conditioning Engineers, Inc. (ASHRAE).
 - .1 ASHRAE 2003, Applications Handbook, SI Edition.
- .2 Canadian Standards Association (CSA International).
 - .1 C22.2 No.205-M1983(R1999), Signal Equipment.
- .3 Institute of Electrical and Electronics Engineers (IEEE).
 - .1 IEEE C37.90.1-02, Surge Withstand Capabilities (SWC) Tests for Relays and Relay Systems Associated with Electric Power Apparatus.
- .4 Public Works and Government Services Canada (PWGSC)/Real Property Branch/Architectural and Engineering Services.
 - .1 MD13800-September 2000, Energy Management and Control Systems (EMCS) Design Manual. English: <ftp://ftp.pwgsc.gc.ca/rps/docentre/mechanical/me214-e.pdf>

1.03 DEFINITIONS

- .1 Acronyms and definitions: refer to Section 25 05 01 - EMCS: General Requirements.

1.04 DESCRIPTION

- .1 General: Network of controllers comprising of MCU('s), or LCU('s) to be provided as indicated in System Architecture Diagram to support new building systems and associated sequence(s) of operations as detailed in these specifications.
 - .1 Provide sufficient controllers to meet intents and requirements of this section.
 - .2 Controller quantity, and point contents to be approved by Departmental Representative at time of preliminary design review.
 - .2 Controllers: stand-alone intelligent Control Units.
 - .1 Incorporate programmable microprocessor, non-volatile program memory, RAM, power supplies, as required to perform specified functions.
 - .2 Incorporate communication interface ports for communication to LANs to exchange information with other Controllers.
 - .3 Capable of interfacing with operator interface device.
 - .4 Execute its logic and control using primary inputs and outputs connected directly to its onboard input/output field terminations or slave devices, and without need to interact with other controller. Secondary input used for reset such as outdoor air temperature may be located in other Controller(s).
 - .1 Secondary input used for reset such as outdoor air temperature may be located in other Controller(s).
-

- .3 Interface to include provisions for use of dial-up modem for interconnection with remote modem.
 - .1 Dial-up communications to use 56 Kbit modems and voice grade telephone lines.
 - .2 Each stand-alone panel may have its own modem or group of stand-alone panels may share modem.

1.05 DESIGN REQUIREMENTS

- .1 To include:
 - .1 Scanning of AI and DI connected inputs for detection of change of value and processing detection of alarm conditions.
 - .2 Perform On-Off digital control of connected points, including resulting required states generated through programmable logic output.
 - .3 Perform Analog control using programmable logic, (including PID) with adjustable dead bands and deviation alarms.
 - .4 Control of systems as described in sequence of operations.
 - .5 Execution of optimization routines as listed in this section.
- .2 Total spare capacity for MCUs and LCUs: at least 25 % of each point type distributed throughout the MCUs and LCUs.
- .3 Field Termination and Interface Devices:
 - .1 To: CSA C22.2 No.205.
 - .2 Electronically interface sensors and control devices to processor unit.
 - .3 Include, but not be limited to, following:
 - .1 Programmed firmware or logic circuits to meet functional and technical requirements.
 - .2 Power supplies for operation of logics devices and associated field equipment.
 - .3 Lockable wall cabinet.
 - .4 Required communications equipment and wiring (if remote units).
 - .5 Leave controlled system in "fail-safe" mode in event of loss of communication with, or failure of, processor unit.
 - .6 Input Output interface to accept as minimum AI, AO, DI, DO functions as specified.
 - .7 Wiring terminations: use conveniently located screw type or spade lug terminals.
- .4 AI interface equipment to:
 - .1 Convert analog signals to digital format with 10 bit analog-to-digital resolution.
 - .2 Provide for following input signal types and ranges:
 - .1 4 - 20 mA;
 - .2 0 - 10 V DC;
 - .3 100/1000 ohm RTD input;
 - .3 Meet IEEE C37.90.1 surge withstand capability.
 - .4 Have common mode signal rejection greater than 60 dB to 60 Hz.
 - .5 Where required, dropping resistors to be certified precision devices which complement accuracy of sensor and transmitter range specified.
- .5 AO interface equipment:
 - .1 Convert digital data from controller processor to acceptable analog output signals using 8 bit digital-to-analog resolution.

- .2 Provide for following output signal types and ranges:
 - .1 4 - 20 mA.
 - .2 0 - 10 V DC.
- .3 Meet IEEE C37.90.1 surge withstand capability.
- .6 DI interface equipment:
 - .1 Able to reliably detect contact change of sensed field contact and transmit condition to controller.
 - .2 Meet IEEE C37.90.1 surge withstand capability.
 - .3 Accept pulsed inputs up to 2 kHz.
- .7 DO interface equipment:
 - .1 Respond to controller processor output, switch respective outputs. Each DO hardware to be capable of switching up to 0.5 amps at 24 V AC.
 - .2 Switch up to 5 amps at 220 V AC using optional interface relay.
- .4 Controllers and associated hardware and software: operate in conditions of 0 degrees C to 44 degrees C and 20 % to 90 % non-condensing RH.
- .5 Controllers (MCU, LCU): mount in wall mounted cabinet with hinged, keyed-alike locked door.
 - .1 Provide for conduit entrance from top, bottom or sides of panel.
 - .2 Mounting details as approved by Departmental Representative for ceiling mounting.
- .6 Cabinets to provide protection from water dripping from above, while allowing sufficient airflow to prevent internal overheating.
- .7 Provide surge and low voltage protection for interconnecting wiring connections.

1.06 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Make submittals in accordance with Section 01 33 00 - Documents and samples to be submitted.
 - .1 Submit product data sheets for each product item proposed for this project.

1.07 MAINTENANCE

- .1 Provide manufacturers recommended maintenance procedures.

Part 2 Products

2.01 LOCAL CONTROL UNIT (LCU)

- .1 Provide multiple control functions for typical built-up and package HVAC systems, hydronic systems and electrical systems.
- .2 Minimum of 16 I/O points of which minimum be 4 AOs, 4 AIs, 4 DIs, 4 DOs.
- .3 Points integral to one Building System to be resident on only one controller.
- .4 Microprocessor capable of supporting necessary software and hardware to meet specified requirements as listed in previous MCU article with following additions:
 - .1 Include minimum 2 interface ports for connection of local computer terminal.
 - .2 Design so that shorts, opens or grounds on input or output will not interfere with other input or output signals.

- .3 Physically separate line voltage (70V and over) circuits from DC logic circuits to permit maintenance on either circuit with minimum hazards to technician and equipment.
 - .4 Include power supplies for operation of LCU and associated field equipment.
 - .5 In event of loss of communications with, or failure of, MCU, LCU to continue to perform control. Controllers that use defaults or fail to open or close positions not acceptable.
 - .6 Provide conveniently located screw type or spade lug terminals for field wiring.
- .5 Product: The existing controls in the building are from AC Controls, Reliable model

2.02 POINT NAME SUPPORT

- .1 Controllers (MCU, LCU) to support PWGSC point naming convention as defined in Section 25 05 01 - EMCS: General Requirements.

Part 3 Execution

3.01 LOCATION

- .1 Location of Controllers to be approved by Departmental Representative.

3.02 INSTALLATION

- .1 Install Controllers in secure locking enclosures.
- .2 Provide necessary power from local 120 V branch circuit panel for equipment.
- .3 Install tamper locks on breakers of circuit breaker panel.
- .4 Use uninterruptible Power Supply (UPS) and emergency power when equipment must operate in emergency and co-ordinating mode.

END OF SECTION

Part 1 General**1.01 SUMMARY**

- .1 Related Sections:
 - .1 Section 07 84 00 – Fire Protection.
 - .2 Section 25 01 11 - EMCS: Start-Up, Verification and Commissioning.
 - .3 Section 25 05 01 - EMCS: General Requirements.
 - .4 Section 25 05 54 - EMCS: Identification.
 - .5 Section 25 90 01 - EMCS: Site Requirements Applications and Systems Sequences of Operation.
 - .6 Section 26 05 00 - Common Work Results - Electrical.
 - .7 Section 26 27 26 - Wiring Devices.

1.02 REFERENCES

- .1 American National Standards Institute (ANSI).
 - .1 ANSI C12.7-1993(R1999), Requirements for Watthour Meter Sockets.
 - .2 ANSI/IEEE C57.13-1993, Standard Requirements for Instrument Transformers.
- .2 American Society for Testing and Materials International, (ASTM).
 - .1 ASTM B 148-97(03), Standard Specification for Aluminum-Bronze Sand Castings.
- .3 National Electrical Manufacturer's Association (NEMA).
 - .1 NEMA 250-03, Enclosures for Electrical Equipment (1000 Volts Maximum).
- .4 Air Movement and Control Association, Inc. (AMCA).
 - .1 AMCA Standard 500-D-98, Laboratory Method of Testing Dampers For Rating.
- .5 Canadian Standards Association (CSA International).
 - .1 CSA-C22.1-02, Canadian Electrical Code, Part 1 (19th Edition), Safety Standard for Electrical Installations.

1.03 DEFINITIONS

- .1 Acronyms and Definitions: refer to Section 25 05 01 - EMCS: General Requirements.

1.04 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit shop drawings and manufacturer's installation instructions in accordance with Section 01 33 00 - Documents and samples to be submitted.
- .2 Manufacturer's Instructions:
 - .1 Submit manufacturer's installation instructions for specified equipment and devices.

1.05 EXISTING CONDITIONS

- .1 Repair surfaces damaged during execution of Work.
- .2 Turn over to Departmental Representative existing materials removed from Work not identified for re-use.

Part 2 Products**2.01 GENERAL**

- .1 Control devices of each category to be of same type and manufacturer.
- .2 External trim materials to be corrosion resistant. Internal parts to be placed under housing.
- .3 Operating conditions: 0 - 32 degrees C with 10 - 90 % RH (non-condensing) unless otherwise specified.
- .4 Terminations: use standard conduit box with slot screwdriver compression connector block unless otherwise specified.
- .5 Transmitters and sensors to be unaffected by external transmitters including walkie talkies.
- .6 Account for hysteresis, relaxation time, maximum and minimum limits in applications of sensors and controls.
- .7 Outdoor installations: use weatherproof construction in NEMA 4 enclosures.
- .8 Range: including temperature, humidity, pressure, as indicated in I/O summary in Section 25 90 01 - EMCS: Site Requirements, Applications and System Sequences of Operation.

2.02 ROOM TEMPERATURE SENSORS

- .1 Equipped with a thermistor that varies with the temperature.
- .2 Sensor range: 4 to 37 °C.
- .3 Accuracy: ± 0.2 °C.
- .4 In an ventilated case allowing operation.

2.03 STATIC AND DIFFERENTIAL PRESSURE TRANSDUCER (AIR – ROOMS OR CONDUITS)

- .1 Omnidirectional sensor with range appropriate for the required readings and compensation for temperature.
 - .2 Accuracy: 2 percent of full scale with 0.5 percent repeatability.
 - .3 Output: 4 - 20 mA or 0-10 VDC.
 - .4 Range for static pressure in conduits: 0 to 1240 Pa (0- to 5-inches CE).
 - .5 Digital display.
 - .6 Acceptable products:
 - 1. Setra;
 - 2. Vaisala;
 - 3. Mamac;
 - 4. KMC;
 - 5. Ashcroft.
-

6. Replacement Products : approved in addendum in accordance with the Instructions to Bidders.

2.04 ELECTROMECHANICAL RELAYS

- .1 Requirements:
- .1 Double voltage, DPDT, plug-in type with termination base.
 - .2 Coils: rated for 24V DC. Other voltage: provide transformer.
 - .3 Contacts: rated at 5 amps at 120 V AC.
 - .4 Relay to have visual status indication

2.05 CURRENT TRANSDUCERS

- .1 Requirements:
- .2 Purpose: combined sensor/transducer, to measure line current and produce proportional signal in one of following ranges:
- .1 4-20 mA DC.
 - .2 0-1 volt DC.
 - .3 0-10 volts DC.
 - .4 0-20 volts DC.
- .3 Frequency insensitive from 10 - 80 hz.
- .4 Accuracy to 0.5% full scale.
- .5 Zero and span adjustments. Field adjustable range to suit motor applications.
- .6 Adjustable mounting bracket to allow for secure/safe mounting inside MCC.

2.06 ELECTRONIC CONTROL DAMPER ACTUATORS

- .1 Requirements:
- .1 Direct mount proportional type as indicated.
 - .2 Spring return for "fail-safe" in Normally Open or Normally Closed position as indicated.
 - .3 Operator: size to control dampers against maximum pressure and dynamic closing/opening pressure, whichever is greater.
 - .4 Power requirements: 5 VA maximum at 24 V AC.
 - .5 Operating range: 0 - 10 V DC or 4 - 20 mA DC.
 - .6 For VAV box applications floating control type actuators may be used.
 - .7 Damper actuator to drive damper from full open to full closed in less than 120 seconds.

2.07 PANELS

- .1 Wall mounted enamelled steel cabinets with hinged and key-locked front door.
- .2 Multiple panels as required to handle requirements with additional space to accommodate 25% additional capacity as required by Departmental Representative without adding additional cabinets.
- .3 Panels to be lockable with same key.

2.08 WIRING

- .1 In accordance with Section 26 27 26 - Wiring Devices.
- .2 For wiring under 70 volts use FT6 rated wiring where wiring is not run in conduit. Other cases use FT4 wiring.
- .3 Wiring must be continuous without joints.
- .4 Sizes:
 - .1 Field wiring to digital device: #18AWG stranded twisted pair.
 - .2 Analog input and output: shielded #18 minimum twisted pair.

Part 3 Execution**3.01 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 Temperature transmitters, humidity transmitters, current-to-pneumatic transducers, solenoid air valves, controllers, relays: install in NEMA I enclosure or as required for specific applications. Provide for electrolytic isolation in cases when dissimilar metals make contact.
- .4 Support field-mounted panels, transmitters and sensors on pipe stands or channel brackets.
- .5 Fire stopping: provide space for fire stopping in accordance with Section 07 84 00 – Fire Protection. Maintain fire rating integrity.
- .6 Electrical:
 - .1 Complete installation in accordance with Section 26 05 00 - Common Work Results - Electrical.
 - .2 Modify existing starters to provide for EMCS as indicated in I/O Summaries and as indicated.
 - .3 Refer to electrical control schematics included as part of control design schematics in Section 25 90 01 - EMCS: Site Requirements Applications and Systems Sequences of Operation. Trace existing control wiring installation and provide updated wiring schematics including additions, deletions to control circuits for review by Departmental Representative before beginning Work.
 - .4 Terminate wires with screw terminal type connectors suitable for wire size, and number of terminations.
 - .5 Install communication wiring in conduit.
 - .1 Provide complete conduit system to link Building Controllers, field panels and OWS(s).
 - .2 Conduit sizes to suit wiring requirements and to allow for future expansion capabilities specified for systems.
 - .3 Maximum conduit fill not to exceed 40%.
 - .4 Design drawings do not show conduit layout.

- .6 Do not run exposed conduits in normally occupied spaces unless otherwise indicated or unless impossible to do otherwise. Departmental Representative to review before starting Work. Wiring in mechanical rooms, wiring in service rooms and exposed wiring must be in conduit.

3.02 TEMPERATURE 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 Duct installations:
 - .1 Do not mount in dead air space.
 - .2 Locate within sensor vibration and velocity limits.
 - .3 Securely mount extended surface sensor used to sense average temperature.
 - .4 Thermally isolate elements from brackets and supports to respond to air temperature only.

3.03 PANELS

- .1 Arrange for conduit and tubing entry from top, bottom or either side.
- .2 Wiring and tubing within panels: locate in trays or individually clipped to back of panel.
- .3 Identify wiring and conduit clearly.

3.04 MAGNEHELIC PRESSURE INDICATORS

- .1 Install adjacent to fan system static pressure sensor and duct system velocity pressure sensor as reviewed by Departmental Representative.
- .2 Locations: as indicated.

3.05 I/P TRANSDUCERS

- .1 Install air pressure gauge on outlet.

3.06 IDENTIFICATION

- .1 Identify field devices in accordance with Section 25 05 54 - EMCS: Identification.

3.07 TESTING AND COMMISSIONING

- .1 Calibrate and test field devices for accuracy and performance in accordance with Section 25 01 11 - EMCS: Start-up, Verification and Commissioning.

END OF SECTION

Part 1 General**1.01 REFERENCES**

- .1 Public Works and Government Services Canada (PWGSC) / Real Property Branch / Architectural and Engineering Services.
 - .1 MD13800-September 2000, Energy Management and Control Systems (EMCS) Design Manual. English: <ftp://ftp.pwgsc.gc.ca/rps/docentre/mechanical/me214-e.pdf>

1.02 SEQUENCING

- .1 Present sequencing of operations for systems, in accordance with MD13800 - Energy Management and Control Systems (EMCS) Design Manual.
 - .1 Ventilation system.
- .2 Sequencing of system operations consistent with the following sequences:
 - .1 Elevator 1
The transfer fan is on at all times.
Alarm: High (85°F) and low (65°F) room temperature
 - .2 Elevator 2
The system is operational at all times.

Off:
 - The fan is off.
 - Dampers are in their normal position.
 - Outside air intake (PAE): Closed.
 - Outside air outlet (SAE): Closed
 - Recirculation: Open
On:
 - The fan is turned on.
 - On a cooling demand from the room temperature sensor, the dampers modulate to maintain the room setpoint, minimum supply temperature is 55°F;
 - On a heating demand, the system is in recirculation mode with 5% outside air;
 - A low freeze limit stops the system on a supply temperature below 40°F, this limit can be bypassed 5 minutes after the system start-up via a relay-delay. The system shall automatically reset itself for 3 attempts; thereafter, it shuts down and requires a manual reset.
Alarms :
 - High (105°F) and low (50°F) temperature;
 - Fan failure;
 - Low freeze limit (after 3 tries).

Part 2 Products

2.01 NOT USED

.1 Not Used.

Part 3 Execution

3.01 NOT USED

.1 Not Used.

END OF SECTION

1 GENERAL

1.01 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CSA C22.10-18, Canadian Electrical Code, Part 1, Safety Standard for Electrical Installations.
 - .2 CAN3-C235-F83 (C2015) - Preferred Voltage Levels for AC Systems, 0 to 50 000 V.
- .2 Electrical and Electronic Manufacturer's Association of Canada (EEMAC)
 - .1 EEMAC 2Y-1-1958, Light Gray Colour for Indoor Switch Gear.
- .3 Canada Green Building Council - Québec

1.02 DEFINITIONS

- .1 Electrical and electronic terms: unless otherwise specified or indicated, terms used in these specifications, and on drawings, are those defined by IEEE SP1122.

1.03 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 for control items in French and English.
- .4 Use one nameplate for both languages.

1.04 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submittals: in accordance with Section 01 33 00 – Documents and samples to be submitted.
 - .2 Shop drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Quebec.
 - .2 Submit wiring diagrams and installation details of equipment indicating proposed location, layout and arrangement, control panels, accessories, piping, ductwork, and other items that must be shown to ensure co-ordinated installation.
 - .3 Identify on wiring diagrams circuit terminals and indicate internal wiring for each item of equipment and interconnection between each item of equipment.
 - .4 Indicate of drawings clearances for operation, maintenance, and replacement of operating equipment devices.
-

- .5 Submit by sending PDF drawings and technical data at Departmental Representative.
- .6 If changes are required, notify Departmental Representative of these changes before they are made.
- .3 Quality Control: in accordance with Section 01 45 00 - Quality Control.
 - .1 Provide CSA certified equipment and material.
 - .2 Submit test results of installed electrical systems and instrumentation.
 - .3 Permits and fees: in accordance with the General Provisions of the contract.
 - .4 Submit, upon completion of Work, load balance report as described in PART 3 - LOAD BALANCE.
 - .5 Submit certificate of acceptance from authority having jurisdiction upon completion of Work to Departmental Representative.
- .4 Manufacturer's Field Reports: submit to Departmental Representative manufacturer's written report, within 3 days of review, verifying compliance of Work and electrical system and instrumentation testing, as described in PART 3 - FIELD QUALITY CONTROL.

1.05 QUALITY ASSURANCE

- .1 Quality Assurance: in accordance with Section 01 45 00 - Quality Control.
- .2 Electrical Work to be carried out by qualified, licensed electricians who hold valid Master Electrical Contractor license as per the conditions of Provincial Act respecting manpower vocational training and qualification.
 - .1 Employees registered in provincial apprentices program: permitted, under direct supervision of licensed electrician, to perform specific tasks.
 - .2 Permitted activities: determined based on training level attained and demonstration of ability to perform specific duties.
- .3 Site Meetings:
 - .1 Site meetings are required.
- .4 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety.

1.06 DELIVERY, STORAGE AND HANDLING

- .1 Material Delivery Schedule: provide Departmental Representative with schedule within 2 weeks after award of Contract.
- .2 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Section 01 74 21 – Management and disposal of construction / demolition waste.

1.07 SYSTEM STARTUP

- .1 Instruct Departmental Representative and operating personnel in operation, care and maintenance of systems, system equipment and components.
 - .2 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.
-

1.08 OPERATING INSTRUCTIONS

- .1 Provide for each system and principal item of equipment as specified in technical sections for use by operation and maintenance personnel.
- .2 Operating instructions to include following:
 - .1 Wiring diagrams, control diagrams, and control sequence for each principal system and item of equipment.
 - .2 Start up, proper adjustment, operating, lubrication, and shutdown procedures.
 - .3 Safety precautions.
 - .4 Procedures to be followed in event of equipment failure.
 - .5 Other items of instruction as recommended by manufacturer of each system or item of equipment.

2 PRODUCTS

2.01 MATERIALS AND EQUIPMENT

- .1 Provide material and equipment in accordance with Section 01 61 00 – General product requirements.
- .2 Material and equipment to be CSA certified or other accredited body. Where CSA certified material and equipment is are not available, obtain special approval from authority having jurisdiction before delivery to site and submit such approval as described in PART 1 - SUBMITTALS.
- .3 Factory assemble control panels and component assemblies.

2.02 ELECTRIC MOTORS, EQUIPMENT AND CONTROLS

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

2.03 WIRING TERMINATIONS

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

2.04 EQUIPMENT IDENTIFICATION

- .1 Identify electrical equipment with nameplates and labels as follows:
 - .1 Nameplates: lamicoid 3 mm thick plastic engraving sheet white plate, black letters core, lettering accurately aligned, engraved into core and glued.
 - .2 Sizes as follows:

NAMEPLATE SIZES

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

- .2 Wording on nameplates to be approved by Departmental Representative prior to manufacture.
- .3 Allow for minimum of twenty-five (25) letters per nameplate.
- .4 Nameplates for terminal cabinets and junction boxes to indicate system and/or voltage characteristics.
- .5 Disconnects, starters and contactors: indicate equipment being controlled and voltage.
- .6 Terminal cabinets and pull boxes: indicate system and voltage.
- .7 Transformers: indicate capacity, primary and secondary voltages.

2.05 WIRING IDENTIFICATION

- .1 Identify wiring with permanent indelible identifying markings, numbered coloured plastic tapes, on both ends of phase conductors of feeders and branch circuit wiring.
- .2 Maintain phase sequence and colour coding throughout.
- .3 Colour coding: to CSA C22.1.
- .4 Use colour coded wires in communication cables, matched throughout system.

2.06 CONDUIT AND CABLE IDENTIFICATION

- .1 Colour code conduits, boxes and metallic sheathed cables.
- .2 Code with plastic tape or paint at points where conduit or cable enters wall, ceiling, or floor, and at 15 m intervals.
- .3 Colours: 25 mm wide prime colour and 20 mm wide auxiliary colour.

	Prime	Auxiliary
Up to 250 V	Yellow	
Up to 600 V	Yellow	Green
Up to 5 kV	Yellow	Blue
Up to 15 kV	Yellow	Red
Telephone	Green	
Other communication	Green	Bleu
Systems fire alarm	Red	
Emergency voice	Red	Bleu
Other security systems	Red	Yellow

2.07 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 outdoor electrical equipment "equipment green" finish.
 - .2 Paint indoor switchgear and distribution enclosures light gray to EEMAC 2Y-1.

3 EXECUTION

3.01 INSTALLATION

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

3.02 NAMEPLATES AND LABELS

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

3.03 LOCATION OF OUTLETS

- .1 Locate outlets in accordance with Section 26 05 32 - Outlet Boxes, Conduit Boxes and Fittings.
- .2 Do not install outlets back-to-back in wall; allow minimum 150 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 Locate light switches on latch side of doors.
 - .1 Locate disconnect devices in mechanical and elevator machine rooms on latch side of floor.

3.04 MOUNTING HEIGHTS

- .1 Mounting height of equipment is from finished floor to centreline of equipment unless specified or indicated otherwise.
- .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: See key directions or plans.
 - .2 Wall receptacles:
 - .1 General: See key directions or plans.
 - .2 Above top of continuous baseboard heater: See key directions or plans.
 - .3 Above top of counters or counter splash backs: See key directions or plans.
 - .4 In mechanical rooms: See key directions or plans.
 - .3 Panelboards: as required by Code or as indicated.
 - .4 Fire alarm stations: See key directions or plans.
 - .5 Fire alarm bells: See key directions or plans.

3.05 CO-ORDINATION OF PROTECTIVE DEVICES

- .1 Ensure circuit protective devices such as overcurrent trips, relays and fuses are installed to required values and settings. Include the submission of a coordination study.
-

3.06 FIELD QUALITY CONTROL

- .1 Load Balance:
 - .1 Measure phase current to panelboards with normal loads (lighting) 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 - SUBMITTALS: phase and neutral currents on panelboards, dry-core transformers and motor control centres, 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 in accordance with Section 01 45 00 - Quality Control.
 - .1 Power distribution system including phasing, voltage, grounding and load balancing.
 - .2 Circuits originating from branch distribution panels.
 - .3 Lighting and its control.
 - .4 Motors, heaters and associated control equipment including sequenced operation of systems where applicable.
 - .5 Systems: fire alarm system communications.
 - .6 Insulation resistance testing:
 - .1 Megger circuits, feeders and equipment up to 350 V with a 500 V instrument.
 - .2 Megger 350-600 V circuits, feeders and equipment with a 1000 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 - 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 Schedule site visits, to review Work, as directed in PART 1 - QUALITY ASSURANCE.

3.07 CLEANING

- .1 Clean and touch up surfaces of shop-painted equipment scratched or marred during shipment or installation, to match original paint.
 - .2 Clean and prime exposed non-galvanized hangers, racks and fastenings to prevent rusting.
-

3.08 ASEISMIC AND ANTI-VIBRATION SYSTEMS

- .1 This section is a performance specification pertaining to the following items:
 - .1 Supply and installation of aseismic restraint devices compliant with applicable codes and standards.
 - .2 Calculations, design and verification of the aseismic restraint devices for the entire works. Hiring an engineer to perform these tasks is mandatory.
 - .3 Requirements for the qualification of the engineer:
 - .1 The engineer, hereafter referred to as “Qualified Engineer”, must be an active member of “Ordre des ingénieurs du Québec” or OIQ, as well as a recognized expert in the fields of earthquake engineering and seismic protection of building electromechanical systems.
 - .2 The resume of the Qualified Engineer must be provided upon request.
 - .3 At the beginning of the project, a letter confirming that the qualified engineer has been hired to assess seismic risks, design and verify the required seismic protection system must be provided.
 - .4 The completion of a seismic risks assessment relating to building electromechanical systems, including load calculations, in compliance with the requirements of Section 4 of the “Code de construction du Québec” or CCQ.
 - .5 The design of a seismic protection system compliant with the requirements of the CCQ and recognized practices, as described in the engineering documents produced by the ASHRAE, the SMACNA, the FEMA and suppliers of seismic protection systems, such as Mason, Kinetics, etc.
 - .6 The drafting of an official comprehensive report on the assessment of seismic risks, including seismic load calculations and the means to address them.
 - .7 The production of specifications for a seismic protection system and its components, including the types of anchors and braces, as well as installation locations.
 - .8 The preparation of instructions to the Contractor for the supply and installation of the seismic and anti-vibration devices.
 - .9 A verification of the installation of seismic protection devices in order to ensure that it met the design requirements.
 - .10 The drafting of an end-of-project report confirming that the seismic protection system was installed in compliance with installation and CCQ requirements.
- .2 Execution of the seismic protection work required by the Qualified Engineer and to the latter’s satisfaction.
- .3 The Qualified Engineer’s fees and the costs related to the supply and installation of the seismic protection devices must be included in the bid.

1 GENERAL

1.01 REFERENCES

- .1 Canadian Standards Association (CSA) International
 - .1 CAN/CSA-C22.2 no. 18-F98 (C013), Outlet Boxes, Conduit Boxes, Fittings, and Associated Hardware.
 - .2 CAN/CSA C22.2 no. 65-F93 (C2013), Wire Connectors.
- .2 National Electrical Manufacturers Association (NEMA)

1.02 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 21 - Management and disposal of construction / demolition waste.
- .2 Remove from site and dispose of all packaging materials at appropriate recycling facilities.
- .3 Divert unused metal materials from landfill to metal recycling facility as approved by Departmental Representative.

2 PRODUCTS

2.01 MATERIALS

- .1 Pressure type wire connectors to: CAN/CSA-C22.2 No.65, with current carrying parts of copper and aluminum alloy sized to fit copper aluminum conductors as required.
 - .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, NEMA to consist of:
 - .1 Connector body and stud clamp for stranded or round copper conductors.
 - .2 Clamp for stranded or round copper conductors.
 - .3 Clamp for stranded aluminum conductors.
 - .4 Stud clamp bolts.
 - .5 Bolts for copper conductors.
 - .6 Bolts for aluminum conductors.
 - .7 Sized for conductors as indicated.
 - .4 Connectors for flexible conduit as required to: CAN/CSA-C22.2 No.18.
-

3 EXECUTION

3.01 INSTALLATION

- .1 Remove insulation carefully from ends of conductor cables and:
 - .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.

1 GENERAL

1.01 PRODUCT DATA

- .1 Provide product data in accordance with Section 01 33 00 – Documents and samples to be submitted.

1.02 DELIVERY, STORAGE AND HANDLING

- .1 Packaging Waste Management: remove for reuse in accordance with Section 01 74 21 - Management and disposal of construction / demolition waste.

2 PRODUCTS

2.01 BUILDING WIRES

- .1 Conductors: stranded for 10 AWG and larger. Minimum size: 12 AWG.
- .2 Copper conductors: size as indicated, with 600 V and 1000 V insulation of cross-linked thermosetting polyethylene material rated RW90 XLPE.

2.02 ARMOURED CABLES

- .1 Conductors: insulated, copper, size as indicated.
- .2 Type: AC90.
- .3 Armour: interlocking type fabricated from aluminum strip.
- .4 Connectors: anti short connectors.

2.03 TECK CABLES 90

- .1 Cables: In accordance with section 26 05 00 – Common Work Requirements - Electrical.
 - .2 Conductors:
 - .1 Grounding conductor: ACM, as indicated.
 - .2 Power supply conductors: ACM, as indicated, size as indicated.
 - .3 Insulation:
 - .1 Ethylene-propylene rubber (EP).
 - .2 Cross-linked polypropylene (XLPE).
 - .3 Rated voltage: 1 000 V.
 - .4 Sleeve: PVC.
 - .5 Metal armor: Galvanized steel flat sheet.
 - .6 Outer casing: PVC, in accordance with the requirements of the National Building Code regarding the building class relevant to this project.
-

- .7 Anchors:
 - .1 One holed steel cable flange for apparent cables 50 mm or less. Two holed steel cable flange for cables 50 mm and over.
 - .2 U-shaped supports for two or several cables, installed as indicated.
 - .3 Threaded hanger rods: 6 mm in diameter for U-shaped supports.
- .8 Connectors:
 - .1 Approved watertight models suitable for TECK cables.

3 EXECUTION

3.01 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Perform grounding isolation tests using method appropriate to site conditions and to approval of Departmental Representative and local authority having jurisdiction over installation. Unless otherwise indicated, to not run cables in walls from bottom to top or horizontally.
- .3 Perform tests before energizing electrical system.

3.02 GENERAL CABLE INSTALLATION

- .1 Conductor length for parallel feeders to be identical.
- .2 Wiring in walls: typically drop or loop vertically from above to better facilitate future renovations.
- .3 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**.
- .4 Provide numbered wire collars for control wiring. Numbers to correspond to control shop drawing legend. Obtain wiring diagram for control wiring.

3.03 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.
 - .2 In underground conduits, as indicated.

3.04 INSTALLATION OF ARMoured CABLES

- .1 In suspended ceilings and in dry walls. Maximum length: 5 meters.
 - .2 Group cables wherever possible on channels.
-

1 GENERAL

1.01 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 21 - Management and disposal of construction / demolition waste.
- .2 Remove from site and dispose of all packaging materials at appropriate recycling facilities.
- .3 Collect and separate for disposal packaging material in appropriate bins for recycling in accordance with Waste Management Plan.
- .4 Divert unused metal materials from landfill to metal recycling facility as approved by Departmental Representative.
- .5 Fold up metal banding, flatten and place in designated area for recycling.

2 PRODUCTS

2.01 SUPPORT CHANNELS

- .1 U shape, size 41 x 41 mm, 2.5 mm thick, in galvanized steel (aluminium inside the greenhouse), surface installation and suspension.

3 EXECUTION

3.01 INSTALLATION

- .1 Secure equipment to masonry, tile and plaster surfaces with nylon shields.
 - .2 Secure equipment to poured concrete with expandable inserts.
 - .3 Secure equipment to hollow masonry walls or suspended ceilings with toggle bolts.
 - .4 Support equipment, conduit or cables using clips, spring loaded bolts, cable clamps designed as accessories to basic channel members.
 - .5 Secure the equipment surface-mounted to the building's structure and not to the suspended ceiling. Before installing the equipment, ensure that the structure is strong enough to support the weight.
 - .6 Fasten exposed conduit or cables to building construction or support system using straps.
 - .1 One-hole steel straps to secure surface conduits and cables 50 mm and smaller.
 - .2 Two-hole steel straps for conduits and cables larger than 50 mm.
 - .3 Beam clamps to secure conduit to exposed steel work.
-

- .7 Suspended support systems.
 - .1 Support individual cable or conduit runs with 6 mm dia threaded rods and spring clips.
 - .2 Support 2 or more cables or conduits on channels supported by 6 mm dia threaded rod hangers where direct fastening to building construction is impractical.
 - .8 For surface mounting of two or more conduits use channels at 2 m on centre spacing.
 - .9 Provide metal brackets, frames, hangers, clamps and related types of support structures where indicated or as required to support conduit and cable runs.
 - .10 Ensure adequate support for raceways and cables dropped vertically to equipment where there is no wall support.
 - .11 Do not use wire lashing or perforated strap to support or secure raceways or cables.
 - .12 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.
 - .13 Install fastenings and supports as required for each type of equipment cables and conduits, and in accordance with manufacturer's installation recommendations.
-

1 GENERAL

1.01 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CSA C22.10-10, Canadian Electrical Code, Part 1, 21th Edition.

1.02 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 – Documents and samples to be submitted.
- .2 Product Data:
 - .1 Provide manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Provide shop drawings: in accordance with Section 01 33 00 - Documents and samples to be submitted.
 - .1 Provide drawings stamped and signed by professional engineer registered or licensed in Provinces in Canada.

1.03 DELIVERY, STORAGE AND HANDLING

- .1 Waste Management and Disposal:
 - .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

2 PRODUCTS

2.01 SPLITTERS

- .1 Construction: sheet metal enclosure, welded corners and formed hinged cover suitable for locking in closed position.
- .2 Terminations: connection blocks to match required size and number of incoming and outgoing conductors as indicated.
- .3 Spare Terminals: minimum three spare terminals or lugs on each connection or lug block sized less than 400 A.

2.02 JUNCTION AND PULL BOXES

- .1 Construction: welded steel enclosure.
 - .2 Covers Flush Mounted: 25 mm minimum extension all around.
 - .3 Covers Surface Mounted: screw-on turned edge covers.
-

3 EXECUTION

3.01 SPLITTER INSTALLATION

- .1 Mount plumb, true and square to building lines.
- .2 Extend splitters full length of equipment arrangement except where indicated otherwise.

3.02 JUNCTION, PULL BOXES AND CABINETS INSTALLATION

- .1 Install pull boxes in inconspicuous but accessible locations.
- .2 Only main junction and pull boxes are indicated. Install additional pull boxes as required by CSA C22.10-10.

3.03 IDENTIFICATION

- .1 Equipment Identification: to Section 26 05 00 - Common Work Results for Electrical.
 - .2 Identification Labels: size 2 indicating system name, current, voltage and phase.
-

1 GENERAL

1.01 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CSA C22.10-10, Canadian Electrical Code, Part 1, 21th Edition.

1.02 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Documents and samples to be submitted.

1.03 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 – General product requirements.
- .2 Waste Management and Disposal:
 - .1 Separate waste materials for recycling in accordance with Section 01 74 21 - Management and disposal of construction / demolition waste.

2 PRODUCTS

2.01 OUTLET AND CONDUIT BOXES GENERAL

- .1 Size boxes in accordance with CSA C22.10-10.
- .2 102 mm square or larger outlet boxes as required.
- .3 Gang boxes where wiring devices are grouped.
- .4 Blank cover plates for boxes without wiring devices.
- .5 347 V outlet boxes for 347 V switching devices.
- .6 Combination boxes with barriers where outlets for more than one system are grouped.

2.02 GALVANIZED STEEL OUTLET BOXES

- .1 One-piece electro-galvanized construction.
 - .2 Single or 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 tile walls.

2.03 CONDUIT BOXES

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

2.04 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.

3 EXECUTION

3.01 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 Provide correct size of openings in boxes for conduit. Do not install reducing washers.
 - .5 Vacuum clean interior of outlet boxes before installation of wiring devices.
 - .6 Identify systems for outlet boxes as required.
-

1 GENERAL

1.01 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CAN/CSA C22.2 NO. 18.1-13 - Metallic outlet boxes (Tri-national standard, with UL 514A and ANCE NMX- J-023/1).
 - .2 CSA C22.2 NO. 45.2-08 (R2013) - Electrical rigid metal conduit - Aluminum, red brass, and stainless steel (Tri-national standard, with NMX-J-576-ANCE and UL 6A).
 - .3 CSA C22.2 NO. 56-13 - Flexible metal conduit and liquid-tight flexible metal conduit.
 - .4 CSA C22.2 NO. 83.1-F07 (C2012) - Electrical Metallic Tubing - Steel (Tri-National Standard, with UL 797 and NMX-J-536-ANCE-2007)
 - .5 CSA C22.2 NO. 211.2-06 (R2011) - Rigid PVC (Unplasticized) Conduit.
 - .6 CAN/CSA C22.2 NO. 227.3-15 - Mechanical protection tubing (MPT) and fittings (Bi-national standard, with UL 1696).

1.02 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Product data: submit manufacturer's printed product literature, specifications and datasheets.
 - .1 Submit cable manufacturing data.

1.03 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate waste materials for recycling in accordance with Section 01 74 21 - Management and disposal of construction / demolition waste.
- .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.

2 PRODUCTS

2.01 CONDUITS

- .1 Rigid metal conduits: in accordance with the CSA C22.2 no. 45 standard, in aluminium, with threaded connectors, watertight in accordance with section 22 of CEQ standard C22.10-10 for environments with excessive moisture content.
 - .2 Electrical metallic tubing (EMT): to CSA C22.2 No. 83, with couplings with expanded ends.
 - .3 Flexible PVC conduit: to CAN/CSA-C22.2 No. 227.3.
-

2.02 CONDUIT FASTENINGS

- .1 One holed steel straps to secure surface conduits 50 mm and smaller.
 - .1 Two holed steel straps for conduits larger than 50 mm.
- .2 Beam clamps to secure conduits to exposed steel work.
- .3 Channel type supports for two or more conduits at 2 m on centre.
- .4 Threaded rods, 6 mm diameter, to support suspended channels.

2.03 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 Watertight connectors and couplings for EMT.
 - .1 Set-screws are not acceptable.

2.04 EXPANSION FITTINGS FOR RIGID CONDUIT

- .1 Weatherproof expansion fittings with internal bonding assembly suitable for 100 mm linear expansion.
- .2 Watertight expansion fittings with integral bonding jumper suitable for linear expansion and 19 mm deflection.
- .3 Weatherproof expansion fittings for linear expansion at entry to panel.

2.05 FISH CORD

- .1 Polypropylene, tension strength: 5 kN.

3 EXECUTION**3.01 MANUFACTURER'S INSTRUCTIONS**

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

3.02 INSTALLATION

- .1 Install conduits to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass.
 - .2 Conceal conduits except in mechanical and electrical service rooms and in unfinished areas.
-

- .3 Surface mount conduits.
- .4 Use rigid aluminum threaded conduit except where specified otherwise.
- .5 Use electrical metallic tubing (EMT).
- .6 Use liquid tight flexible metal conduit for connection to motors or vibrating.
- .7 Minimum conduit size for lighting and power circuits: 19 mm.
- .8 Bend conduit cold:
 - .1 Replace conduit if kinked or flattened more than 1/10th of its original diameter.
- .9 Mechanically bend aluminum conduit over 19 mm diameter.
- .10 Field threads on rigid conduit must be of sufficient length to draw conduits up tight.
- .11 Install fish cord in empty conduits.
- .12 Remove and replace blocked conduit sections.
 - .1 Do not use liquids to clean out conduits.
- .13 Dry conduits out before installing wire.

3.03 SURFACE CONDUITS

- .1 Run parallel or perpendicular to building lines.
- .2 Locate conduits behind infrared or gas fired heaters with 1.5 m clearance.
- .3 Run conduits in flanged portion of structure.
- .4 Group conduits wherever possible on suspended surface channels.
- .5 Do not pass conduits through structural members except as indicated.
- .6 Do not locate conduits less than 75 mm parallel to steam or hot water lines with minimum of 25 mm at crossovers.

3.04 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.

3.05 CONDUITS UNDERGROUND

- .1 Slope conduits to provide drainage.
 - .2 Waterproof joints (PVC excepted) with heavy coat of bituminous paint.
-

3.06 CLEANING

- .1 Proceed in accordance with Section 01 74 11 - Cleaning.
- .2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

1 GENERAL

1.01 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CSA C22.2 NO. 29-15 - Panelboards and enclosed panelboards.

1.02 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with Section 01 33 00 - Documents and samples to be submitted.
- .2 Drawings to include electrical detail of panel, branch breaker type, quantity, ampacity and enclosure dimension.

1.03 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 21 - Management and disposal of construction / demolition waste.
- .2 Remove from site and dispose of packaging materials at appropriate recycling facilities.
- .3 Collect and separate for disposal packaging material in appropriate bins for recycling in accordance with Waste Management Plan.
- .4 Divert unused metal and wiring materials from landfill to metal recycling facility approved by Departmental Representative.

2 PRODUCTS

2.01 PANELBOARDS

- .1 Panelboards: to CSA C22.2 No.29 and product of one manufacturer.
 - .1 Install circuit breakers in panelboards before shipment.
 - .2 In addition to CSA requirements manufacturer's nameplate must show fault current that panel including breakers has been built to withstand.
 - .2 250 V panelboards: bus and breakers rated for 10000 A (symmetrical) interrupting capacity or as indicated on the plans.
 - .3 600 V panelboard: bus bars will be used at the default voltage, 35 kA minimum (symmetrical); the breakers will have a nominal interrupting capacity of 35 kA (symmetrical) or as indicated.
 - .4 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.
 - .5 Panelboards: mains, number of circuits, and number and size of branch circuit breakers as indicated.
-

- .6 Two keys for each panelboard and key panelboards alike.
- .7 Aluminum bus with neutral of same ampere rating as mains.
- .8 Mains: suitable for bolt-on breakers.
- .9 Trim with concealed front bolts and hinges.
- .10 Trim and door finish: air dried grey enamel or galvanized steel.

2.02 BREAKERS

- .1 Breakers: to Section 26 28 16.02 - Moulded Case Circuit Breakers.
- .2 Breakers with thermal and magnetic tripping in panelboards except as indicated otherwise.
- .3 Lock-on devices for all breakers installed as indicated.
- .4 The breakers for fire alarms, safety lighting, door monitoring and exit indicator lights will be equipped with locking devices.

2.03 EQUIPMENT IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results - Electrical.
- .2 Nameplate for each panelboard size 4 engraved as indicated.
- .3 Nameplate for each circuit in distribution panelboards size 2 engraved as indicated.
- .4 Complete circuit directory with typewritten legend showing location and load of each circuit.

3 EXECUTION

3.01 INSTALLATION

- .1 Locate panelboards as indicated and mount securely, plumb, true and square, to adjoining surfaces.
 - .2 Install surface mounted panelboards on plywood backboards in accordance with Section 06 10 00 - Carpentry. Where practical, group panelboards on common backboard.
 - .3 Mount panelboards to height specified in Section 26 05 00 - Common Work Results - Electrical or as indicated.
 - .4 Connect loads to circuits.
 - .5 Connect neutral conductors to common neutral bus with respective neutral identified.
-

1 GENERAL

1.01 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CSA C22.2 NO. 42-10 (R2015) - General use receptacles, attachment plugs, and similar wiring devices.
 - .2 CSA C22.2 NO. 42.1-13 - Cover plates for flush-mounted wiring devices (Bi-national standard, with UL 514D).
 - .3 CSA C22.2 NO. 55-15 - Special use switches.
 - .4 CSA C22.2 NO. 111-10 (R2015) - General-use snap switches (Bi-national standard, with UL 20).

1.02 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings and product data in accordance with Section 01 33 00 - Documents and samples to be submitted.

1.03 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 21 - Management and disposal of construction / demolition waste.
- .2 Remove from site and dispose of all packaging materials at appropriate recycling facilities.
- .3 Collect and separate for disposal packaging material in appropriate bins for recycling in accordance with Waste Management Plan.
- .4 Divert unused metal and wiring materials from landfill to metal recycling facility as approved by Departmental Representative.

1.04 MATERIALS OR ACCEPTABLE PRODUCTS

- .1 When materials or products are prescribed by their trademark, see the Instructions to Bidders in order to know the procedure concerning the request for approval of replacement products.

2 PRODUCTS

2.01 SWITCHES

- .1 15 A, 20 A, 120 V, single pole, bipolar, single and three-way, switches to: CSA-C22.2 No.55 and CSA-C22.2 No.111.
 - .2 Manually-operated industrial 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 White toggle.
-

- .3 Toggle operated fully rated for tungsten filament and fluorescent lamps, and up to 80% of rated capacity of motor loads.
- .4 Switches of one manufacturer throughout project.

2.02 RECEPTACLES

- .1 Duplex receptacles, CSA type 5-20 R, 125 V, 20A, U ground, to: CSA-C22.2 No.42 with following features:
 - .1 White urea moulded housing.
 - .2 Suitable for No. 10 AWG for back and side wiring.
 - .3 Break-off links for use as split receptacles.
 - .4 Eight back wired entrances, four side wiring screws.
 - .5 Triple wipe contacts and riveted grounding contacts.
- .2 Other receptacles with ampacity and voltage as indicated.
- .3 Receptacles of one manufacturer throughout project.

2.03 COVER PLATES

- .1 Cover plates for wiring devices to: CSA-C22.2 No.42.1.
- .2 Cover plates from one manufacturer throughout project.
- .3 Stainless steel, vertically brushed, 1 mm thick cover plates cover plates, thickness 2.5 mm.
- .4 Cast cover plates for wiring devices mounted in surface-mounted FS or FD type conduit boxes.
- .5 Weatherproof spring-loaded cast aluminum cover plates complete with gaskets for outside and greenhouses' single receptacles or switches.
- .6 Compliant with CEQ standard C22.10-10, section 22, inside the greenhouse (environment with a high moisture content).

3 EXECUTION

3.01 INSTALLATION

- .1 Switches:
 - .1 Install single throw switches with handle in "UP" position when switch closed.
 - .2 Install switches in gang type outlet box when more than one switch is required in one location.
 - .3 Mount toggle switches at height in accordance with Section 26 05 00 - Common Work Results – Electrical as indicated.
- .2 Receptacles:
 - .1 Install receptacles in gang type outlet box when more than one receptacle is required in one location.
 - .2 Mount receptacles at height in accordance with Section 26 05 00 - Common Work Results - Electrical as indicated.

- .3 Cover plates:
 - .1 Protect stainless steel cover plate finish with paper or plastic film until painting and other work is finished.
 - .2 Install suitable common cover plates where wiring devices are grouped.
 - .3 Do not use cover plates meant for flush outlet boxes on surface-mounted boxes.

1 GENERAL

1.01 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 – Documents and samples to be submitted.
- .2 Product Data:
 - .1 Provide fuse performance data characteristics for each fuse type and size and curves. Performance data to include: average melting time-current characteristics.
- .3 Shop Drawings:
 - .1 Provide shop drawings in accordance with Section 01 33 00 - Documents and samples to be submitted.
 - .2 Submit drawings stamped and signed by professional engineer registered or licensed in Provinces of Canada.

1.02 DELIVERY, STORAGE AND HANDLING

- .1 Ship fuses in original containers.
- .2 Do not ship fuses installed in switchboard.
- .3 Store fuses in original containers in storage cabinet.
- .4 Waste Management and Disposal:
 - .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Management and disposal of construction / demolition waste.

1.03 EXTRA MATERIALS

- .1 Provide maintenance materials in accordance with Section 01 78 00 – Documents / Items to be submitted upon completion of work.
- .2 Three spare fuses of each type and size installed above 100A.
- .3 Six spare fuses of each type and size installed up to and including 100A.

2 PRODUCTS

2.01 FUSES - GENERAL

- .1 Fuse type references J1 and J2, etc. have been adopted for use in this specification.
 - .2 Fuses: product of one manufacturer.
-

2.02 FUSE TYPES

- .1 Class J fuses.
 - .1 Type J1, time delay, capable of carrying 500% of its rated current for 10 s minimum.
 - .2 Type J2, fast acting.

2.03 FUSE STORAGE CABINET

- .1 Fuse storage cabinet, manufactured from 2.0 mm thick aluminum 750 mm high, 600 mm wide, 300 mm deep, hinged, lockable front access door finished in accordance with Section 26 05 00 - Common Work Results for Electrical.

3 EXECUTION**3.01 INSTALLATION**

- .1 Install fuses in mounting devices immediately before energizing circuit.
 - .2 Ensure correct fuses fitted to physically matched mounting devices.
 - .3 Ensure correct fuses fitted to assigned electrical circuit.
 - .4 Install spare fuses in fuse storage cabinet.
-

1 GENERAL

1.01 REFERENCES

- .1 Canadian Standards Association (CSA International).
 - .1 CSA C22.2 NO. 5-13 - Molded-case circuit breakers, molded-case switches and circuit-breaker enclosures (Tri-national standard, with UL 489 and NMX-J-266-ANCE-2013).

1.02 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit product data in accordance with Section 01 33 00 - Documents and samples to be submitted.
- .2 Include time-current characteristic curves for breakers with ampacity of 60 A.

1.03 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Management and disposal of construction / demolition waste.
- .2 Collect and separate for disposal packaging material in appropriate bins for recycling in accordance with Waste Management Plan.
- .3 Separate for reuse and recycling and place in designated containers waste in accordance with Waste Management Plan.

2 PRODUCTS

2.01 BREAKERS GENERAL

- .1 Moulded-case circuit breakers.
- .2 Bolt-on moulded case circuit breaker: quick-make, quick-break type, for manual operation.
- .3 Common-trip breakers: with single handle for multi-pole applications.
- .4 The breakers be rated for the interrupting capacity indicated or a minimum effective interrupting capacity of 10000 A (symmetrical).

2.02 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.
-

2.03 MAGNETIC BREAKERS (DESIGN B)

- .1 Moulded case circuit breaker to operate automatically by means of magnetic tripping devices to provide instantaneous tripping for short circuit protection.

2.04 SOLID STATE TRIP BREAKERS (DESIGN D)

- .1 Moulded case circuit breaker to operate by means of solid-state trip unit with associated current monitors and self-powered shunt trip to provide inverse time current trip under overload condition, and long and short time tripping for phase and ground fault short circuit protection (LSI).

3 EXECUTION

3.01 INSTALLATION

- .1 Install circuit breakers as indicated.
-

1 GENERAL

1.01 REFERENCES

- .1 Canadian Standards Association (CSA International).
 - .1 CAN/CSA C22.2 NO. 4-16 - Enclosed and dead-front switches (Tri-national standard with NMX-J-162-ANCE-2016 and UL 98.
 - .2 CSA C22.2 NO. 39-13 - Fuseholder assemblies.

1.02 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit product data in accordance with Section 01 33 00 - Documents and samples to be submitted.

1.03 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Management and disposal of construction / demolition waste.
- .2 Remove from site and dispose of packaging materials at appropriate recycling facilities.
- .3 Collect and separate for disposal packaging material in appropriate bins for recycling in accordance with Waste Management Plan.
- .4 Separate for reuse and recycling and place in designated containers waste in accordance with Waste Management Plan.
- .5 Fold up metal banding, flatten and place in designated area for recycling.

2 PRODUCTS

2.01 DISCONNECT SWITCHES

- .1 Non-fusible, horsepower rated disconnect switch in CSA Enclosure 3R, to CAN/CSA C22.2 No.4 size as indicated.
 - .2 Provision for padlocking in on-off switch position by three locks.
 - .3 Mechanically interlocked door to prevent opening when handle in ON position.
 - .4 Quick-make, quick-break action.
 - .5 ON-OFF switch position indication on switch enclosure cover.
-

2.02 EQUIPMENT IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results - Electrical.
- .2 Indicate name of load controlled on size 4 nameplate.

3 EXECUTION

3.01 INSTALLATION

- .1 Install disconnect switches.
-

1 GENERAL

1.01 REFERENCES

- .1 International Electrotechnical Commission (IEC)
 - .1 IEC 60947-4-1:2009+AMD1:2012 CSV Consolidated version Low-voltage switchgear and controlgear - Part 4-1: Contactors and motor-starters - Electromechanical contactors and motor-starters.

1.02 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Documents and samples to be submitted.
- .2 Product Data:
 - .1 Provide manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Provide shop drawings: in accordance with Section 01 33 00 - Documents and samples to be submitted.
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Provinces of Canada.
 - .2 Provide shop drawings for each type of starter to indicate:
 - .1 Mounting method and dimensions.
 - .2 Starter size and type.
 - .3 Layout and components.
 - .4 Enclosure types.
 - .5 Wiring diagram.
 - .6 Interconnection diagrams.

1.03 CLOSEOUT SUBMITTALS

- .1 Provide maintenance materials in accordance with Section 01 78 00 – Documents / Items to be submitted upon completion of work.
 - .2 Submit operation and maintenance data for each type and style of motorstarter for incorporation into maintenance manual.
 - .3 Extra Materials:
 - .1 Provide listed spare parts for each different size and type of starter.
 - .1 3 contacts, stationary.
 - .2 3 contacts, movable.
 - .3 1 contacts, auxiliary.
 - .4 1 control transformer.
 - .5 1 operating coil.
 - .6 2 fuses.
 - .7 10% indicating lamp bulbs used at least 1 per color.
-

1.04 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle in accordance with Section 01 61 00 – General product requirements.
- .2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
- .3 Packaging Waste Management: remove for reuse and return by manufacturer of pallets crates padding and packaging materials in accordance with Section 01 74 21 - Management and disposal of construction / demolition waste.

2 PRODUCTS**2.01 MATERIALS**

- .1 Starters: to IEC 60947-4 with AC4 utilization category.

2.02 FULL VOLTAGE MAGNETIC STARTERS

- .1 Magnetic and combination magnetic starters of size, type, rating and enclosure type as indicated with components as follows:
 - .1 Contactor solenoid operated, rapid action type.
 - .2 Motor overload protective device in each phase, manually reset from outside enclosure.
 - .3 Wiring and schematic diagram inside starter enclosure in visible location.
 - .4 Identify each wire and terminal for external connections, within starter, with permanent number marking identical to diagram.
- .2 Combination type starters to include fused disconnect switch with operating lever on outside of enclosure to control disconnect, and provision for:
 - .1 Locking in "OFF" position with up to 3 padlocks.
 - .2 Independent locking of enclosure door.
 - .3 Provision for preventing switching to "ON" position while enclosure door open.
- .3 Accessories:
 - .1 Selector switches : heavy duty and oil tight labelled as indicated.
 - .2 DEL indicating lights: heavy duty and oil tight type and color as indicated.
 - .3 2-N/O and 2-N/C spare auxiliary contacts unless otherwise indicated.

2.03 CONTROL TRANSFORMER

- .1 Single phase, dry type, control transformers with primary voltage as indicated and 120V secondary, complete with secondary fuse, installed in with starter as indicated.
 - .2 Size control transformer for control circuit load plus 20% spare capacity.
-

2.04 ACCESSORIES

- .1 Pushbutton: heavy duty, oil tight.
- .2 Selector switches: heavy duty, oil tight.
- .3 Indicating lights: heavy duty, oil tight, type and color as indicated.

2.05 FINISHES

- .1 Apply finishes to enclosure in accordance with Section 26 05 00 - Common Work Results for Electrical.

2.06 EQUIPMENT IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Manual starter designation label, white plate, black letters, size 1, engraved as indicated.
- .3 Magnetic starter designation label, white plate, black letters, size 7 engraved as indicated.

3 EXECUTION**3.01 INSTALLATION**

- .1 Install starters and control devices in accordance with manufacturer's instructions.
- .2 Install and wire starters and controls as indicated.
- .3 Ensure correct fuses installed.
- .4 Confirm motor nameplate and adjust overload device to suit.

3.02 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical and manufacturer's instructions.
- .2 Operate switches and contactors to verify correct functioning.
- .3 Perform starting and stopping sequences of contactors and relays.
- .4 Check that sequence controls, interlocking with other separate related starters, equipment, control devices, operate as indicated.

3.03 CLEANING

- .1 Clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Remove surplus materials, excess materials, rubbish, tools and equipment.
 - .2 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Management and disposal of construction / demolition waste.
-

1 GENERAL

1.01 REFERENCES

- .1 American National Standards Institute (ANSI)
 - .1 ANSI C82.1-2004 (R2015) Lamp Ballasts-Line Frequency Fluorescent Lamp Ballast.
 - .2 ANSI C82.4-02(R2007), Ballasts for High-Intensity-Discharge and Low-Pressure Sodium Lamps Multi Supply Type.
- .2 American National Standards Institute/Institute of Electrical and Electronics Engineers (ANSI/IEEE)
 - .1 IEEE C62.41.1-2002 (R2008) IEEE Guide on the Surge Environment in Low-Voltage (1000 V and less) AC Power Circuits.
- .3 IES LM-79 and LM-80, LED lamp.
- .4 Canadian Standards Association (CSA International).
- .5 Underwriters' Laboratories of Canada (ULC).

1.02 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Documents and samples to be submitted.
- .2 Product Data:
 - .1 Provide manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Provide complete photometric data prepared by independent testing laboratory for luminaires where specified, for approval review by Departmental Representative.
 - .3 Photometric data to include: VCP Table where applicable.
- .3 Quality assurance submittals: provide following in accordance with Section 01 45 00 - Quality Control.
 - .1 Manufacturer's instructions: provide manufacturer's written installation instructions and special handling criteria, installation sequence, and cleaning procedures.

1.03 QUALITY ASSURANCE

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

1.04 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 – General product requirements.
 - .2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
-

- .3 Packaging Waste Management: remove for reuse and return by manufacturer of pallets crates padding and packaging materials in accordance with Section 01 74 21 - Management and disposal of construction / demolition waste.
- .4 Divert unused metal materials from landfill to metal recycling facility.
- .5 Disposal and recycling of fluorescent lamps as per local regulations.
- .6 Disposal of old PCB filled ballasts.

2 PRODUCTS

2.01 LAMPS

- .1 DEL lamp, color temperature 4000 K, color rendering index 70 for outside fixtures and 80 for inside fixtures, life 93% of light rendering after 50 000 hours.

2.02 DRIVERS

- .1 LED driver
 - .1 Named voltage: 120-277 V, 60 Hz.
 - .2 Power factor > 0.9.
 - .3 Harmonic distortion <20% at full load.
 - .4 Integral 10kV surge suppression protection.
 - .5 Integral weathertight.

2.03 FINISHES

- .1 Light fixture finish and construction to meet ULC listings and CSA certifications related to intended installation.

2.04 OPTICAL CONTROL DEVICES

- .1 As indicated in luminaire schedule.

2.05 LUMINAIRES

- .1 As indicated in luminaire schedule.

3 EXECUTION

3.01 INSTALLATION

- .1 Locate and install luminaires as indicated.
- .2 Provide adequate support to suit ceiling system.

3.02 WIRING

- .1 Connect luminaires to lighting circuits:
 - .1 Install flexible or rigid conduit for luminaires as indicated.
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3.03 LUMINAIRE SUPPORTS

- .1 For suspended ceiling installations, luminaires will be supported independently from the suspended ceiling and anchored to the structure in such a way as to be at the same horizontal level. The general Contractor will submit the anchoring method for approval.

3.04 LUMINAIRE ALIGNMENT

- .1 Align luminaires mounted in continuous rows to form straight uninterrupted line.
- .2 Align luminaires mounted individually parallel or perpendicular to building grid lines.

3.05 CLEANING

- .1 Clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Remove surplus materials, excess materials, rubbish, tools and equipment.
 - .2 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Management and disposal of construction / demolition waste.
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Part 1 General**1.1 RELATED SECTION**

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

1.2 REFERENCES

- .1 National Building Code of Canada 2015.
- .2 CAN/ULC-S524-14 - Installation of Fire Alarm Systems.
- .3 CAN/ULC-S536-13 - Standard for inspection and testing of fire alarm systems.
- .4 CAN/ULC-S537-13 - Standard for verification of fire alarm systems.
- .5 CAN/CSA-C22.1 - Canadian Electrical Code, Part I Safety Standard for Electrical Installations

1.3 SUBMITTALS

- .1 Product data
 - .1 Submit manufacturer's printed product literature, specifications and datasheets in accordance with Section Documents and samples to be submitted.
- .2 Shop drawings:
 - .1 Submit shop drawings in accordance with Section Documents and samples to be submitted.
 - .2 Include:
 - .1 All necessary accessories for installation of the various elements.
 - .2 Riser diagram of overall system illustrating control equipment, alarm zoning, signalling circuits and individual conductors, terminations, and number of terminal devices.
- .3 Quality assurance submittals: submit following in accordance with Section Documents and samples to be submitted.
 - .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.
- .4 Closeout submittals
 - .1 Submit maintenance and engineering data for incorporation into manual specified in Section Closeout Submittals in accordance with ANSI/NFPA 20.
 - .2 The Departmental Representative will review and approve submittals according to the terms of the present section.
 - .3 Submit the following.
 - .1 Manufacturer's data for:
 - .1 Photoelectric detectors.
 - .2 Addressable loop fault isolator module;
 - .3 Conduits;
 - .4 Outlet boxes;

- .5 Fittings for conduits and outlet boxes;
- .6 Mark data which describe more than one type of item to indicate which type will be provided.
- .7 Submit one (1) electronic copy for each item.
- .2 Include instructions for operation for all items of the fire alarm network in the manual mentioned in Section Closeout Submittals.
- .3 Test Reports:
 - .1 Test reports to be in compliance with CAN/ULC-S537-13.
 - .2 Test reports to be submitted and approved by the DCC Representative for provisional acceptance.

1.4 QUALITY ASSURANCE

- .1 Qualifications
 - .1 Manufacturer: Only 2 manufacturers can be qualified for this project. Honeywell or Johnson Control.
 - .2 Installer: company or person specializing in fire alarm system installations certified by manufacturer.
 - .3 Fire alarm technician: Provide services of representative or technician from manufacturer of system, experienced in installation and operation of type of system being provided, to supervise installation, adjustment, preliminary testing, and final testing of system and to provide instruction to project personnel.

1.5 DELIVERY, STORAGE AND HANDLING

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

Part 2 Products

2.1 MATERIALS/EQUIPMENT

- .1 Equipment and devices: ULC listed and labelled and supplied by single manufacturer.
- .2 Smoke detectors: to CAN/ULC-S529.
- .3 All fire alarm equipment must be red in color with bilingual indications.

2.2 SYSTEM OPERATION

- .1 The existing fire alarm system of the building is a single operation addressable type of Honeywell brand. The main control panel is a Honeywell's model XLS-140 and is located in the electrical room A-002A. The project involves adding photoelectric smoke detectors and addressable relays to the existing fire alarm system in the context of the installation of two new elevators.

- .2 Elevator control sequence:
 - .1 On detection of smoke in the elevator mechanical room, a signal will be transmitted via addressable relay to the elevator's controller.
 - .2 On detection of smoke in the top of the elevator shaft, a signal will be transmitted via addressable relay to the elevator's controller.
 - .3 On detection of smoke in the elevator hall, exit floor, a signal will be transmitted via addressable relay to the elevator's controller.
 - .4 The activation of the general alarm in another location of the building, a signal will be transmitted via addressable relay to the elevator's controller

2.3 PHOTOELECTRIC SMOKE DETECTORS

- .1 Provide addressable smoke photoelectric detector with addressable thermistor.
- .2 Provide required bases, boxes and accessories for each detector.
- .3 An anomaly in the detector or its control module must activate system default signals.
- .4 Detectors must be installed in accordance with manufacturer's instructions and ULC approval.
- .5 Product: photoelectric detection devices TC806B1076 from Honeywell or approved equivalent.

2.4 ADDRESSABLE LOOP FAULT ISOLATOR MODULES

- .1 Provide fault isolator modules for the addressable loop in locations indicated or at each group of maximum 20 components.
- .2 Provide all accessories for installation compliant with manufacturer's instructions and ULC approval.
- .3 Product: addressable loop fault isolator module TC811 from Honeywell or approved equivalent.

2.5 ADDRESSABLE RELAY

- .1 Addressable module for auxiliary functions including 2 relays contacts types N.O. or N.C.2.
- .2 Capacity of auxiliary contacts:
 - .1 circuits of 3 A, 30 V, DC, resistive load or
 - .2 circuits of 0.9 A, 120/125 V, AC resistive load
 - .3 circuits of 0.5 A, 30 V, DC, AC inductive load
- .3 Product: Honeywell XLS-CM-R module or approved equivalent.

2.6 CONDUITS

- .1 Electrical Metallic Tubing (EMT) with sealtight fittings.
- .2 Perform work in accordance with Section 26 05 34 – Conduits, Conduit Fastenings and Conduit Fittings.
- .3 Installation of conduits for Class A loops must be in accordance with ULC/S524 with regard to minimum horizontal and vertical clearance.

2.7 WIRING

- .1 Twisted copper conductors, type FAS, FT6 at 105°C, copper; rated voltage 300V.
- .2 Ground continuity shall be provided throughout the system for fire alarm system ground leakage detection. Use ground wire when required.
- .3 Circuits shall meet the manufacturer's resistance, impedance, insulation and monitoring requirements for the various types of circuits.
- .4 Alarm circuits: minimum 16 AWG shielded conductors as per manufacturer's requirements.
- .5 Fire Protection: where required by codes or where indicated, conductors shall be fire resistant or adequately protected.
- .6 Fire alarm system cables shall be permanently labelled at the ends of each conductor.
- .7 Fire alarm system wiring shall be continuous between the panel and the device. Where splices are required, they shall be in accessible junction boxes and only on labeled terminal blocks.

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 fire alarm systems in accordance with CAN/ULC-S524-14, the National building code Canada 2015 and according to the manufacturer's recommendations.
- .2 Install the entire conduits and conductors required for the complete fire alarm network, according to the manufacturer's indications and recommendations.
- .3 Install as indicated on the plans, detectors, addressable modules, isolators and connect them to the wiring of alarm circuits.
- .4 For each addressable module and relay module, write their designation on a P-TOUCH type marker.
- .5 Install end-of-line devices at the end of detection and signaling circuits in a separate box.
- .6 Connect all circuits to the fire alarm control panel and the auxiliary signaling module and make all the required connections to the main control station.
- .7 Recess devices where possible. Surface install devices in rooms and corridors without a suspended ceiling.
- .8 Locate and install detectors and connect to alarm circuit wiring. Do not mount detectors within 450 mm of air outlets. Maintain at least 450 mm radius clear space on ceiling, below and around detectors.
- .9 Addressable loops must not serve more than one floor/zone.

- .10 No circuit should be loaded to more than 80% of its maximum capacity.
- .11 All openings made for the passage of cables in floor slabs and in fire walls must be properly sealed, in accordance with local fire prevention codes.
- .12 Program all the functions according to the sequences described in this document.
- .13 Perform with the elevator company technician, the testing of the elevator in relation to the fire alarm signals when detecting the following elements:
 - .1 General detection.
 - .2 Smoke detection at the elevator shaft.
 - .3 Smoke detection in the elevator mechanical room.
 - .4 Smoke detection in the elevator hall on the exit floor.
- .14 The wiring of the fire alarm system must be continuous between the panel and the device. When junctions are required, they must be in accessible junction boxes and only on labeled terminal blocks.
- .15 In accordance with ULC-S537-13 - Audit of Fire Alarm Systems, a report is to be issued upon completion of the work.
- .16 At the end of the works when the building is delivered, the General Contractor must ensure that the personal safety systems and their components (i.e. fire alarm systems, recalling the elevators) are working as expected. The contractor shall ensure that the overall operation of all life safety systems installed and involved in the present work in the building has been verified. The General Contractor must produce and then submit documents confirming commissioning to the effect that the various building systems comply with the requirements of the NBC. Annotations to the verification report to the effect that the tests could not be carried out because the auxiliary systems technician was not present during the tests or any other reason are not acceptable.

3.3 FIELD QUALITY CONTROL

- .1 Site tests
 - .1 Perform tests in accordance with Section 26 05 00 – Common Work Results for Electrical and CAN/ULC-S537-14 and produce a complete verification report according to this standard.
 - .2 Fire alarm system; without being limited to:
 - .1 Test each device and alarm circuit to ensure manual stations, combined, thermal and smoke detectors transmit alarm to control panel and actuate general alarm.
 - .2 Check annunciator panels to ensure zones are shown correctly.
 - .3 Simulate grounds and breaks on alarm and signalling circuits to ensure proper operation of system.
- .2 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 Schedule site visits, to review work, as directed in PART 1 – QUALITY ASSURANCE.

3.4 TRAINING

- .1 The subcontractor must arrange and pay for on-site lectures and demonstrations by fire alarm equipment manufacturer to train operational personnel in use and maintenance of fire alarm system.
- .2 This session will also allow users to familiarize themselves with this equipment. Plan a 1 hour training course. Make sure understanding how to use it. Ask the people who have received the training to sign the work order of the technician whose "Training session" is written on it.

3.5 CLEANING

- .1 Proceed in accordance with Section 01 74 11 – Cleaning.
 - .2 Upon completion and verification of performance of installation, remove surplus materials, rubbish, tools and equipment.
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