



1600, boulevard René-Lévesque Ouest,  
16<sup>e</sup> étage, Montréal (Québec) H3H 1P9

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**PWGSC**  
**Health Canada**  
**New UPS and electrical rooms**

**Mechanical and electrical Specification**

**ISSUED FOR BID**

**SEPTEMBER 2018**

Spec number : 181-03430-01  
Client file: R.094477.001



1600, boulevard René-Lévesque Ouest,  
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Mechanical

## **TPSGC – SANTÉ CANADA**

### **New UPS and electrical room**

### **Mechanical Specification**

### **ISSUED for BIDS**

Prepared by:

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Jean Bergeron, P. Eng.  
Discipline Lead

Notre no de dossier : 181-03430-01  
Dossier client : R.094477.001

September 2018



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Electrical

## **TPSGC – SANTÉ CANADA**

### **New UPS and electrical room**

### **Electrical Specification**

### **ISSUED for BIDS**

Prepared by:

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Rachid Bakour, P. Eng.  
Discipline Lead

Our file : 181-03430-01  
Client file : R.094477.001

August 2018

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**END OF SECTION**

**Part 1 General**

**1.1 RELATED REQUIREMENTS**

- .1 The present section includes all the sections in series 23, 25, 26 applicable to the scope of works in ventilation, air conditioning, electricity and controls and must be used conjointly with the following sections, considered as being an integral part of the documents.
  - .1 01 56 00 – Temporary barriers and enclosures
  - .2 01 33 00 - Submittal procedures
  - .3 01 74 11 – Cleaning

**1.2 WORK COVERED BY CONTRACT DOCUMENTS**

- .1 Work of this Contract comprises of the replacement of the following ventilation equipment and accessories at the Public services and Procurement Sante Canada site – Longueuil, located at 1001 St-Laurent, Longueuil, Québec, J4K 1C7, Canada
  - .1 Dismantle and dispose of the Air Handling Units (AHU).
  - .2 Dismantle and dispose of the ventilation ducts
  - .3 Dismantle and dispose of the network piping of the dismantled units.
  - .4 Remove and dispose of the outdated ventilation control equipment
  - .5 Supply and install the following new AHU and their respective equipment.
  - .6 Supply and install the new ventilation duct sections and connect the new equipment. Adjust the size of the duct to connect the new units to existing ventilation ducts.
  - .7 Supply and install a transfer grille and a duct with acoustic insulation
  - .8 Supply and install a return grille to be installed in duct upstream the new AHU.
  - .9 Supply and install the new piping for the new AHU
  - .10 Supply, install, connect and program to the Building Automation System (BAS).
  - .11 Supply and install insulation and sound insulation for the ventilation ducts and piping. Replace the insulation sections removed during dismantlement and carry out any repairs due to their deterioration during the works.
  - .12 Supply, install and connect the measuring and control equipment required (such as thermostats).
  - .13 Provide and install anchors required for installation of equipment and ducts. Design anchorage and curbs to ensure an installation according to the codes in force. The design of seismic protection devices and systems must be performed by a specialized in the field of earthquake engineering and recognized in the Province of Quebec.
  - .14 Supply training on the new equipment and control systems.
  - .15 Supply a project manual
  - .16 Supply the material and repair and patch the walls, ceilings and roof following the works.

- .17 Clean all the ventilation ducts of all ventilation systems on site. Supply and install the doors and access panels for the ventilation ducts and architectural ceilings.
- .18 Perform start-up of the new systems and new Building Automation System. Demonstrate the proper functioning of the ventilation control sequences.

### 1.3 ELECTRICAL WORK

- .1 Provide labor, all equipment, tools, and materials required for fabrication, installation, operation of systems, as described in specification sections and drawings. The electrical work described below does not constitute a limitation of all the works to be carried out. Any additional work, not described but required for the completion of the project, will be considered as part of the tasks to be performed.
- .2 General
  - .1 Sections dealing with the administrative arrangements mentioned above.
  - .2 Sections relating to utilities, works and temporary facilities, previously mentioned.
  - .3 Section 23 05 48 - Vibration and seismic systems and devices for piping and HVAC equipment;
  - .4 Section 26 05 01 - Electrical - General Requirements for Work Results
- .3 In general, the work to be done is shown in the following sections:
  - .1 Section 26 05 20 - Connectors for cables and boxes 0-1000 V
  - .2 Section 26 05 21 - Wires and cables
  - .3 Section 26 05 28 - Secondary Grounding
  - .4 Section 26 05 29 - Mounts and Suspensions for Electrical Installations
  - .5 Section 26 05 32 - Outlet Boxes, Bypass Boxes and Accessories.
  - .6 Section 26 05 34 - Conduits, Fasteners and Conduit Fittings
  - .7 Section 26 24 16.01 - Breaker Distribution Panels
  - .8 Section 26 24 16.02 - Molded Case Circuit Breaker
  - .9 Section 26 27 26 - Wiring Devices
  - .10 Section 26 33 53 - Uninterruptible Power System
  - .11 Section 26 52 00 - Security Lighting
- .4 Electrical work mainly includes:
  - .1 Modification to emergency electrical distribution;
  - .2 Removal of uninterruptible power system;
  - .3 Supply, installation of a new uninterruptible power supply system;
  - .4 Removal, modifications and / or connections to existing systems or apparatus, including fire alarm, earthing, lighting and accessories required, Lighting control, sockets and accessories required,
  - .5 Power supply, complete electrical connections for mechanical appliances: plumbing, heating and ventilation.

.6 Coordination with mechanical divisions:

- .1 Consult all specifications, plans and tables of mechanics, for the exact and final location of plumbing systems, ventilation, air conditioning, heating, cooling, fire protection, automatic regulation, etc.
- .2 Coordinate closely with the mechanical contractors to determine the exact characteristics (according to submitted shop drawings) of the systems mentioned above, and provide all appropriate facilities and connections to make them operational, all in accordance with the laws and regulations in force.

.7 Pay all applicable license fees.

**1.4 CONTRACT METHOD**

- .1 Construct Work a stipulated price contract.

**1.5 CONTRACTOR USE OF PREMISES**

- .1 Unrestricted use of site until Substantial Performance.
- .2 Limit use of premises for Work to allow:
  - .1 Owner occupancy.
  - .2 Work by other contractors (if necessary)
- .3 At completion of operations condition of existing work: equal to or better than that which existed before new work started.
- .4 Set up and build temporary access and protection in compliance with section 01 56 00 Access and temporary protection

**1.6 OWNER OCCUPANCY**

- .1 Schedule and substantially complete designated portions of Work for Owner's occupancy prior to Substantial Performance of entire Work.

**1.7 ALTERATIONS, ADDITIONS OR REPAIRS TO EXISTING BUILDING**

- .1 Execute work with least possible interference or disturbance to building operations and normal use of premises for this period of the year ie. Before the location is open to the public. Arrange with Departmental representative to facilitate execution of work.
- .2 Use only existing doors and stairways in building for moving workers and material.
  - .1 Protect doors, floors and walls, to satisfaction of Departmental representative prior to use.
  - .2 Accept liability for damage, safety of equipment and overloading of existing equipment.

**1.8 EXISTING SERVICES**

- .1 Notify Departmental representative and utility companies of intended interruption of services and obtain required permission.



- .2 Where Work involves breaking into or connecting to existing services, give Departmental representative 48 hours' notice for necessary interruption of mechanical or electrical service throughout course of work. Minimize duration of interruptions. Carry out work at times as directed by governing authorities with minimum disturbance to the activities of PWGSC.
- .3 Provide alternative routes for personnel and vehicular traffic.
- .4 Establish location and extent of service lines in area of work before starting Work. Notify Departmental representative of findings.
- .5 Submit schedule to and obtain approval from Departmental representative for any shut-down or closure of active service or facility including power and communications services. Adhere to approved schedule and provide notice to affected parties.
- .6 Protect, relocate or maintain existing active services. When inactive services are encountered, cap off in manner approved by authorities having jurisdiction.
- .7 Record locations of maintained, re-routed and abandoned service lines.
- .8 Construct barriers in accordance with Section 01 56 00 - Temporary Barriers and Enclosures.

## **1.9 DOCUMENTS REQUIRED**

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

## **1.10 PROJECT MANUAL**

- .1 Supply a project manual containing the following elements and all other pertinent information, which must be handed over to PWGSC at the end of the project
- .2 Prepare one copy (in a 3-ring binder) and an electronic version supplied on a USB key.
  - .1 Technical data sheets of equipment and accessories
  - .2 Manufacturers' installation instructions
  - .3 Manufacturers' operations and maintenance instructions
  - .4 Control details, screen captures of control systems
  - .5 As-Noted drawings

**1.11 REFERENCE DOCUMENTS**

- .1 WSP drawings
  - .1 Mechanical
    - .1 M-01: Drawing list, legend and basement floor plan - demolition
    - .2 M-02: Basement floor plan – New
  - .2 Electrical
    - .1 E01: Drawing list, legend and basement floor plan - demolition
    - .2 E-02: Basement floor plan – New
    - .3 E-03 : Diagram – demolition
    - .4 E-04 : Diagram – New

**END OF SECTION**

## MECHANICAL

TAG	APPLICABLE SECTION	IDENTIFICATION OF DRAWING	DATE RECEIVED	DATE OF TRANSMISSION	OBSERVATION
M-1	21 44 16 19	Portable Extinguishers			
M-2	23 05 05	Detail seismic system			
M-3	23 05 29	Supports			
M-4	23 05 48	Detail of VIBRATION AND SEISMIC			
M-5	23 05 53	Manometer			
M-6	23 05 53	Hydronics Identification			
M-7	23 05 53	HVAC Identification			
M-8	23 05 53	Valves Identification			
M-9	23 07 13	Insulation			
M-10	23 07 15	Insulation			
M-11	23 21 13 01	Copper piping tube and fittings			
M-12	23 21 13 02	Steel piping tube and fittings			
M-13	23 21 14	Supports			
M-14	23 21 14	automatic air vent			
M-15	23 21 14	Piping filter			
M-16	23 21 14	Thermometer			
M-17	23 21 14	Valves			
M-18	23 21 14	Back flow			
M-19	23 21 14	Flow indicator			
M-20	23 21 14	Balancing valves			
M-21	23 21 14	Pressure regulator			
M-22	23 33 00	Acces door			
M-23	23 33 00	Tap thermométric			
M-24	23 33 16	Fire Damper			
M-25	23 37 13	Diffuseurs			
M-26	23 44 00	Air Filter			
M-27	23 81 40	Heat Pumps			
M-28	25 00 00	Cable			
M-29	25 00 00	Controls Diagram with sequences			
M-30	25 00 00	List of points			

NOTE: This list is not exhaustive and does not relieve the responsibility of the contractor

	IDENTIFICATION	DATE RECEIVED	PROCESSING DATE	DATE OF TRANSMISSION	Observation
DOC-1	Verification and test report and certificate of conformity in fire alarm				
DOC-2	Evidence with training signature of operating and maintenance personnel				
DOC-3	Certificate of conformity of the installation according to the Codes and Standards in force				
DOC-4	Operations and Maintenance Manual				
DOC-5	Proof of insurance				
DOC-6	Letters of guarantee				

NOTE: This list is not exhaustive and does not relieve the responsibility of the contractor

## ELECTRICAL

TAG	APPLICABLE SECTION	IDENTIFICATION OF DRAWING	DATE RECEIVED	DATE OF TRANSMISSION	Observation
E-1	20 84 00	Products for fireproof seals			
E-2	26 05 01	Equipment identification (lamicoides plate, etc.)			
E-3	26 05 20	Connectors for cables and box			
E-4	26 05 21	Wires and cables			
E-5	26 05 21	Fire alarm wiring			
E-6	26 05 21	TECK cables			

TAG	APPLICABLE SECTION	IDENTIFICATION OF DRAWING	DATE RECEIVED	DATE OF TRANSMISSION	Observation
E-7	26 05 21	Command cables			
E-8	26 05 28	Secondary grounding (MALT bar)			
E-9	26 05 32	E-9.1 Outlet and bypass box E-9.2 Box for masonry E-9.3 Accessoires			
E-10	26 05 34	Conduits, fasteners and fittings			
E-11	26 24 16.01	Distribution panels with circuit breakers			
E-12	26 24 16.02	Molded case circuit breaker			
E-13	26 27 26	Wire devices.			
E-14	26 52 00	Autonomous safety lighting blocks			
E-15	26 53 00	Exit light indicators			

	IDENTIFICATION	DATE RECEIVED	PROCESSING DATE	DATE OF TRANSMISSION	Observation
DOC-1	Verification and test report and certificate of conformity in fire alarm				
DOC-2	Evidence with training signature of operating and maintenance personnel				
DOC-3	Certificate of conformity of the installation according to the Codes and Standards in force				
DOC-4	Operations and Maintenance Manual				
DOC-5	Proof of insurance				
DOC-6	Letters of guarantee				

NOTE: This list is not exhaustive and does not relieve the responsibility of the contractor

**Part 1 General**

**1.1 ADMINISTRATIVE**

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

**1.2 SHOP DRAWINGS AND PRODUCT DATA**

- .1 The term "shop drawings" means drawings, diagrams, illustrations, schedules, performance charts, brochures and other data which are to be provided by Contractor to illustrate details of a portion of Work.
- .2 Submit drawings stamped and signed by professional engineer registered or licensed in the Province of Quebec, Country of Canada.
- .3 Indicate materials, methods of construction and attachment or anchorage, erection diagrams, connections, explanatory notes and other information necessary for completion of Work. Where articles or equipment attach or connect to other articles or equipment, indicate that such items have been co-ordinated, regardless of Section under which adjacent items will be supplied and installed. Indicate cross references to design drawings and specifications.
- .4 Allow Departmental representative 5 working days for review of each submission.

- .5 Adjustments made on shop drawings Departmental representative are not intended to change Contract Price. If adjustments affect value of Work, state such in writing to Departmental representative prior to proceeding with Work.
- .6 Make changes in shop drawings as Departmental representative may require, consistent with Contract Documents. When resubmitting advise Departmental representative in writing of revisions other than those requested.
- .7 Accompany submissions with transmittal letter, in duplicate or electronically (PDF), containing:
  - .1 Date.
  - .2 Project title and number.
  - .3 Contractor's name and address.
  - .4 Identification and quantity of each shop drawing, product data and sample.
  - .5 Other pertinent data.
- .8 Submissions include:
  - .1 Date and revision dates.
  - .2 Project title and number.
  - .3 Name and address of:
    - .1 Subcontractor.
    - .2 Supplier.
    - .3 Manufacturer.
  - .4 Contractor's stamp, signed by Contractor's authorized representative certifying approval of submissions, verification of field measurements and compliance with Contract Documents.
  - .5 Details of appropriate portions of Work as applicable:
    - .1 Fabrication.
    - .2 Layout, showing dimensions, including identified field dimensions, and clearances.
    - .3 Setting or erection details.
    - .4 Capacities.
    - .5 Performance characteristics.
    - .6 Standards.
    - .7 Operating weight.
    - .8 Wiring diagrams.
    - .9 Single line and schematic diagrams.
    - .10 Relationship to adjacent work.
- .9 After Departmental representative review, distribute copies.
- .10 Submit 1 electronic copy or 2 printed copies of shop drawings for each requirement requested in specification Sections and as Departmental representative may reasonably request.
- .11 Submit 2 printed copies or one electronic version of product data sheets or brochures for requirements requested in specification Sections and as requested by Departmental

- representative where shop drawings will not be prepared due to standardized manufacture of product.
- .12 Submit 2 printed copies or one electronic version of test reports for requirements requested in specification Sections and as requested by Departmental representative
    - .1 Report signed by authorized official of testing laboratory that material, product or system identical to material, product or system to be provided has been tested in accord with specified requirements.
    - .2 Testing must have been within 3 years before the date of contract award for project.
  - .13 2 printed copies or one electronic version copies of certificates for requirements requested in specification Sections and as requested by Departmental representative.
    - .1 Statements printed on manufacturer's letterhead and signed by responsible officials of manufacturer of product, system or material attesting that product, system or material meets specification requirements.
    - .2 Certificates must be dated after award of project contract complete with project name.
  - .14 Submit 2 printed copies or one electronic version copies of manufacturer's instructions for requirements requested in specification Sections and as requested by Parcs Canada or its representative.
    - .1 Pre-printed material describing installation of product, system or material, including special notices and Material Safety Data Sheets concerning impedances, hazards and safety precautions.
  - .15 Submit 2 printed copies or one electronic version copies of Manufacturer's Field Reports for requirements requested in specification Sections and as requested by Departmental representative
  - .16 Documentation of the testing and verification actions taken by manufacturer's representative to confirm compliance with manufacturer's standards or instructions.
  - .17 Submit 6 electronic copies of Operation and Maintenance Data for requirements requested in specification Sections and as requested by Parcs Canada or its representative.
  - .18 Delete information not applicable to project.
  - .19 Supplement standard information to provide details applicable to project.
  - .20 If upon review by Departmental representative, no errors or omissions are discovered or if only minor corrections are made, copies will be returned and fabrication and installation of Work may proceed. If shop drawings are rejected, noted copy will be returned and resubmission of corrected shop drawings, through same procedure indicated above, must be performed before fabrication and installation of Work may proceed.
  - .21 The review of shop drawings by departmental representative is for sole purpose of ascertaining conformance with general concept.
    - .1 This review shall not mean that departmental representative approves detail design inherent in shop drawings, responsibility for which shall remain with Contractor submitting same, and such review shall not relieve Contractor of



responsibility for errors or omissions in shop drawings or of responsibility for meeting requirements of construction and Contract Documents.

- .2 Without restricting generality of foregoing, Contractor is responsible for dimensions to be confirmed and correlated at job site, for information that pertains solely to fabrication processes or to techniques of construction and installation and for co-ordination of Work of sub-trades.

### **1.3 PHOTOGRAPHIC DOCUMENTATION**

- .1 Submit one electronic copy of digital photography in fine resolution as directed by Departmental representative.
- .2 Project identification: name and number of project and date of exposure indicated.
- .3 Number of viewpoints:
  - .1 Viewpoints and their location as determined by Departmental representative.
- .4 Frequency of photographic documentation: as directed by Departmental representative.
  - .1 Upon completion of: as directed by Departmental representative.

### **1.4 CERTIFICATES AND TRANSCRIPTS**

- .1 Immediately after award of Contract, submit Workers' Compensation Board status.
- .2 Submit transcription of insurance immediately after award of Contract.

**END OF SECTION**

## **PARTIE 1 GENERAL INFORMATION**

### **.1 SECTION CONTENT**

- .1 Various aspects of health and safety that Entrepreneurs must take into account to meet the requirements of health and safety in construction sites.

### **.2 RELATED SECTIONS**

- .1 20 33 00 - documents and samples to submit
- .2 20 41 00 - regulatory requirements

### **.3 REFERENCES**

- .1 Canada labour code, part II, Canadian regulations on safety and health at work
- .2 Health Canada/information system on the dangerous substances used at work (WHMIS)
  - .1 Material safety data sheets (MSDS).
- .3 Province of Quebec
  - .1 Act the health and safety of work, R.S.Q. 1997 (updated July 26, 2005).

### **.4 DOCUMENTS/SAMPLES TO BE SUBMITTED FOR APPROVAL/INFORMATION**

- .1 For all chemical products such as glues, solvents, lubricants, paints, compressed gas (oxygen, acetylene and other) used in the construction, provide:
- .2 Sheets
  - .1 Submit data sheets required as well as the specifications and documentation of manufacturers products under section 20 33 00 - Documents and samples to be submitted.
  - .2 Specify the characteristics of the products, performance criteria and constraints.
    - (1) Submit two (2) copy s of MSDSS required under the terms of the information system on dangerous substances used at work (WHMIS), which must conform to this system, according to section 20 33 00 - Documents and to submit samples.

### **.5 REQUIREMENTS OF REGULATORY AGENCIES**

- .1 Perform the work in accordance with section 20 41 00 - regulatory requirements.

### **.6 RESPONSIBILITY**

- .1 The responsibility of the health and safety of those present on the site, as well as the protection of the property situated on site; assume also, in contiguous areas to the construction site, the protection of people and the environment insofar as they are affected by the work.

- .2 Respect, and enforce security requirements set out in the contract documents, orders, laws and local regulations, territorial, provincial and federal law applicable, by employees, as well as in the health and safety plan prepared for the site.

## **.7 COMPLIANCE REQUIREMENTS**

- .1 to comply with the law on safety and hygiene at work, regulation on safety in the workplace, R.S.M. current edition.
- .2 to comply with the law on health and safety of labour, regulations on industrial and commercial establishments, R.R.Q.
- .3 to comply with the general regulation - hygiene and safety at work Act, R.N.-B.
- .4 to comply with the law on health and safety at work, R.S.Q.
- .5 to comply with the regulation on health and safety at work under the Canada Labour Code.

## **.8 RISK CONTINGENCIES**

- .1 in the presence of conditions, risk or particular factors or contingencies affecting the security during the execution of the work, observe the procedures put in place on the right of the employee to refuse a dangerous work, in accordance with the laws and regulations of the province of Quebec and inform-engineer orally and in writing.

## **.9 HEALTH AND SAFETY COORDINATOR**

- .1 follow all instructions of the health and safety coordinator hired by the General contractor.

## **.10 DOCUMENT DISPLAY**

- .1 ensure that documents, articles, orders, and relevant notices are displayed prominently, on site, in accordance with the laws and regulations of the province of Quebec and in consultation with the engineer.

## **.11 FIX IN THE EVENT OF NON-COMPLIANCE**

- .1 take immediate steps to correct situations deemed non-conforming, on the plans of health and safety, by the competent authority or the engineer.
- .2 back-to engineer a written report the measures taken to correct the situation in the event of non-compliance on health and safety.
- .3 the engineer may order the stop work if the contractor does not have the necessary corrections with regard to the non-compliant health and safety conditions considered.

## **.12 DEVICES TO CARTRIDGES**

- .1 use cartridge devices only with the written permission of the engineer.

## **.13 STOP WORK**

- .1 priority to the health and safety of the public as well as the site personnel, and the protection of the environment, on issues related to the cost and timing of the work.

**END OF SECTION**

**Part 1 General**

**1.1 REFERENCES**

- .1 Canadian General Standards Board (CGSB)
  - .1 CGSB 1.59[Latest revision], Alkyd Exterior Gloss Enamel.
  - .2 CAN/CGSB 1.189-Latest revision, Exterior Alkyd Primer for Wood.
- .2 Canadian Standards Association (CSA International)
  - .1 CSA-O121-M1978 (R2003), Douglas Fir Plywood.
- .3 Public Works Government Services Canada (PWGSC) Standard Acquisition Clauses and Conditions (SACC)-ID: R0202D, Title: General Conditions 'C', In Effect as Of: May 14, 2004.

**1.2 INSTALLATION AND REMOVAL**

- .1 Provide temporary controls in order to execute Work expeditiously.
- .2 Remove from site all such work after use.

**1.3 GUARD RAILS AND BARRICADES**

- .1 Provide temporary secure, rigid guard rails and barricades along the roof edge.

**1.4 WEATHER ENCLOSURES**

- .1 Provide weather tight closures to unfinished door and window openings, tops of shafts and other openings in floors and roofs.

**1.5 DUST TIGHT SCREENS**

- .1 Provide dust tight screens or insulated partitions to localize dust generating activities, and for protection of workers, finished areas of Work and public.
- .2 Maintain and relocate protection until such work is complete.

**1.6 ACCESS TO SITE**

- .1 Provide and maintain access roads, sidewalk crossings, ramps and construction runways as may be required for access to Work.

**1.7 PUBLIC TRAFFIC FLOW**

- .1 Provide and maintain competent signal flag operators, traffic signals, barricades and flares, lights, or lanterns as required to perform Work and protect public.

**1.8 FIRE ROUTES**

- .1 Maintain access to property including overhead clearances for use by emergency response vehicles.

**1.9 PROTECTION FOR OFF-SITE AND PUBLIC PROPERTY**

- .1 Protect surrounding private and public property from damage during performance of Work.
- .2 Be responsible for damage incurred.

**1.10 PROTECTION OF BUILDING FINISHES**

- .1 Provide protection for finished and partially finished building finishes and equipment during performance of Work.
- .2 Provide necessary screens, covers, and hoardings.
- .3 Confirm with Departmental representative the locations and installation schedule 3 days prior to installation.
- .4 Be responsible for damage incurred due to lack of or improper protection.

**END OF SECTION**

**Part 1 General**

**1.1 REFERENCES**

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

**1.2 PROJECT CLEANLINESS**

- .1 Maintain Work in tidy condition, free from accumulation of waste products and debris
- .2 Remove waste materials from site at daily regularly scheduled times or dispose of as directed by Departmental representative. Do not burn waste materials on site
- .3 Make arrangements with and obtain permits from authorities having jurisdiction for disposal of waste and debris.
- .4 Provide on-site containers for collection of waste materials and debris.
- .5 Dispose of waste materials and debris off site.
- .6 Clean interior areas prior to start of finishing work, and maintain areas free of dust and other contaminants during finishing operations.
- .7 Store volatile waste in covered metal containers, and remove from premises at end of each working day.
- .8 Provide adequate ventilation during use of volatile or noxious substances. Use of building ventilation systems is not permitted for this purpose.
- .9 Use only cleaning materials recommended by manufacturer of surface to be cleaned, and as recommended by cleaning material manufacturer.
- .10 Schedule cleaning operations so that resulting dust, debris and other contaminants will not fall on wet, newly painted surfaces nor contaminate building systems.

**1.3 FINAL CLEANING**

- .1 When Work is Substantially Performed remove surplus products, tools, construction machinery and equipment not required for performance of remaining Work.
- .2 Remove waste products and debris other than that caused by others, and leave Work clean and suitable for occupancy.
- .3 Prior to final review remove surplus products, tools, construction machinery and equipment.
- .4 Remove waste products and debris
- .5 Remove waste materials from site at regularly scheduled times. Do not burn waste materials on site.
- .6 Make arrangements with and obtain permits from authorities having jurisdiction for disposal of waste and debris.

- .7 Clean and polish glass, mirrors, hardware, wall tile, stainless steel, chrome, porcelain enamel, baked enamel, plastic laminate, and mechanical and electrical fixtures. Replace broken, scratched or disfigured glass.
- .8 Remove stains, spots, marks and dirt from decorative work, electrical and mechanical fixtures, furniture fitments, walls, and floors.
- .9 Clean lighting reflectors, lenses, and other lighting surfaces.
- .10 Vacuum clean and dust building interiors, behind grilles, louvres and screens.
- .11 Wax, seal, shampoo or prepare floor finishes, as recommended by manufacturer.
- .12 Inspect finishes, fitments and equipment and ensure specified workmanship and operation.
- .13 Sweep and clean sidewalks, stairs and other exterior surfaces; sweep or rake the rest of the grounds.
- .14 Remove dirt and other disfiguration from exterior surfaces.
- .15 Clean and sweep roofs, gutters, courtyards, and window wells.
- .16 Sweep and clean hard surfaces.
- .17 Carefully clean material and equipment, and clean or replace filters of mechanical systems.
- .18 Clean out drains, floor drains and evacuators.
- .19 Clear out crawl spaces and other accessible areas of debris or surplus materials.
- .20 Remove snow and ice from access roads to the building.

**END OF SECTION**



**Part 1 General**

**1.1 RELATED REQUIREMENTS**

- .1 Section 23 05 53.01 – Identification for Piping and Equipment

**1.2 REFERENCE STANDARDS**

- .1 National Fire Prevention Association (NFPA)
  - .1 NFPA 10-2013, Standard for Portable Fire Extinguishers.
- .2 Underwriter's Laboratories of Canada (ULC)
  - .1 CAN/ULC-S508-02 (R2013), Standard for the Rating and Testing of Fire Extinguishers.

**1.3 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit required documents and samples in accordance with general requirements.
- .2 Product Data:
  - .1 Provide manufacturer's printed product literature and data sheets, and include product characteristics, performance criteria, physical size, finish and limitations.

**Part 2 Products**

**2.1 CARBON DIOXIDE EXTINGUISHER**

- .1 Carbon dioxide extinguishers with insulated handle, flexible hose assembly and discharge horn, operated by self-closing lever valve or pressing lever, fully loaded, ULC labelled, for Class B and C fires, 6.9 kg capacity or as indicated.
- .2 Acceptable products: "CFH Securite", Sentry CD15A-1 models or approved equivalent.

**2.2 FIRE EXTINGUISHER BRACKET**

- .1 Extinguisher manufacturer to recommend bracket type.

**2.3 DISPLAY**

- .1 Wall signs will be installed perpendicular to wall or multidirectional "V", as needed:
  - .1 Corridors: Perpendicular sign.
  - .2 Other rooms: Multidirectional sign.
- .2 Acceptable products: "CFH Securite" FDS121 or F6 (as applicable) models or approved equivalent.

## **2.4 MARKING**

- .1 Fire extinguishers marked in accordance with ANSI/NFPA 10 and CAN/ULC-S508.

## **Part 3 Execution**

### **3.1 INSTALLATION**

- .1 Install or mount fire extinguishers on brackets, as indicated, in accordance with NFPA 10.
- .2 Extinguisher handle must be located 1350 mm from the floor.
- .3 Install required sign above fire extinguishers. The sign's lower end must be located 2100 mm from the floor.

### **3.2 IDENTIFICATION**

- .1 Identify all elements in accordance with:
  - .1 Section on the Fire protection system and mechanical devices identification.
  - .2 NFPA 10 recommendations.
- .2 Attach on the fire extinguisher a label indicating the year and month of installation. Space will be provided to record periodic service dates.

### **3.3 FIELD QUALITY CONTROL**

- .1 Perform quality control according to general requirements.
- .2 Verify that all portable extinguishers have been installed in accordance with this section and NFPA 10.
- .3 Records:
  - .1 Provide the Consultant with records certifying that portable extinguishers have been installed in accordance with the Code, NFPA 10 and plans and that ready to use in the event of a fire.
  - .2 The provided certificate must also include:
    - .1 Contractor name.
    - .2 Contractor address.
    - .3 Contractor permit number.
    - .4 List of installed materials, equipment and devices.
    - .5 Confirmation of approved signage's supply and installation.

**END OF SECTION**

**Part 1 General**

**1.1 PAYMENT PROCEDURES FOR TESTING LABORATORY SERVICES**

- .1 Engage and pay for services of independent testing laboratory if required.

**1.2 REFERENCES**

- .1 Definitions:
  - .1 HVAC System: complete air duct system from outside air intake louvers to furthest air supply terminal unit and including:
    - .1 Rigid supply and return ductwork;
    - .2 Flexible ductwork;
    - .3 Mixing plenum boxes;
    - .4 Return air plenums including ceiling plenums;
    - .5 Cooling and heating coils and compartments;
    - .6 Condensate drain pans, eliminator blades and humidifiers;
    - .7 Fans, fan blades and fan housing;
    - .8 Filter housing and frames;
    - .9 Acoustically insulated duct linings;
    - .10 Diffusers, registers and terminal units;
    - .11 Dampers and controls;
- .2 Reference Standards:
  - .1 National Air Duct Cleaners Association (NADCA)
    - .1 ACR Standard, Latest edition: Assessment, Cleaning and Restoration of HVAC Systems.
  - .2 North American Insulation Manufacturers Association (NAIMA)
    - .1 NAIMA Cleaning Fibrous Glass Insulated Duct Systems - Recommended Practices.
  - .3 United States Environmental Protection Agency (US EPA)
    - .1 US EPA Latest edition, 40 CFR Parts 152 and 156.

**1.3 ADMINISTRATIVE REQUIREMENTS**

- .1 Site Evaluation: conduct site visit two (2) weeks before start of work to establish specific co-ordinated video survey and cleaning plan to establish specific co-ordinated video survey and cleaning plan determining how areas of facility and HVAC systems will be protected during cleaning operations.
  - .1 Organize and lay out plan for video survey and identify camera and cleaning apparatus insertion points.
  - .2 Ensure plan identifies sequence and schedule of survey and cleaning operations for each individual HVAC system and for complete facility.

- .1 Take account of elbows, bends, turning vanes, dampers, transitions, take-offs, and other internal features.
- .3 Departmental representative to review video survey and cleaning plan one (1) week minimum prior to start of work.
  - .1 Proceed with survey and cleaning work only after receiving written approval from Departmental representative.
- .2 Scheduling: Hours of Operation: complete work during non-business hours. Coordinate with Departmental Representative.
- .3 Project Co-ordination: assign Project Co-ordinator to oversee air duct cleaning processes.
  - .1 Provide Departmental representative with contact information of Project Co-ordinator including: name, telephone number, and cell phone number.
- .4 Security: Departmental representative will pay costs and provide security escort at times requested on Contractor's submitted work schedule.
  - .1 Cancellation of security escort requires 72 hours minimum written notice.
  - .2 Failure to cancel security escort requirements 72 hours minimum before scheduled event will result in Contractor paying for security costs.
- .5 Damaged or broken equipment and components found during initial testing and inspection will be repaired or replaced by Departmental representative.

#### **1.4 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit video survey and cleaning plan developed during site evaluation.
  - .1 Ensure plan includes sequence of operation, identification of camera and cleaning apparatus insertion points and schedule for work.
- .3 Product Data:
  - .1 Submit manufacturer's printed product literature and data sheets for antimicrobial agents and include product characteristics, performance criteria and limitations.
  - .2 In the case of antimicrobial agents or coatings, provide two (2) copies of safety data sheets in accordance with WHMIS MSDS (Workplace Hazardous Materials Information System) requirements.
- .4 Testing Laboratory Services: submit name and address of laboratory engaged for work of this Section.
  - .1 Submit laboratory analysis report of particulate collection indicating:
    - .1 Location of collection;
    - .2 Particulate grade;
    - .3 Particulate size;
    - .4 Percentage concentration of individual particulates in each sample.
- .5 EPA Registration: submit verification of EPA Registration of antimicrobial agent.

- .6 Submit verification of delivery of hazardous or toxic waste materials to contaminated waste facility, as described in PART 3 - CLEANING - Waste Management.

## **1.5 CLOSEOUT SUBMITTALS**

- .1 Post Cleaning Inspection Report: submit two (2) copies of Final Inspection Report, including data collected, observations and recommendations as well as following information:
  - .1 Name and address of facility;
  - .2 Name and address of HVAC cleaning contractor;
  - .3 Description of HVAC systems with drawings or sketches identifying systems cleaned;
  - .4 Identification scheme for location points in systems that were inspected with accompanying notes describing methods of inspection or tests used;
  - .5 Identification of points where samples were collected and type of analysis used for each collection;
  - .6 Identification of each sample collected;
  - .7 Comments complete with photographs of each sampling location and other observed system features;
  - .8 Identify systems tested, observations, actions taken and recommendations for future maintenance.
- .2 Record post cleaning video survey: submit two (2) copies of video survey on DVD or USB Drive or memory card media, and include on video survey following:
  - .1 Areas tested for particulate analysis or microbial growth evaluation;
  - .2 Areas of special interest and location;
  - .3 Special internal features;
  - .4 Problems such as broken or damaged controls or components;
  - .5 Ensure system tested, locations, observations, actions taken and recommendations are clearly identified in English and French on video using text or voice over.
- .3 Submit verification of delivery of hazardous or toxic waste materials to contaminated waste facility.

## **1.6 EXTRA MATERIALS**

- .1 Extra Stock Materials:
  - .1 Supply four (4) extra filters for each HVAC System cleaned.
  - .2 Ensure filters are correct match, size, type and configuration of existing HVAC Systems.

## **1.7 QUALITY ASSURANCE**

- .1 Contractor: verification of membership in NADCA or verification of five (5) years minimum experience in work similar to or exceeding work of this Section.

- .2 Project Co-ordinator: Air System Cleaning Specialist (ASCS) certified by NADCA on full time basis or verification of [five (5) years minimum experience in work similar to or exceeding work of this Section.

## **Part 2 Products**

### **2.1 ACCESS DOORS AND PANELS**

- .1 Equipment Access Doors and Panels: construct from same materials as equipment panelling complete with sealing gasket and positive locking device.
  - .1 Size access doors and panels in equipment to allow for inspection and cleaning.
- .2 Ductwork Access Doors: construct access doors from 1.27 mm minimum galvanized sheet steel with gasketed seal.
  - .1 Ensure access door is 25 mm greater in every dimension than access opening.
  - .2 Access door size 200 mm x 200 mm minimum.
  - .3 Secure access doors with sheet metal screws on 75 mm centres minimum. Ensure three (3) screws per side minimum.
- .3 Access Doors and Panels Acoustic Lining:
  - .1 Install acoustic lining to match existing.
  - .2 Self-adhesive glass fibre tape capable of adhering to both acoustic lining and metal access door or panel materials.
  - .3 Water-based duct sealer for repairing cut acoustic lining.
- .4 Access doors and panels – architectural ceilings (giving access to doors and panels for hidden ducts). Doors and access panels must be in galvanized steel sheet at least 1.27 mm thick.
  - .1 The openings for doors and access panels in architectural ceilings must measure 25 mm or larger for access panels in the ventilation ducts, in all directions.
  - .2 The doors and access panels in architectural ceilings must be of the same colour as the ceiling and blend in as much as possible. Coordinate with Departmental representative the placement and details of these doors and access panels.
  - .3 The doors and access panels must be properly secured to the architectural ceiling.

### **2.2 ANTIMICROBIAL AGENT**

- .1 Use antimicrobial agents registered with US EPA-40 CFR.

### **2.3 SYSTEM FILTERS**

- .1 Supply and install new filters for each HVAC System cleaned.

### **2.4 AIR DUCT CLEANING EQUIPMENT**

- .1 Manually propelled full contact brushes:
  - .1 Ensure brushes are specifically manufactured and shaped to fit individual ducts, equipment and components of HVAC system.

- .1 Ensure brushes are sized to fit various duct sizes in HVAC system.
- .2 Ensure brushes make scrubbing motion and full contact with HVAC system interior surfaces to be cleaned.
- .2 Brushes: manually propelled with integrally-mounted motor or drive and nylon or polypropylene or other non-metallic material bristles.
  - .1 Ensure the motor or drive has capacity to continue to push brush after bristles are distorted.
  - .2 Replace worn and ineffective brushes when required.

## **2.5 MULTI-FUNCTIONAL ROBOTIC CLEANING SYSTEM**

- .1 Self-propelled remote controlled, track or wheeled drive equipped with: camera halogen lights: rotating or reciprocating brushes etc.
  - .1 Ensure brushes are specifically manufactured and shaped to fit individual ducts and acoustic lined ducts, equipment and components of HVAC system.
  - .2 Ensure brushes make scrubbing motion and full contact with HVAC system interior surfaces.
  - .3 Replace worn and ineffective brushes when required.
- .2 Camera: fully rotational, pivotal, remote control focus and dustproof digital with 480 lines of resolution, capable of storing four (4) hours of recorded media.
  - .1 Camera Light: two (2) x 20 watt Halogen or equivalent with dimmer

## **2.6 HEPA FILTER EVACUATION FAN**

- .1 Evacuation Fan: includes fan, HEPA filter, flexible hose and motor capable of maintaining debris and particulates airborne in airstream until they reach evacuation fan and maintaining system under negative pressure.
  - .1 Ensure HEPA filters are clean and maintain evacuation fan and HEPA filter to run efficiently.

## **2.7 HEPA VACUUM UNIT**

- .1 Vacuum Unit: includes vacuum fan, integral HEPA filter, suction hose and vacuum head, capable of maintaining HVAC System debris and particulates airborne in air stream until they reach vacuum unit and maintaining system under negative pressure.
  - .1 Ensure HEPA filters are clean and maintain vacuum unit and HEPA filter to run efficiently.

## **Part 3 Execution**

### **3.1 PREPARATION**

- .1 Close down HVAC system.
- .2 Locate and identify externally visible HVAC system features which may affect cleaning process including:
  - .1 Control devices;

- .2 Fire and smoke control dampers;
- .3 Balancing dampers: indicate and record positions for resetting;
- .4 Air volume control boxes: indicate and record positions for resetting;
- .5 Fire alarm devices;
- .6 Monitoring devices and controls;
- .3 Cut openings in equipment panels and ductwork for access to system interior.
  - .1 Square or rectangular opening sizes: 200 mm minimum each side.
  - .2 Circular opening sizes: 200 mm minimum diameter.
- .4 Installation of Access Doors and Panels: install access doors and panels for equipment where required to facilitate system inspection and cleaning.
  - .1 Install access doors and panels for inspection and cleaning of equipment as follows:
    - .1 Heating and cooling coils;
    - .2 Fan units;
    - .3 Filters;
    - .4 Dampers;
    - .5 Sensors;
- .5 Installation of Access Doors in Ductwork: install access doors in ductwork where required to facilitate system inspection and cleaning.
  - .1 Access door installation is not permitted in flexible ductwork.
    - .1 Inspect flexible ductwork only by disconnecting from main duct and inspecting from open end.
- .6 When acoustically lined duct is cut for access, repair cut edges of acoustic lining using self-adhesive fibre glass tape and water based duct sealer.
  - .1 Adhere new acoustic lining to match existing to inside of access panel or door to ensure continuity of acoustic properties of system.
- .7 Remove and reinstall ceiling panels to gain access to HVAC system as required.
  - .1 Replace damaged or soiled ceiling panels after air duct cleaning procedures.

### **3.2 EXAMINATION / PRE-CLEANING INSPECTION**

- .1 Verification of Conditions:
  - .1 Make visual inspection of interior of HVAC system using remote controlled robotic camera.
  - .2 Insert camera at pre-established strategic locations to evaluate condition and cleanliness of HVAC systems and components.
  - .3 Refer to report: « Inspection Fongique des Systèmes de Ventilation » by WSP, in March 2016.
- .2 Evaluation and Assessment:
  - .1 Identify location and type of internal components.



- .2 Identify extent of potential problems.
- .3 If toxic or hazardous materials or deposits are suspected after initial inspection immediately stop work and inform Departmental representative.
  - .1 Do not proceed further with inspection operations until written approval from Departmental representative.

### **3.3 DUCT CLEANING**

- .1 Do duct cleaning in accordance with NADCA ACR Standard.
- .2 Divide the ductwork and clean it by section so that dust and debris produced during the cleaning of a section are not deposited in an already cleaned section.
  - .1 Isolate zone of duct using closed-cell polyurethane foam or air inflated zone bag before cleaning.
- .3 Ensure vacuum units and evacuation fans are securely in place before starting cleaning operation of isolated section of HVAC air duct system.
- .4 Install HEPA filter evacuation fan at one end of zone section and insert full contact brushes at other end.
- .5 Clean HVAC supply air duct system and components where particulate sample collected from surfaces is greater than 75 mg of particulate per 0.01 square metres.
- .6 Clean exhaust, return, transfer ductwork and plenums, equipment and components where particulate sample collected from surfaces is greater than 75 mg of particulate per 0.01 square metres.
- .7 Energize brushes to travel from insertion point to HEPA filter evacuation fan.
  - .1 Pass brushes through sections as often as necessary to achieve required cleanliness.
  - .2 Change brush sizes as required to ensure positive contact with duct and component interiors.
  - .3 Clean corners and pockets where dirt and debris can accumulate.
- .8 Clean equipment, components and other features in isolated zone before moving to next zone of HVAC air duct system.
- .9 Remove perforated supply diffusers from suspended tee-bar ceiling.
  - .1 Dismantle and clean perforated plates and supply diffuser duct collars.
  - .2 Re-assemble perforated plate diffusers and reconnect to HVAC system using supply diffuser duct collar after cleaning.
- .10 Clean diffusers, registers, louvers and other terminal units.
- .11 Advise Departmental representative 72 hours minimum before deactivation of fire alarm and smoke detectors duct cleaning operations.
  - .1 Departmental representative will pay for costs of deactivation of fire alarm and smoke detector system.

### **3.4 ACOUSTICALLY LINED DUCTWORK CLEANING**

- .1 Clean glass fibre acoustically insulated ducts to NAIMA recommended practices.

- .1 Use specifically designed robotic apparatus that has been demonstrated not to damage acoustic glass fibre lining.
- .2 Monitor cleaning process progress by onboard camera.

### **3.5 COMPONENTS AND EQUIPMENT CLEANING**

- .1 Brush and vacuum coils, humidifiers, air handling unit enclosures, and heat exchanger surfaces to achieve required cleanliness.
- .2 When cleaning equipment and components by brushing and vacuuming is inappropriate or insufficient, dismantle and remove equipment or component and move to area designated by Departmental representative for cleaning.
  - .1 Pressure wash with water and cleaning solution until required cleanliness is achieved.
  - .2 Clean equipment and components in place only if there is no hazard to adjacent materials.
- .3 Compressed air and manual cleaning is acceptable only for cleaning individual components and small areas as follows and only after written approval from Departmental representative:
  - .1 Fan blades;
  - .2 Dampers;
  - .3 Turning vanes;
  - .4 Controls;
  - .5 Sensor bulbs;
  - .6 Fire alarms;
  - .7 Smoke detectors;

### **3.6 ANTI MICROBIAL APPLICATION**

- .1 Apply antimicrobial agents when fungal growth is suspected or where unacceptable levels of fungal contamination have been verified through visual inspection or testing.
- .2 Apply antimicrobial agents after removal of surface deposits and debris.
  - .1 Verify air duct interiors are free from deposits and debris by visual inspection or testing.
  - .2 Report findings to Departmental representative.
  - .3 Proceed with application of antimicrobial agents after written approval from Departmental representative.
- .3 Apply antimicrobial agents in accordance with manufacturer's written instructions and US EPA 40 CFR registration and listing.
- .4 Manual spray antimicrobial agents directly onto interior surfaces of HVAC air duct system.
  - .1 Do not use fog mist for downstream surfaces.

**3.7 FIELD QUALITY CONTROL/FINAL INSPECTIONS**

- .1 Post Cleaning Inspection: carry out final inspection using robotic camera and other visual inspection methods after final cleaning has been completed.
  - .1 Carry out video survey according to recognized practices.
  - .2 Include in final survey areas inspected by Contractor prior to cleaning.
  - .3 Identify on HVAC system record drawings access points used for inspection and cleaning.
  - .4 Re-collect and analyze particulates collected at same locations where original samples were collected before cleaning.
  - .5 Reset components including dampers and sensors, which have been disturbed during cleaning operations.

**3.8 SYSTEM STARTUP**

- .1 Install new system filters after cleaning operations are completed.
- .2 Cover each inspection opening with access door or panel and secure in place after inspection and cleaning are completed.
- .3 Restart each HVAC system.

**3.9 CLEANING**

- .1 Clean in accordance with Section 01 74 11 – Cleaning.

**END OF SECTION**

**Part 1            General**

**1.1            ACTION AND INFORMATIONAL SUBMITTALS**

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

**1.2            CLOSEOUT SUBMITTALS**

- .1        Submit Closeout Submittals.
- .2        Operation and Maintenance Data: submit operation and maintenance data for Air Handling Units (AHU) and their respective condenser units for incorporation into manual.
  - .1        Operation and maintenance manual approved by, and final copies deposited with, Departmental representative before final inspection.
  - .2        Operation data to include:
    - .1        Control schematics for systems including environmental controls.
    - .2        Description of systems and their controls.
    - .3        Description of operation of systems at various loads together with reset schedules and seasonal variances.
    - .4        Operation instruction for systems and component.
    - .5        Description of actions to be taken in event of equipment failure.
    - .6        Valves schedule and flow diagram.
    - .7        Colour coding chart.
  - .3        Maintenance data to include:
    - .1        Servicing, maintenance, operation and trouble-shooting instructions for each item of equipment.
    - .2        Data to include schedules of tasks, frequency, tools required and task time.
  - .4        Performance data to include:
    - .1        Equipment manufacturer's performance datasheets with point of operation as left after commissioning is complete.
    - .2        Equipment performance verification test results.
    - .3        Special performance data as specified.
    - .4        Testing, adjusting and balancing reports for HVAC.
  - .5        Approvals:
    - .1        Submit two (2) copies of draft Operation and Maintenance Manual to Departmental representative for approval. Submission of individual data will not be accepted unless directed by Departmental representative
    - .2        Make changes as required and re-submit as directed by Departmental representative.

- .6 Additional data:
  - .1 Prepare and insert into operation and maintenance manual additional data when need for it becomes apparent during specified demonstrations and instructions.
- .7 Site records:
  - .1 The Contractor will provide one (1) set of reproducible mechanical drawings. Mark changes as work progresses and as changes occur. Include changes to existing mechanical systems, control systems and low voltage control wiring.
  - .2 Transfer information on the drawings to show work as actually installed.
  - .3 Use different colour waterproof ink for each service.
  - .4 Make available for reference purposes and inspection.
- .8 As-built drawings:
  - .1 Prior to start of Testing, Adjusting and Balancing for HVAC, finalize production of as-built drawings.
  - .2 Identify each drawing in lower right hand corner in letters at least 12 mm high as follows: - "AS BUILT DRAWINGS: THIS DRAWING HAS BEEN REVISED TO SHOW MECHANICAL SYSTEMS AS INSTALLED" (Signature of Contractor) (Date).
  - .3 Submit to Departmental representative for approval and make corrections as directed.
  - .4 Perform testing, adjusting and balancing for HVAC using as-built drawings.
  - .5 Submit completed reproducible as-built drawings with Operating and Maintenance Manuals.
- .9 Submit copies of as-built drawings for inclusion in final TAB report.

### **1.3 MAINTENANCE MATERIAL SUBMITTALS**

- .1 Submit closeout Submittals.
- .2 Furnish spare parts as follows:
  - .1 One (1) filter cartridge or one (1) set of filter media for each filter or filter bank in addition to final operating set.
- .3 Provide one set of special tools required to service equipment as recommended by manufacturers.
- .4 Furnish one commercial quality grease gun, grease and adapters to suit different types of grease and grease fittings.

### **1.4 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:

- .1 Store materials off ground and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
- .2 Store and protect the AHU and condenser units from nicks, scratches, and blemishes.
- .3 Replace defective or damaged materials with new.

## **Part 2 Execution**

### **2.1 EXAMINATION**

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for the AHUs and their condenser units' installation in accordance with manufacturer's written instructions.
  - .1 Inform departmental representative of none acceptable conditions immediately upon discovery.
  - .2 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental representative.

### **2.2 INSTALLATION AND MODIFICATIONS**

- .1 Install the AHU and their condenser units and perform the connection to the ventilation ducts in accordance with ASHRAE, SMACNA and the manufacturer's instructions.

### **2.3 PAINTING REPAIRS AND RESTORATION**

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

### **2.4 SYSTEM CLEANING**

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

### **2.5 DEMONSTRATION**

- .1 Departmental representative will use equipment and systems for test purposes prior to acceptance. Supply labour, material, and instruments required for testing.
- .2 Trial usage to apply to following equipment and systems:
  - .1 TP-1
  - .2 Building Automation System (BAS)
- .3 Supply tools, equipment and personnel to demonstrate and instruct operating and maintenance personnel in operating, controlling, adjusting, trouble-shooting and servicing of all systems and equipment during regular work hours, prior to acceptance.
- .4 Use operation and maintenance manual, as-built drawings, and audio visual aids as part of instruction materials.

- .5 Instruction duration time requirements as specified in appropriate sections.
- .6 Departmental representative reserves the right to record these demonstrations on video tape for future reference.

**2.6 CLEANING**

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

**2.7 PROTECTION**

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

**END OF SECTION**

**Part 1 General**

**1.1 SUMMARY**

.1 Section Includes:

- .1 Use of mechanical systems during construction.

**1.2 USE OF SYSTEMS**

.1 Use of existing permanent heating and ventilating systems for supplying temporary ventilation heat is permitted only under following conditions.

- .1 Entire system is complete, pressure tested, cleaned, 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, and changed every week 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 Contractor.
  - .3 Monitored continuously by Contractor.
- .8 Warranties and guarantees are not relaxed.
- .9 Regular preventive and other manufacturers recommended maintenance routines are performed by Contractor at own expense and under supervision of Departmental Representative.
- .10 Refurbish entire system before static completion; clean internally and externally, restore to "as- new" condition, replace filters in air systems.
- .2 Filters specified in this Section are over and above those specified in other Sections of this project.
- .3 Exhaust systems are not included in approvals for temporary heating ventilation.

**Part 2 Products**

**2.1 NOT USED**

- .1 Not Used.



**Part 3            Execution**

**3.1                NOT USED**

.1            Not Used.

**END OF SECTION**

## **Part 1            General**

### **1.1            REFERENCE STANDARDS**

- .1 Canadian Standards Association (CSA)/CSA International
  - .1 CSA B51, Boiler and pressure vessel code
  - .2 CSA B214, Installation Code for hydronic heating system.
- .2 Bureau de normalisation du Québec (BNQ)
  - .1 NQ 3650-900, Pressure vessel installation code.
- .3 National Fire Protection Association (NFPA).

## **Part 2            Products**

### **2.1            MATERIAL**

- .1 Paint: zinc-rich
- .2 Fire Stopping: in accordance with applicable codes

### **2.2            EVACUATION / DRAIN VALVES**

- .1 Ball type with nominal diameter of DN 19 unless otherwise indicated, threaded end for hose, stopper and chain.
- .2 Acceptable products: Dahl, Fig. 50430 « Apollo » or « Jenkins ».

### **2.3            DIELECTRIC COUPLINGS**

- .1 Dielectric couplings with nominal diameter equal or less than DN 50;
  - .1 Couplings or lined fittings with thermoplastic liner.
  - .2 Acceptable Products: Victaulic 47-TT « Apollo » or « Spirax-Sarco ».
- .1 Dielectric couplings with nominal diameter equal or greater than DN 50;
  - .1 Flanges with teflon packing.

### **2.4            ROSETTES**

- .1 Fabrication: one piece rosettes held in place using locking screws.
  - .1 Material: chromed or nickel-plated brass or 302 grade stainless steel.
- .2 Dimensions: exterior dimension larger than the opening or the transverse bushing.
- .3 Interior diameter appropriate to the exterior diameter of the pipes on which they are mounted or their thermal insulation.

**Part 3            Execution**

**3.1                PIPEWORK INSTALLATION**

- .1      Screwed fittings jointed with Teflon tape.
- .2      Protect openings against entry of foreign material.
- .3      Install to isolate equipment and allow removal without interrupting operation of other equipment or systems.
- .4      Assemble piping using fittings manufactured to ANSI standards.
- .5      Install exposed piping, equipment, rectangular cleanouts and similar items parallel or perpendicular to building lines.
- .6      Install concealed pipework to minimize furring space, maximize headroom, conserve space.
- .7      Except where otherwise indicated, install water or glycol piping giving it an ascending slope in the direction of the flow of liquid to promote the free evacuation of it and free ventilation of the network
  - .1          Main pipe: slope 1:700
  - .2          Secondary pipe (branch): 1: 100
- .8      Slope piping, except where indicated, in direction of flow for positive drainage and venting.
- .9      Group piping wherever possible and as indicated.
- .10     Ream pipes, remove scale and other foreign material before assembly.
- .11     Clean the inside of the fittings and join the elements without trapping them.
- .12     Saddle type branch fittings may be used on mains if branch line is no larger than half size of main.
- .13     Use eccentric reducers at pipe size changes to ensure positive drainage and venting.
- .14     Provide for thermal piping expansion.
- .15     Firmly attach water supply pipes in the walls.
- .16     When the drawings indicate outlets for the possible connection of other sanitary fixtures, plug the outlets with gas and water plugs or caps.
- .17     Valves:
  - .1          Remove interior parts before soldering.
  - .2          Install with stems above horizontal position unless indicated.
  - .3          Install valves in accessible locations for maintenance without removing adjacent piping.
  - .4          Install globe valves in bypass around control valves.
  - .5          Use gate valves at branch take-offs for isolating purposes except where specified.
  - .6          Install butterfly valves between weld neck flanges to ensure full compression of liner.

- .7 Use chain operators on valves NPS 65 and larger where installed more than 2400 mm above floor in Mechanical Rooms.
- .18 Check Valves:
  - .1 Install silent check valves on discharge of pumps and as indicated.

### 3.2 SLEEVES

- .1 General: install where pipes pass through masonry, concrete structures, fire rated assemblies, and as indicated.
- .2 Material: schedule 40 black steel pipe.
- .3 Construction: use annular fins continuously welded at mid-point at foundation walls and where sleeves extend above finished floors.
- .4 Sizes: 6 mm minimum clearance between sleeve and uninsulated pipe or between sleeve and insulation.
- .5 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 to CAN/CGSB-1.181.
- .6 Sealing:
  - .1 Foundation walls and below grade floors: fire retardant, waterproof non-hardening mastic.
  - .2 Elsewhere:
    - .1 Provide space for firestopping.
    - .2 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.

### 3.3 ESCUTCHEONS

- .1 Install on pipes passing through walls, partitions, floors, and ceilings in finished areas.
- .2 Construction: one piece type with set screws.
  - .1 Chrome or nickel plated brass or type 302 stainless steel..
- .3 Sizes: outside diameter to cover opening or sleeve.
  - .1 Inside diameter to fit around pipe or outside of insulation if so provided.

### 3.4 PREPARATION FOR FIRE STOPPING

- .1 Install firestopping within annular space between pipes, ducts, insulation and adjacent fire separation.

- .2 Uninsulated unheated pipes not subject to movement: no special preparation.
- .3 Uninsulated heated pipes subject to movement: wrap with non-combustible smooth material to permit pipe movement without damaging fires topping material or installation.  
Insulated pipes and ducts: ensure integrity of insulation and vapour barriers.

### **3.5 CONNECT TO PIPING EQUIPMENT**

- .1 Use valves with unions or flanges to isolate equipment from the piping system and to facilitate maintenance and assembly / removal of components.
- .2 Use double joint connections when equipment is mounted on antivibration pads and when piping is likely to move.
- .3 Unless otherwise indicated, connect the piping to appliances and others, as per manufacturers written instructions.

### **3.6 FLUSHING OUT OF PIPING SYSTEMS**

- .1 Flush system before to fill the system.
- .2 Before start-up, clean interior of piping systems in accordance with requirements of Section 01 74 11- Cleaning.
- .3 Preparatory to acceptance, clean and refurbish equipment and leave in operating condition, including replacement of filters in piping systems.

### **3.7 PRESSURE TESTING OF EQUIPMENT AND PIPEWORK**

- .1 Advise Departmental Representative 48 hours minimum prior to performance of pressure ask tests.
- .2 Pipework: test as specified in relevant sections of heating, ventilating and air conditioning work.
- .3 Maintain specified test pressure without loss for 4 hours minimum unless specified for longer period of time in relevant mechanical sections.
- .4 Prior to tests, isolate equipment and other parts which are not designed to withstand test pressure or media.
- .5 Conduct tests in presence of Departmental Representative.
- .6 Pay costs for repairs or replacement, retesting, and making good. Departmental Representative to determine whether repair or replacement is appropriate.
- .7 Insulate or conceal work only after approval and certification of tests by Departmental Representative.

### **3.8 EXISTING NETWORKS**

- .1 Connect the new piping to the existing network at points approved by the ministerial representative.
- .2 Ask for written permission from the ministerial representative at least 10 days before commencing the work.

- .3 Assume complete responsibility for damages that could be caused to the existing installation by the present works.

### **3.9 CLEARANCES**

- .1 Provide clearance around apparatus to facilitate inspection, maintenance, and observation of proper operation, as recommended by the manufacturer and the requirements of applicable codes and standards.
- .2 Provide sufficient work space, as recommended by the manufacturer, to disassemble and remove equipment or parts of equipment, if necessary, without interrupting the operation of other devices or network components.

### **3.10 EVACUATION / DRAIN VALVES**

- .1 Install drain / drain valves at low points of the network, appliances and isolation valves
- .2 Connect one pipe to each drain / drain valve and route it over a floor drain
- .3 Connect one pipe to each drain / drain valve and route it over a floor drain.
  - .1 The discharge point must be clearly visible.

### **3.11 AIR VENTS**

- .1 Install automatic air vents at high points of the hydronic network and in piping systems.
- .2 Install isolation valves at each automatic air vent.

### **3.12 DIELECTRIC CONNECTIONS**

- .1 Use dielectric fittings to join dissimilar metal elements.
- .2 Use dielectric connections appropriate to the type of piping and suitable for the nominal network pressure.

### **3.13 IDENTIFICATION**

- .1 Identifier tous les éléments conformément à la section sur l'identification des réseaux et des appareils mécaniques.

### **3.14 THERMAL INSULATION**

- .1 Insulate the pipes according to the section on insulation for pipes.

**END OF SECTION**

**Part 1 General**

**1.1 REFERENCE STANDARDS**

- .1 American National Standards Institute/American Society of Mechanical Engineers (ANSI/ASME)
  - .1 ANSI/ASME B31.1-2007, Power Piping.
  - .2 ANSI/ASME B31.3-2006, Process Piping.
  - .3 ANSI/ASME Boiler and Pressure Vessel Code-2007:
    - .1 BPVC 2007 Section I: Power Boilers.
    - .2 BPVC 2007 Section V: Nondestructive Examination.
    - .3 BPVC 2007 Section IX: Welding and Brazing Qualifications.
- .2 American National Standards Institute/American Water Works Association (ANSI/AWWA)
  - .1 ANSI/AWWA C206-03, Field Welding of Steel Water Pipe.
- .3 American Welding Society (AWS)
  - .1 AWS C1.1M/C1.1-2000 (R2006), Recommended Practices for Resistance Welding.
  - .2 AWS Z49.1-2005, Safety in Welding, Cutting and Allied Process.
  - .3 AWS W1-2000, Welding Inspection Handbook.
- .4 Canadian Standards Association (CSA International)
  - .1 CSA W47.2 Certification of Companies for Fusion Welding of Aluminum.
  - .2 CSA W48 Filler Metals and Allied Materials for Metal Arc Welding.
  - .3 CSA B51 Boiler, Pressure Vessel and Pressure Piping Code.
  - .4 CSA W178.1, Certification of Welding Inspection Organizations.
  - .5 CSA W178.2, Certification of Welding Inspectors.

**1.2 ACTION AND INFORMATIONAL SUBMITTALS**

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

**1.3 QUALITY ASSURANCE**

- .1 Qualifications:
  - .1 Welders:
    - .1 Welding qualifications in accordance with CSA B51.
    - .2 Use qualified and licensed welders possessing certificate for each procedure performed from authority having jurisdiction.
    - .3 Submit welder's qualifications to Departmental Representative.
    - .4 Each welder to possess identification symbol issued by authority having jurisdiction.

- .5 Certification of companies for fusion welding of aluminum in accordance with CSA W47.2.
- .2 Inspectors:
  - .1 Inspectors qualified to CSA W178.2.
- .3 Certifications:
  - .1 Registration of welding procedures in accordance with CSA B51.
  - .2 Copy of welding procedures available for inspection.
  - .3 Safety in welding, cutting and allied processes in accordance with CSA-W117.2.

## **Part 2 Products**

### **2.1 ELECTRODES**

- .1 Electrodes: in accordance with CSA W48 Series.

## **Part 3 Execution**

### **3.1 QUALITY OF WORK**

- .1 Perform welding in accordance with ANSI/ASME B31.1 or B31.3 (according to the case) to ANSI/ASME Boiler and Pressure Vessel Code, Sections I and IX and ANSI/AWWA C206, using procedures conforming to AWS B3.0, and C1.1,, and to details otherwise provided in Divisions 21, 22, 23 and 25 if necessary.

### **3.2 INSTALLATION REQUIREMENTS**

- .1 Identify each weld with welder's identification symbol.
- .2 Backing rings:
  - .1 Where used, fit to minimize gaps between ring and pipe bore.
  - .2 Do not install at orifice flanges.
- .3 Fittings:
  - .1 NPS 2 and smaller: install welding type sockets.
  - .2 Branch connections: install welding tees or forged branch outlet fittings.

### **3.3 WELDING AND SITE ASSEMBLY**

- .1 Supply and install all temporary devices for:
  - .1 Evacuation of welding gases;
  - .2 Protection of workers;
  - .3 Protection of buildings;
  - .4 All in accordance with the general conditions.



- .2 Before starting the works, confirm the personnel who will execute the welding and submit a sample of each welder and each type of material to be welded (steel or stainless steel)
- .3 Ensure the coordination of the protection of all surrounding equipment and coordination concerning the temporary deactivation of the smoke detectors
- .4 Fire extinguishers and protective covers must be in sufficient quantities.

### **3.4 INSPECTION AND TESTS - GENERAL REQUIREMENTS**

- .1 Perform quality control in accordance with general conditions.
- .2 Review weld quality requirements and defect limits of applicable codes and standards with Departmental Representative before work is started.
- .3 Establish an Inspection and Test Plan in co-operation with Departmental Representative.
- .4 Do not conceal welds until they have been inspected, tested and approved by inspector.
- .5 Allow inspector to visually inspect welds during early stages of welding procedures in accordance with Welding Inspection Handbook. Repair or replace defects as required by codes and as specified.

### **3.5 SPECIALIST EXAMINATIONS AND TESTS**

- .1 General:
  - .1 Examinations and tests must be performed by specialist qualified to CSA W178.1 and CSA W178.2 and approved by Departmental Representative.
  - .2 Examinations and tests must be performed to ANSI/ASME Boiler and Pressure Vessels Code, Section V, CSA B51 and requirements of authorities having jurisdiction.
  - .3 In accordance with the inspection and testing plan, submit all welds to non-destructive testing and to visual inspection.
- .2 Submit welds to a hydraulic test in compliance with ANSI/ASME B31.1.
- .3 Visual inspections: examine all welds performed on the exterior circumference and all points where possible, in the interior of the piping.

### **3.6 REPAIR OF WELDS WHICH FAILED TESTS**

- .1 Re-inspect and re-test repaired or re-worked welds at Contractor's expense.

**END OF SECTION**

**Part 1 General**

**1.1 REFERENCE STANDARDS**

- .1 American Society of Mechanical Engineers (ASME)
  - .1 ASME B31.1, Power Piping.
- .2 ASTM International
  - .1 ASTM A125, Standard Specification for Steel Springs, Helical, Heat-Treated.
  - .2 ASTM A307, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
  - .3 ASTM A563, Standard Specification for Carbon and Alloy Steel Nuts.
- .3 Factory Mutual (FM)
- .4 Manufacturer's Standardization Society of the Valves and Fittings Industry (MSS)
  - .1 MSS SP58, Pipe Hangers and Supports - Materials, Design and Manufacture.
  - .2 MSS SP69, Pipe Hangers and Supports - Selection and Application.
  - .3 MSS SP89, Pipe Hangers and Supports - Fabrication and Installation Practices.
- .5 National Research Council Canada (NRC)
  - .1 National Plumbing Code of Canada.
- .6 Underwriter's Laboratories of Canada (ULC)

**1.2 ACTION AND INFORMATIONAL SUBMITTALS**

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

**Part 2 Products**

**2.1 SYSTEM DESCRIPTION**

- .1 Design Requirements:
  - .1 Construct pipe hanger and support to manufacturer's recommendations utilizing manufacturer's regular production components, parts and assemblies.
  - .2 Base maximum load ratings on allowable stresses prescribed by ASME B31.1 or MSS SP58.
  - .3 Ensure that supports, guides, anchors do not transmit excessive quantities of heat to building structure.
  - .4 Design hangers and supports to support systems under conditions of operation, allow free expansion and contraction, prevent excessive stresses from being introduced into pipework or connected equipment.
  - .5 Provide for vertical adjustments after erection and during commissioning. Amount of adjustment in accordance with MSS SP58.

## 2.2 GENERAL

- .1 Fabricate hangers, supports and sway braces in accordance with MSS SP58. and ANSI B31.1
- .2 All support must include the following three pieces at minimum: anchor sleeve, suspension rod, collar or stirrup
- .3 All anchors installed in concrete structures must be approved to withstand seismic loads, including those used for gravity support. Anchor sleeves are therefore prohibited.
- .4 All supports and suspensions must be UL listed for Canada and approved by the FM, for all fire protection installations.
- .5 Use components for intended design purpose only. Do not use for rigging or erection purposes.

## 2.3 PIPE HANGERS

- .1 Finishes:
  - .1 Pipe hangers and supports: galvanized after manufacture.
  - .2 Use electro-plating galvanizing process or hot dipped galvanizing process.
  - .3 Ensure steel hangers in contact with copper piping are epoxy coated or copper plated.
- .2 Upper attachment structural: suspension from lower flange of I-Beam:
  - .1 Cold piping NPS 2 maximum: malleable iron C-clamp with hardened steel cup point setscrew, locknut [carbon steel retaining clip].
  - .2 Cold piping NPS 2 1/2 or greater, hot piping: malleable iron beam clamp, eye rod, jaws and extension with carbon steel retaining clip, tie rod, nuts and washers, MSS-SP58
- .3 Upper attachment structural: suspension from upper flange of I-Beam:
  - .1 Cold piping NPS 2 maximum: ductile iron top-of-beam C-clamp with hardened steel cup point setscrew, locknut and carbon steel retaining clip,
  - .2 Cold piping NPS 2 1/2 or greater, hot piping: malleable iron top-of-beam jaw-clamp with hooked rod, spring washer, plain washer and nut
- .4 Upper attachment to concrete:
  - .1 Ceiling: carbon steel welded eye rod, clevis plate, clevis pin and cotters with weldless forged steel eye nut. Ensure eye 6 mm minimum greater than rod diameter.
  - .2 Concrete inserts: wedge shaped body with knockout protector plate MSS SP 58.
- .5 Hanger rods: threaded rod material to MSS SP58:
  - .1 Ensure that hanger rods are subject to tensile loading only.
- .6 Pipe attachments: material to MSS SP58:
  - .1 Attachments for steel piping: carbon steel galvanized.
    - .1 Acceptable products: « Anvil » fig. 260; « Hilti »; « Myatt »; « Tolco ».

- .2 Attachments for copper piping: copper plated black steel.
  - 1. Acceptable products: « Anvil » fig. CT-69; « Hilti »; « Myatt »; « Tolco ».
- .3 Use insulation shields for hot pipework.
- .4 Oversize pipe hangers and supports.
- .5 Articulation elements shall be provided as required to allow horizontal and vertical movement of the supported piping.
- .7 Adjustable clevis: material to MSS SP 58, clevis bolt with nipple spacer and vertical adjustment nuts above and below clevis.
- .8 Yoke style pipe roll: carbon steel yoke, rod and nuts with cast iron roll, to MSS SP58.
  - .1 Acceptable product: « Anvil » fig. 177
- .9 U-bolts: carbon steel to MSS SP58 with 2 nuts at each end to ASTM A563.
  - .1 Finishes for steel pipework: galvanized.
  - .2 Finishes for copper, glass, brass or aluminum pipework: galvanized, with formed portion plastic or epoxy coated.
- .10 Pipe rollers: cast iron roll and roll stand with carbon steel rod to MSS SP58.
  - .1 Acceptable product: Anvil fig. 271;
- .11 Support for piping where there is expansion and contraction with stirrup and roll cast iron with metal saddles.

## **2.4 WALL SUPPORTS**

- .1 Use to support non-expandable piping only
- .2 Description:
  - .1 C-profile rail mounting system with curved flanges;
  - .2 Galvanized or stainless steel;
  - .3 Pliers or fasteners suitable for the piping to be supported;
  - .4 Mounting plate at appropriate locations;
- .3 Leave a clearance of 25 mm or more to allow space for insulation.
- .4 Acceptable products: POWER-STRUT, Hilti, Anvil or approved equivalent.

## **2.5 COLLARS FOR UPRIGHT COLUMNS**

- .1 Steel or cast iron piping;
  - .1 Galvanized carbon steel collars
  - .2 In accordance with MSS SP58, type 42
  - .3 Acceptable products: Anvil fig. 261, Hilti, Myatt, Tolco or approved equivalent.

- .2 Copper piping:
  - .1 Copper-coated carbon steel clamps
  - .2 In accordance with MSS SP58, type 42
  - .3 Acceptable products: Anvil fig. CT-121, Hilti, Myatt, Tolco
- .3 Bolts: to ASTM A 307
- .4 Nuts: to ASTM A 563

## **2.6 INSULATION PROTECTION SHIELDS**

- .1 Insulated cold piping:
  - .1 Insulation protection shield to: MSS SP69
  - .2 Conforms to MSS SP 58
  - .3 Galvanized sheet carbon steel.
  - .4 Half perimeter of the external insulation pipe
  - .5 Length designed for maximum 3 m span., minimum 305 mm.
  - .6 Acceptable Products : « Anvil », fig. 167; « Hilti »; « Myatt »; « Tolco ».
- .2 Insulated hot piping:
  - .1 Insulation protection shield
  - .2 Half perimeter of the external insulation pipe
  - .3 Galvanized sheet carbon steel
  - .4 Conforms to MSS SP 58
  - .5 Length 300 mm
  - .6 n/a
  - .7 Acceptable Products: « Anvil » fig. 160 à 165; « Myatt »; « Tolco ».

## **2.7 EQUIPMENT SUPPORTS**

- .1 Fabricate equipment supports not provided by equipment manufacturer from structural grade steel
- .2 Supports shall be fabricated from welded metal profiles and built according to best practices and provincial codes related to this type of work. The works shall be executed by qualified welders and manpower.

## **2.8 EQUIPMENT ANCHOR BOLTS AND TEMPLATES**

- .1 Provide templates to ensure accurate location of anchor bolts.

## **2.9 MOUNTING BASES**

- .1 For rack-mounted units: Concrete plinths at least 100 mm high, 150 mm beyond the frame of the supported unit with chamfered edges.
- .2 Concrete : see structural plans. Coordonnate exact placement and base dimensions.

**Part 3 Execution**

**3.1 INSTALLATION**

- .1 Vibration Control Devices:
  - .1 Install on piping systems at pumps, boilers, chillers, cooling towers, and as indicated.
- .2 Use adjustable suspension brackets on horizontal piping.
- .3 Clamps on riser piping:
  - .1 Support independent of connected horizontal pipework using riser clamps and riser clamp lugs welded to riser.
  - .2 Bolt-tightening torques to industry standards.
  - .3 Steel pipes: install below coupling or shear lugs welded to pipe.
  - .4 Cast iron pipes: install below joint.
  - .5 Vertical piping shall be solidly attached to the column base and at all storeys at floor level. The maximum distance between two supports must never exceed 4500 mm.
- .4 Clevis plates:
  - .1 Fasten the elements (plates and stirrups) in the concrete structure using at least one (1) at each corner.
- .5 Provide supplementary structural steelwork where structural bearings do not exist or where concrete inserts are not in correct locations.
- .6 Cast iron horizontal piping will be supported by two brackets per section of pipe as well as each side of joints. Supports for `DN6 and less cast piping will be in steel especially fabricated for this purpose and the supports for `DN6 and more cast piping will be cast iron saddles specially designed for this purpose.
- .7 Anchor sleeves
  - .1 Coordinate the installation of anchor sleeves in concrete with the structural engineer and install them according to his recommendations.
  - .2 Obtain permission before using vertical expansion anchor sleeves
  - .3 Use at least two sleeves to support each stirrup or support
  - .4 Do hang anything from the steel decking.

**3.2 HANGER SPACING**

- .1 Plumbing piping: to National Plumbing Code of Canada (NPC) and Provincial Code as well as spec requirement.
- .2 Piping for fire protection: according to the fire prevention code and NFPA 13.
- .3 Piping for oil and gaz with nominal diameter equal to or less than DN ½: one (1) support every 1.8 m.
- .4 Copper piping: up to NPS 1/2: one (1) support every 1.5 m.

- .5 Support plastic piping according to manufacturer's recommendations.
- .6 Flexible joint roll groove pipe: in accordance with table below for steel, but not less than one hanger at joints. Table listings for straight runs without concentrated loads and where full linear movement is not required.
- .7 Within 300 mm of each elbow.
- .8 Pipe hanging table:

Maximum Pipe Size : NPS	Maximum Spacing Steel	Maximum Spacing Copper
up to 1-1/4	2.4 m	1.8 m
1-1/2	3.0 m	2.4 m
2	3.0 m	2.4 m
2-1/2	3.7 m	3.0 m
3	3.7 m	3.0 m
3-1/2	3.7 m	3.3 m
4	3.7 m	3.6 m
5	4.3 m	
6	4.3 m	
8	4.3 m	
10	4.9 m	
12	4.9 m	

- .9 Pipework greater than NPS 12: to MSS SP58
- .10 Spacing between supports for grouped piping will be established according to the pipe with the smallest dimension.

### 3.3 HANGER INSTALLATION

- .1 Install hanger so that rod is vertical under operating conditions.
- .2 Adjust hangers to equalize load.

### 3.4 DIELECTRIC CONNECTION

- .1 Supply and install rubber pad to prevent contact between elements of different material.
- .2 Adhesive tape is not permitted.

### 3.5 HORIZONTAL MOVEMENT

- .1 Angularity of rod hanger resulting from horizontal movement of pipework from cold to hot position not to exceed 4 degrees from vertical.
- .2 Where horizontal pipe movement is less than 13 mm, offset pipe hanger and support so that rod hanger is vertical in the hot position.

### 3.6 FINAL ADJUSTMENT

- .1 Adjust hangers and supports:
  - .1 Ensure that rod is vertical under operating conditions.
  - .2 Equalize loads.

- .2 Adjustable clevis:
  - .1 Tighten hanger load nut securely to ensure proper hanger performance.
  - .2 Tighten upper nut after adjustment.
- .3 C-clamps:
  - .1 Follow manufacturer's recommended written instructions and torque values when tightening C-clamps to bottom flange of beam.
- .4 Beam clamps:
  - .1 Hammer jaw firmly against underside of beam.

**END OF SECTION**



**Part 1 General**

**1.1 REFERENCE STANDARDS**

- .1 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  - .1 Material Safety Data Sheets (MSDS).
- .2 National Fire Protection Association (NFPA)
  - .1 NFPA 13-, Standard for the Installation of Sprinkler Systems.
- .3 Quebec construction Code (CCQ)
- .4 ASHRAE

**1.2 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00- Submittal Procedures. Include product characteristics, performance criteria, and limitations.
- .2 Submit copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 01 33 00- Submittal Procedures.

**1.3 QUALITY ASSURANCE**

- .1 Recognised manufacturer insulation assemble

**Part 2 Products**

**2.1 GENERAL**

- .1 Size and shape of bases as well as performance characteristics of vibration isolation as indicated.
- .1 Material must be supplied with colour coded mounting elements, and all fasteners such as bolts, sleeves, washers, nuts and suspension rods.

**2.2 ELASTOMERIC PADS**

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

- .4 Type EP4 - rubber-steel-rubber; 9 mm minimum thick rubber bonded to 1.71 mm steel plate; 30 durometer natural rubber, waffle or ribbed; holes sleeved with isolation washers; maximum loading 415 kPa.

## **2.3 ELASTOMERIC MOUNTS**

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

## **2.4 SPRINGS**

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

## **2.5 SPRING MOUNT**

- .1 Zinc or cadmium plated hardware; housings coated with rust resistant paint.
- .2 Type M2 - stable open spring: support on bonded 6 mm minimum thick ribbed neoprene or rubber friction and acoustic pad.
- .3 Type M3 - stable open spring: 6 mm minimum thick ribbed neoprene or rubber friction and acoustic pad, bonded under isolator and on isolator top plate; levelling bolt for rigidly mounting to equipment.
- .4 Type M4 - restrained stable open spring: supported on bonded 6 mm minimum thick ribbed neoprene or rubber friction and acoustic pad; built-in resilient limit stops, removable spacer plates.
- .5 Type M5 - enclosed spring mounts with snubbers for isolation up to 950 kg maximum.

## **2.6 HANGERS**

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

## **2.7 ACOUSTIC BARRIERS FOR ANCHORS AND GUIDES**

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

## **2.8 HORIZONTAL THRUST RESTRAINT**

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

## **2.9 STRUCTURAL BASES**

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

## **Part 3 Execution**

### **3.1 INSTALLATION**

- .1 Install vibration isolation equipment in accordance with manufacturer's instructions and adjust mountings to level equipment.
- .2 Ensure piping, ducting and electrical connections to isolated equipment do not reduce system flexibility and that piping, conduit and ducting passage through walls and floors do not transmit vibrations.
- .3 Unless indicated otherwise, support piping connected to isolated equipment with spring mounts or spring hangers with 25 mm minimum static deflection as follows:
  - .1 Up to NPS4: first 3 points of support. NPS5 to NPS8: first 4 points of support. NPS10 and Over: first 6 points of support.
  - .2 First point of support: static deflection of twice deflection of isolated equipment, but not more than 50 mm.
  - .3 The first 5 support and pipe hanging points on each side of pumps, compressors and water towers will be equipped with vibration isolators having the same static bending as the vibration isolators of the piece of equipment to which these pipes are connected.
- .4 Where isolation is bolted to floor use vibration isolation rubber washers.

- .5 Block and shim level bases so that ductwork and piping connections can be made to rigid system at operating level, before isolator adjustment is made. Ensure that there is no physical contact between isolated equipment and building structure.

.6

### **3.2**

#### **FIELD QUALITY CONTROL**

- .1 Start-up as required in compliance with general conditions.
- .2 Quality control as required in compliance with general conditions.
- .3 Certain field quality control will be carried out by the manufacturer in compliance with general conditions.

**END OF SECTION**

**Part 1 General**

**1.1 Office des normes générales du Canada (CGSB)**

- .1 CAN/CGSB-1.60, Peinture-émail brillante d'intérieur aux résines alkydes.
- .2 CAN/CGSB-24.3, Identification des réseaux de canalisations.

**1.2 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submittals: in accordance with general requirements.
- .2 Samples:
  - .1 Submit samples to include nameplates, labels, tags, lists of proposed legends.

**Part 2 Products**

**2.1 MANUFACTURER'S EQUIPMENT NAMEPLATES**

- .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, as appropriate:
  - .1 Equipment: manufacturer's name, model, size, serial number, capacity.
  - .2 Motor: voltage, Hz, phase, power factor, duty, frame size.
- .4 ACNOR and ULC identification tag as organisation requirement:

**2.2 SYSTEM NAMEPLATES**

- .1 Colours:
  - .1 Hazardous: red letters, white background.
  - .2 Elsewhere: black letters, white background (except where required otherwise by applicable codes).
- .2 Construction:
  - .1 3 mm thick [white anodized aluminum] [laminated plastic], matte finish, with square corners, letters accurately aligned and machine engraved into core.
- .3 Identification for PSPC 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.

## 2.3 EXISTING IDENTIFICATION SYSTEMS

- .1 Apply existing identification system to new work.
- .2 Where existing identification system does not cover for new work, use identification system specified this section.
- .3 Before starting work, obtain written approval of identification system from Departmental Representative

## 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 Legend:

- .1 Block capitals of the following dimensions:

Exterior pipe dimension, or dimension of insulation (mm)	Dimensions of letters (mm)
19 to 32	13
38 to 51	19
64 to 150	32
200 to 250	64
Over 250	89

- .3 Pictograms:

- .1 Where required: Workplace Hazardous Materials Information System (WHMIS) regulations.

- .4 Légend

- .1 Capital letters of height and colour in compliance with CAN/CGSB 24.3.

- .5 Arrows showing direction of flow:

- .1 Outside diameter of pipe or insulation less than 75 mm: 100 mm long x 50 mm high.
- .2 Outside diameter of pipe or insulation 75 mm and greater: 150 mm long x 50 mm high.
- .3 Use double-headed arrows where flow is reversible.

- .6 Extent of background colour marking:

- .1 To full circumference of pipe or insulation.
- .2 Length to accommodate pictogram, full length of legend and arrows.
- .7 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 with protective overcoating, waterproof contact adhesive undercoating, suitable for ambient of 100% RH and continuous operating temperature of 150 degrees C and intermittent temperature of 200 degrees C.
  - .2 Acceptable Products: «W.H.», «Brady Inc.», «Seton Name Plate Corp», «VMAP».
- .8 Paint
  - .1 In compliance with CAN/CGSB-1.60.
  - .2 Natural gas and propane:
    - .1 Paint the whole network with to coats of antirust paint.
- .9 Colours and Legends:
  - .1 Where not listed, obtain direction from Departmental Representative.
  - .2 Fire protection: white on red background;
  - .3 Medical Gas: see table 6 of N.Q. 5710-500.
  - .4 Colours for legends, arrows: to following table:

Background colour:	Legend, arrows:
Yellow	BLACK
Green	WHITE
Red	WHITE
  - .5 Background colour marking and legends for piping systems:

Contents	Background colour marking	Legend
Chilled water supply	Green	CH. WTR. SUPPLY
Chilled water return	Green	CH. WTR. RETURN
Condensate gravity flow	Yellow	Condensate (Gravity)
Sanitary	Green	SAN

## 2.5 IDENTIFICATION OF AIR DUCTS

- .2 Letters 50 mm high and arrows indicating the direction of flow 150 mm long x 50 mm height,
- .3 Colour: black or contrasting colour with the that of the duct..

## 2.6 IDENTIFICATION OF VALVE EQUIPMENT

- .1 Plates 3 mm thick, stratified plastic or white anodized aluminum, mat finish, with square corners and letters aligned with precision, machine engraved to the core

- .2 Writing colour black, with the exception of fire protection system which shall be red.
- .3 Plate must indicate function of the valve and what it controls
- .4 Plate to be held in place with a brass chain
- .5 Supply, for each network six (6) functional diagrams in the approved format, with diagrams and list of elements labeled, with the designation number, type of equipment, network, function, location, as well as normal functioning position of the elements.

## **2.7 IDENTIFICATION OF VENTILATION DEVICES**

- .1 Plates 3 mm thick, stratified plastic or white anodized aluminum, mat finish, with square corners and letters aligned with precision, machine engraved to the core

## **2.8 PROTECTION OF TRAFFIC AREAS**

- .1 75 mm (3 ") self-adhesive vinyl warning tape with oblique stripes in alternating yellow and black colors

## **2.9 LANGUAGE**

- .1 Identification in French.

## **Part 3 Execution**

### **3.1 TIMING**

- .1 Provide identification only after painting specified Section [09 91 23- Interior Painting]has been completed.

### **3.2 INSTALLATION**

- .1 Perform work in accordance with CAN/CGSB-24.3 except as specified otherwise.
- .2 Provide the ULC and CSA certification plates required by each respective organization.
- .3 Install tape or strips on clean surfaces free of grease and dust. Wrap the tape around the pipe, overlapping the ends to a length equal to the diameter of the pipe
- .4 Identify systems, equipment to conform to PSPC PMSS.

### **3.3 NAMEPLATES**

- .1 Locations:
  - .1 In conspicuous location 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 Equipment

- .1 Identify boilers, burners, pumps, compressors, chillers, water towers, exchangers, tanks, condensers, alarm valves, test faucets, drain valves, ventilation systems (modular units), air conditioning units, all individually installed central ventilation units such as fans, coils, filters, recuperators, humidifiers, control panels and other central equipment.
- .2 Boilers must be identified in the front and back in order for operators to carry out maneuvers without risk to themselves.

**3.4 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 either 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, and dampers. Where this is not possible, place identification as close as possible, preferably on upstream side.
- .9 Identification easily and accurately readable from usual operating areas and from access points.
- .10 Perpendicularly with the best line of vision possible, in consideration for the location where operators usually are, the lighting conditions, reduced visibility of colours or legends caused by accumulation of dust and dirt, as well as risk of damage.
- .11 In the case of underground piping, bury the warning tape of the piping, inscription upwards, along the entire length of the pipe layout to a depth of 30 cm below the surface of the ground or under the surface of the layer of form under a hard coating.
- .12 In the case of air ducts:
  - .1 Place a plate near each hatch or duct access door.
  - .2 Mark plates with stencils on the final finish only.

**3.5 LOCATION OF THE IDENTIFICATION ON THE VAVLES**

- .1 Affix labels on valves, except those connected to plumbing fixtures or radiators, and unless they are in the vicinity and in view of the equipment to which they are connected.

- .2 Install a copy of the block diagram and the list of taps, framed under anti-reflective glass, at the location determined by the Consultant. Also insert a copy (in reduced format, if necessary) into each of the operation and maintenance manuals
- .3 Number the valves in order in each network

### **3.6 APPARENT EQUIPEMENT**

- .1 Identify the location of each non-visible ventilation equipment by means of P-Touch c / a pressure-sensitive tape 12 mm wide TC-201 with black lettering on a white background on the ceiling metal suspension with acoustic tiles or on the access hatch of drywall / gypsum ceilings.
- .2 PROTECTION OF TRAFFIC
- .3 Installer warning tape when the bottom of mechanical (pipe, conduit, box, etc.) is installed between 1 m and 2 m (40" and 80") from the floor or or hindering normal traffic, thus providing a limited amount of traffic under the equipment. Protect protruding parts with Armaflex 1 " insulation in the form of obstructions.
- .4 Tape will be installed over the entire possible width of passage and on the lowest part of this equipment.

### **3.7 FIELD QUALITY CONTROL**

- .1 Perform quality control in accordance with general directives..
- .2 Before finishing the work, verify that identification has been carried out in compliance with the present section.

**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               QUALIFICATIONS OF TAB PERSONNEL**

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

**1.3 PURPOSE OF TAB**

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

**1.4 EXCEPTIONS**

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

**1.5 CO-ORDINATION**

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

**1.6 PRE-TAB REVIEW**

- .1 Review contract documents before project construction is started and confirm in writing to Parcs Canada or its Consultant adequacy of provisions for TAB and other aspects of design and installation pertinent to success of TAB.
- .2 Review specified standards and report to Ministerial representative in writing proposed procedures which vary from standard.
- .3 During construction, co-ordinate location and installation of TAB devices, equipment, accessories, measurement ports and fittings.

**1.7 START-UP**

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

**1.8 OPERATION OF SYSTEMS DURING TAB**

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

**1.9 START OF TAB**

- .1 Advise Ministerial representative seven (7) days prior to start of TAB.
- .2 Start TAB when building is essentially completed, including:
  - .1 Installation of ceilings, doors, windows, other construction affecting TAB.

- .2 Application of weather stripping, sealing, and caulking.
- .3 Pressure, leakage, other tests specified elsewhere Division 23.
  - .1 Provisions for TAB installed and operational.
- .4 Start-up, verification for proper, normal and safe operation of mechanical and associated electrical and control systems affecting TAB including but not limited to:
  - .1 Proper thermal overload protection in place for electrical equipment.
  - .2 Air systems:
    - .1 Filters in place, clean.
    - .2 Duct systems clean.
    - .3 Ducts, air shafts, ceiling plenums are airtight to within specified tolerances.
    - .4 Correct fan rotation.
    - .5 Fire, smoke, volume control dampers installed and open.
    - .6 Coil fins combed, clean.
    - .7 Access doors, installed, closed.
    - .8 Outlets installed and volume control dampers open.

#### **1.10 APPLICATION TOLERANCES**

- .1 Do TAB to following tolerances of design values:
  - .1 HVAC systems: plus 5 %, minus 5 %.

#### **1.11 ACCURACY TOLERANCES**

- .1 Measured values accurate to within plus or minus 2 % of actual values.

#### **1.12 INSTRUMENTS**

- .1 Prior to TAB, submit to Ministerial representative list of instruments used together with serial numbers.
- .2 Calibrate in accordance with requirements of most stringent of referenced standard for either applicable system or HVAC system.
- .3 Calibrate within three (3) months of TAB. Provide certificate of calibration to Ministerial representative.

#### **1.13 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit, prior to commencement of TAB:
- .2 Proposed methodology and procedures for performing TAB if different from referenced standard.

#### **1.14 PRELIMINARY TAB REPORT**

- .1 Submit for checking and approval of Ministerial representative, prior to submission of formal TAB report, sample of rough TAB sheets. Include:

- .1 Details of instruments used.
- .2 Details of TAB procedures employed.
- .3 Calculation procedures.
- .4 Summaries.

#### **1.15 TAB REPORT**

- .1 Format in accordance with referenced standards.
- .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 Ministerial representative for verification and approval, in both official languages in D-ring binders, complete with index tabs. (three (3) of each language).

#### **1.16 VERIFICATION**

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

#### **1.17 SETTINGS**

- .1 After TAB is completed to satisfaction of Ministerial representative, replace drive guards, close access doors, lock devices in set positions, and 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 Ministerial representative

#### **1.19 HYDRONIC SYSTEMS**

- .1 The readings to be made will include the following, depending on the systems, devices, control or control: flow rate, velocity of liquid, flow, pressure loss (or pressure drop), temperature, rotation speed, the power demand, the voltage, the noise and vibration levels. Measuring points, in the case of appliances, shall be located in the following places, as appropriate:
  - .1 At the inlet and outlet of valves, filters, heating coils, heat exchangers, pumps, coilers, chillers, cooling towers and all other equipment causing a change in condition;
  - .2 At controllers and controlled devices

- .2 Measuring points, in the case of systems, shall be located in the following locations, as applicable: to the main pipes, the main and secondary bypass pipes and the supply pipes of the terminal elements (coils, radiators, air-heaters etc.)
- .3 Provide the following information for each hydronic system:
  - .1 Flow in l/s, at each coil;
  - .2 Flow in l/s, at each exchanger or cooler;
  - .3 Flow in l/s, at each pump;
  - .4 Pressure drop in kPa, at each exchanger or cooler;
  - .5 Pressure in kPa, at the suction and discharge of each pump;
  - .6 Flow in l/s, each balancing valve and the temperature for each network valve
  - .7 Diagram of each network showing the measurement points. Diagrams must be in accordance with plans and indicate pumps and other equipment (including room numbers)

#### **1.20 AIR SYSTEMS**

- .1 Standard: TAB to most stringent of pertinent standards and reference documents of AABC, NEBB, SMACNA, ASHRAE.
- .2 Do TAB of systems, equipment, components, controls specified Division 23
- .3 Qualifications: personnel performing TAB must be qualified to supply the required services in accordance with AABC and NEBB.
- .4 Quality assurance: perform TAB under direction of a qualified supervisor.
- .5 Measurements: to include as appropriate for systems, equipment, components, controls: air velocity, static pressure, flow rate, pressure drop (or loss), temperatures (dry bulb, wet bulb, dew point), duct cross-sectional area, RPM, electrical power, voltage, noise, vibration.
- .6 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, controlled device.
- .7 Locations of systems measurements to include as appropriate: main ducts, main branch, sub-branch, run-out (or grille, register or diffuser).

#### **1.21 OTHER TAB REQUIREMENTS**

- .1 General requirements applicable to work specified this paragraph:
  - .1 Qualifications of TAB personnel: as for air systems specified this section.
  - .2 Quality assurance: as for air systems specified this section.
- .2 Building pressure conditions:
  - .1 Adjust HVAC systems, equipment, controls to ensure specified pressure conditions at all times

**1.22 POST-OCCUPANCY TAB**

- .1 Measure DBT, WBT or %RH, air velocity, air flow patterns, NC levels, in occupied zone of various areas of the building
- .2 Participate in systems checks twice during Warranty Period - #1 approximately three (3) months after acceptance and #2 within the last month of termination of Warranty Period.

**END OF SECTION**



**Part 1            General**

**1.1            REFERENCES**

- .1 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.
- .2 Reference Standards:
  - .1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
    - .1 ANSI/ASHRAE/IESNA 90.1-Latest edition, SI; Energy Standard for Buildings except Low-Rise Residential Buildings.
  - .2 ASTM International Inc.
    - .1 ASTM B209M-Latest edition, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric).
    - .2 ASTM C335- Latest edition Standard Test Method for Steady State Heat Transfer Properties of Pipe Insulation.
    - .3 ASTM C411- Latest edition , Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.
    - .4 ASTM C449/C449M- Latest edition, Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.
    - .5 ASTM C547- Latest edition, Standard Specification for Mineral Fiber Pipe Insulation.
    - .6 ASTM C553- Latest edition, Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
    - .7 ASTM C612- Latest edition, Standard Specification for Mineral Fiber Block and Board Thermal Insulation.
    - .8 ASTM C795- Latest edition, Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.
    - .9 ASTM C921- Latest edition, Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.
  - .3 Canadian General Standards Board (CGSB)
    - .1 CGSB 51-GP-52Ma- Latest edition , Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.
  - .4 Green Seal Environmental Standards (GSES)

- .1 Standard GS-36- Latest edition, Commercial Adhesives.
- .5 South Coast Air Quality Management District (SCAQMD), California State
  - .1 SCAQMD Rule 1168- Latest edition, Adhesive and Sealant Applications.
- .6 Thermal Insulation Association of Canada (TIAC): National Insulation Standards (2005).
- .7 Underwriters Laboratories of Canada (ULC)
  - .1 CAN/ULC-S102- Latest edition, Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.
  - .2 CAN/ULC-S701- Latest edition, Standard for Thermal Insulation, Polystyrene, Boards and Pipe Covering.

## **1.2 ACTION AND INFORMATIONAL SUBMITTALS**

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

## **1.3 QUALITY ASSURANCE**

- .1 Qualifications:
  - .1 Installer: 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 or member of TIAC.

## **1.4 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle all material and equipment.
- .2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address and ULC markings.

## **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 factory applied vapour retarder jacket to CGSB 51-GP-52Ma (as scheduled in PART 3 of this Section).
- .4 TIAC Code C-2: Mineral fibre blanket to ASTM C553 faced with factory applied vapour retarder jacket to CGSB 51-GP-52Ma (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.

## 2.3 JACKETS

- .1 Canvas:
  - .1 220 gm/m<sup>2</sup> cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C921.
- .2 Lagging adhesive: compatible with insulation.
  - .1 Maximum VOC limit GSES GS-36.

## 2.4 ACCESSORIES

- .1 Vapour retarder lap adhesive:
  - .1 Water based, fire retardant type, compatible with insulation.
    - .1 Maximum VOC limit GSES GS-36.
- .2 Indoor Vapour Retarder Finish:
  - .1 Vinyl emulsion type acrylic, compatible with insulation.
- .3 Insulating Cement: hydraulic setting on mineral wool, to ASTM C449.
- .4 ULC Listed Canvas Jacket:
  - .1 220 gm/m<sup>2</sup> cotton, plain weave, SPEC NOTE: Specify when outdoor vapour retarder is required as a coating over insulation.
- .5 Outdoor Vapour Retarder Mastic:
  - .1 Vinyl emulsion type acrylic, compatible with insulation.
  - .2 Reinforcing fabric: Fibrous glass, untreated 305 g/m<sup>2</sup>.
- .6 Tape: self-adhesive, aluminum, 50 mm wide minimum.
- .7 Contact adhesive: quick-setting
  - .1 VOC limit according to GSES GS-36.
- .8 Canvas adhesive: washable.
  - .1 VOC limit according to GSES GS-36.
- .9 Tie wire: 1.5 mm stainless steel.
- .10 Banding: 12 mm wide, 0.5 mm thick stainless steel.
- .11 Facing: 25 mm galvanized steel hexagonal wire mesh stitched on one face of insulation.
- .12 Fasteners: 2 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 two (2) layers with staggered joints when required nominal thickness exceeds 75 mm.
- .4 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.
  - .1 Ensure hangers, and supports are outside vapour retarder jacket.
- .5 Hangers and supports in accordance with Sections 23 31 13 01 - metal ducts - low pressure to 500 PA.
  - .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 DUCTWORK INSULATION SCHEDULE**

- .1 Insulation types and thicknesses: conform to following table:

TIAC Code	Vapour Retarder	Thickness (mm)	
Rectangular cold and dual temperature supply air ducts	C-1	yes	50
Rectangular warm air ducts	C-1	no	25
Supply, return and exhaust ducts exposed in space being served	none		
Outside air ducts to mixing plenum	C-1	yes	25
Mixing plenums	C-1	yes	25
Exhaust duct between dampers and louvers	C-1	no	25
Acoustically lined ducts	none		

- .2 Exposed round ducts 600 mm and larger, smaller sizes where subject to abuse:

- .1 Use TIAC code C-1 insulation, scored to suit diameter of duct.

- .1 Finishes: conform to following table:

TIAC Code		
Rectangular	Round	
Indoor, concealed	none	none
Indoor, exposed within mechanical room	CRF/1	CRD/2
Indoor, exposed elsewhere	CRF/2	CRD/3
Outdoor, exposed to precipitation	CRF/3	CRD/4
Outdoor, elsewhere	CRF/4	CRD/5

### **3.5 CLEANING**

- .1 Clean in accordance with Section 01 74 11 - Cleaning.

**END OF SECTION**

**Part 1            General**

**1.1            SUMMARY**

- .1    Section Includes:
  - .1    Thermal insulation for piping and piping accessories in commercial type applications.

**1.2            REFERENCES**

- .1    American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
  - .1    ASHRAE Standard 90.1- latest 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-latest edition, Standard Specification for Aluminum and Aluminum Alloy Sheet and Plate .
  - .2    ASTM C335-latest edition, Standard Test Method for Steady State Heat Transfer Properties of Horizontal Pipe Insulation.
  - .3    ASTM C411- latest edition , Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.
  - .4    ASTM C449/C449M- latest edition, Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.
  - .5    ASTM C533- latest edition, Calcium Silicate Block and Pipe Thermal Insulation.
  - .6    ASTM C547- latest edition, Mineral Fiber Pipe Insulation.
  - .7    ASTM C795- latest edition, Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.
  - .8    ASTM C921- latest edition, Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.
- .3    Canadian General Standards Board (CGSB)
  - .1    CGSB 51-GP-52Ma- latest edition , Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.
  - .2    CAN/CGSB-51.53- latest edition, 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. 37.
  - .2    Canadian Environmental Protection Act (CEPA), 1999, c. 33.
  - .3    Transportation of Dangerous Goods Act (TDGA), 1992, c. 34.
- .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- latest edition, Surface Burning Characteristics of Building Materials and Assemblies.
  - .2 CAN/ULC-S701- latest edition, Thermal Insulation, Polystyrene, Boards and Pipe Covering.
  - .3 CAN/ULC-S702- latest edition, Thermal Insulation, Mineral Fibre, for Buildings
  - .4 CAN/ULC-S702.2- latest edition, Thermal Insulation, Mineral Fibre, for Buildings, Part 2: Application Guidelines.

### **1.3 DEFINITIONS**

- .1 For purposes of this section:
  - .1 "CONCEALED" - insulated mechanical services in suspended ceilings and non-accessible chases and furred-in spaces.
  - .2 "EXPOSED" - will mean "not concealed" as specified.
- .2 TIAC ss:
  - .1 CRF: Code Rectangular Finish.
  - .2 CPF: Code Piping Finish.

### **1.4 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.

### **1.5 QUALITY ASSURANCE**

- .1 Qualifications:
- .2 Installer: 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 and member of TIAC.
- .3 Health and Safety:
  - .1 Practice necessary construction occupational health and safety measures.

### **1.6 DELIVERY, STORAGE AND HANDLING**

- .1 Packing, shipping, handling and unloading:
  - .1 Deliver, store and handle materials in accordance with manufacturer's written instructions.
  - .2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
- .2 Storage and Protection:
  - .1 Protect from weather, construction traffic.
  - .2 Protect against damage.
  - .3 Store at temperatures and conditions required by manufacturer.

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**Part 2            Products**

**2.1                FIRE AND SMOKE RATING**

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

**2.2                INSULATION**

- .1        TIAC Code A-6: flexible unicellular tubular elastomer.
  - .1        Insulation: with vapour retarder jacket.
  - .2        Jacket: to CGSB 51-GP-52Ma.
  - .3        Maximum "k" factor: compliant with ASTM C335..
  - .4        Certified by manufacturer: free of potential stress corrosion cracking corrodants.

**2.3                INSULATION SECUREMENT**

- .1        Contact adhesive: quick setting.

**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                PRE-INSTALLATION REQUIREMENT**

- .1        Pressure testing of piping systems and adjacent equipment to be complete, witnessed and certified.
- .2        Surfaces clean, dry, 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 this specification.
- .3        Use two 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        Install hangers, supports outside vapour retarder jacket.
- .5        Supports, Hangers:
  - .1        Apply high compressive strength insulation, suitable for service, at oversized saddles and shoes where insulation saddles have not been provided.



### 3.4 INSTALLATION OF ELASTOMERIC INSULATION

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

### 3.5 PIPING INSULATION SCHEDULES

- .1 Includes valves, valve bonnets, strainers, flanges and fittings unless otherwise specified.
- .2 TIAC Code:[A-6.
  - .1 Seals: lap seal adhesive, lagging adhesive.
  - .2 Installation: TIAC Code: A-6.
- .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 runouts to plumbing fixtures, chrome plated piping, valves, fittings.

Tuyauterie	Temp degrees C	TIAC code	Diamètre nominal (DN) de la tuyauterie et épaisseur de calorifuge (mm)				
			to 25	32 to 50	65 to 100	125 to 150	200 and over
Glycol Loop	0 - 30	A-1	25	25	25	38	38

- .4 Finishes:
  - .1 Exposed insulation canvas jacket.
  - .2 Installation: to appropriate TIAC code CRF/1 through CPF/5

### 3.6 CLEANING

- .1 Proceed with cleaning during works.
  - .1 Leave the site tidy at the end of each work day.
- .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 REFERENCE STANDARDS**

- .1 American Society for Testing and Materials International (ASTM)
  - .1 ASTM E202-00, Standard Test Methods for Analysis of Ethylene Glycols and Propylene Glycols.
- .2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  - .1 Material Safety Data Sheets (MSDS).

**Part 2 Products – N/A**

**Part 3 Execution**

**3.1 CLEANING HYDRONIC AND STEAM SYSTEMS**

- .1 Timing: systems operational, hydrostatically tested and with safety devices functional, before cleaning is carried out.
- .2 Clean the piping network in collaboration with a qualified water treatment specialist to perform system cleaning.
- .3 Install instrumentation such as flow meters, orifice plates, pitot tubes, flow metering valves only after cleaning is certified as complete by water treatment specialist.
- .4 Conditions at time of cleaning of systems:
  - .1 Systems: free from construction debris, dirt and other foreign material.
  - .2 Control valves: operational, fully open to ensure that terminal units can be cleaned properly.
  - .3 Strainers: clean prior to initial fill.
  - .4 Install temporary filters on pumps not equipped with permanent filters.
  - .5 Install pressure gauges on strainers to detect plugging.
- .5 Hydronic Systems:
  - .1 Fill system with water, ensure air is vented from system.
  - .2 Use water metre to record volume of water in system to +/- 0.5%.
  - .3 Closed loop systems: circulate system cleaner at 60 degrees C for at least 36 h. Drain as quickly as possible. Refill with water and inhibitors. Test concentrations and adjust to recommended levels.
  - .4 Flush velocity in system mains and branches to ensure removal of debris. System pumps may be used for circulating cleaning solution provided that velocities are adequate.
- .6 Glycol Systems:
  - .1 In addition to procedures specified above perform specified procedures.

- .2 Test to prove concentration will prevent freezing to minus 40 degrees C. Test inhibitor strength and include in procedural report. Refer to ASTM E202.

### **3.2 START-UP OF HYDRONIC SYSTEMS**

- .1 After cleaning is completed and system is filled:
  - .1 Establish circulation and expansion tank level, set pressure controls.
  - .2 Ensure air is removed.
  - .3 Check pumps to be free from air, debris, possibility of cavitation when system is at design temperature.
  - .4 Dismantle system pumps used for cleaning, inspect, replace worn parts, install new gaskets and new set of seals.
  - .5 Clean out strainers repeatedly until system is clean.
  - .6 Commission water treatment systems as specified in Section 23 25 00- HVAC Water Treatment Systems.
  - .7 Check water level in expansion tank.
  - .8 Repeat with water at design temperature.
  - .9 Check pressurization to ensure proper operation and to prevent water hammer, flashing, cavitation. Eliminate water hammer and other noises.
  - .10 Bring system up to design temperature and pressure.
  - .11 Adjust pipe supports, hangers, and springs as necessary.
  - .12 Monitor pipe movement, performance of expansion joints, loops, guides, anchors.
  - .13 If bellows type expansion joints flex incorrectly, shut down system, re-align, repeat start-up procedures.
  - .14 Re-tighten bolts using torque wrench, to compensate for heat-caused relaxation.
  - .15 Fully open balancing valves (except those that are factory-set).
  - .16 Check operation of over-temperature protection devices on circulating pumps.
  - .17 Adjust alignment of piping at pumps to ensure flexibility, adequacy of pipe movement, absence of noise or vibration transmission.

### **3.3 FIELD QUALITY CONTROL**

- .1 Perform quality control according to general requirements.

**END OF SECTION**

**Part 1 General**

**1.1 REFERENCES**

- .1 American National Standards Institute (ANSI)/American Welding Society (AWS)
  - .1 ANSI/AWS A5.8/A5.8M, AMD1 Specification Filler Metals for Brazing and Braze Welding.
- .2 ASME
  - .1 ANSI/ASME B16.15, Cast Copper Alloy Threaded Fittings Classes 125 and 250.
  - .2 ANSI B16.18, Cast Copper Alloy, Solder Joint Pressure Fittings.
  - .3 ANSI/ASME B16.22, Wrought Copper and Copper-Alloy Solder Joint Pressure Fittings.
- .3 ASTM International
  - .1 ASTM B32, Standard Specification for Solder Metal.
  - .2 ASTM B61, Standard Specification for Steam or Valve Bronze Castings.
  - .3 ASTM B62, Standard Specification for Composition Bronze or Ounce Metal Castings.
  - .4 ASTM B88M, Standard Specification for Seamless Copper Water Tube Metric.
- .4 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  - .1 Material Safety Data Sheets (MSDS).
- .5 Manufacturers Standardization Society (MSS)
  - .1 MSS SP80, Bronze Gate, Globe, Angle and Check Valves.
  - .2 MSS SP 110, Ball valves threaded, socket welding, solder joint, grooved and flare ends.

**1.2 ACTION AND INFORMATIONAL SUBMITTALS**

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

**1.3 MAINTENANCE MATERIALS SUBMITTALS**

- .1 Extra Materials:
  - .1 Furnish following spare parts in accordance with general prescriptions.

**Part 2 Products**

**2.1 TUBING**

- .1 Usages: DN 1 1/4 "branch lines and less - water or glycol systems.
  - .1 Steel piping in compliance with section 23 21 13.02 or as follows
  - .2 Copper tubes: Type L in compliance with ASTM B88M.

## **2.2 FITTINGS**

- .1 Wrought copper and copper alloy solder joint pressure fittings: to ANSI B16.22.
- .2 Cast copper alloy solder joint pressure fittings: in compliance with ANSI B16.18.

## **2.3 JOINTS**

- .1 Socket joints tin-antimony solder 95:5: in compliance with ASTM B32.

## **2.4 BALL VALVES OR BALANCING VALVES**

- .1 Connections:
  - .1 NPS 1 1/4 and smaller threaded
    - .1 Compliant with MSS SP-110, Class 600, Category 4 MPa, bronze body.
    - .2 Supply tracking dials when these are used to balance the devices.
    - .3 Acceptable product: Nibco fig. FP600 or T585-70 when tracking dials are required or approved equivalent.

## **Part 3 Execution**

### **3.1 PIPING INSTALLATION**

- .1 Install piping, valves and fittings in accordance with section 23 05 05 – Piping installation, as well as requirements of the present section.

**END OF SECTION**

This section applies to brine and condenser water with a service temperature between 5 degrees C and 120 degrees C, and pressure at 860 kPa.

**Part 1        General**

**1.1        REFERENCES**

- .1 American National Standards Institute/American Water Works Association (ANSI/AWWA)
  - .1 ANSI/AWWA C111/A21.11, Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
- .2 American Society of Mechanical Engineers (ASME)
  - .1 ASME B16.1, Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250.
  - .2 ASME B16.3, Malleable Iron Threaded Fittings: Classes 150 and 300.
  - .3 ASME B16.5, Pipe Flanges and Flanged Fittings: NPS through NPS 24 Metric/Inch Standard.
  - .4 ASME B16.9, Factory-Made Wrought Buttwelding Fittings.
  - .5 ASME B18.2.1, Square Hex, Heavy Hex and Askew Head Bolts and Hex, Heavy Hex, Hex Flange. Loded Head and Lag Screws (Inch Series).
  - .6 ASME B18.2.2, Nuts for General Applications: Machine Screw Nuts, Hex, Square, Hex Flange, and Coupling Nuts (Inch Series).
- .3 ASTM International
  - .1 ASTM A47/A47M, Standard Specification for Ferritic Malleable Iron Castings.
  - .2 ASTM A53/A53M, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated Welded and Seamless.
  - .3 ASTM A 312/A312M standard specification for seamless and welded austenitic stainless steel pipes.
  - .4 ASTM A536, Standard Specification for Ductile Iron Castings.
  - .5 ASTM B61, Standard Specification for Steam or Valve Bronze Castings.
  - .6 ASTM B62, Standard Specification for Composition Bronze or Ounce Metal Castings.
  - .7 ASTM E202, Standard Test Method for Analysis of Ethylene Glycols and Propylene Glycols.
- .4 CSA International
  - .1 CSA B242, Groove and Shoulder Type Mechanical Pipe Couplings.
  - .2 CSA W48, Filler Metals and Allied Materials for Metal Arc Welding.
- .5 Manufacturer's Standardization of the Valve and Fittings Industry (MSS)
  - .1 MSS-SP-67, Butterfly Valves.
  - .2 MSS-SP-70, Gray Iron Gate Valves, Flanged and Threaded Ends.
  - .3 MSS-SP-71, Gray Iron Swing Check Valves Flanged and Threaded Ends.

- .4 MSS-SP-80, Bronze Gate, Globe, Angle and Check Valves.
- .5 MSS-SP-85, Gray Iron Globe and Angle Valves, Flanged and Threaded Ends.
- .6 MSS-SP-110, Ball Valves, Threaded, Socket Welding, Solder Joint, Grooved and Flared Ends.
- .7 The latest editions in force must be respected.

## **1.2 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with General requirements.
- .2 Shop Drawings:
  - .1 Indicate on drawings:
    - .1 Hydronic Systems Steel 23 21 13.02.

## **1.3 CLOSEOUT SUBMITTALS**

- .1 Submit documents and required items in accordance General Requirements.
- .2 Operation and Maintenance Data: submit operation and maintenance data for hydronic systems for incorporation into manual.
  - .1 Include special servicing requirements.

## **Part 2 Products**

### **2.1 PIPE**

- .1 Steel pipe: to ASTM A53, Grade B, as follows:
  - .1 Branches up to 1 ¼ diameter: in compliance with the following or according to section 23 21 13.01;
  - .2 up to 2 diameter: Sched 40 continuous weld, fileted ends;
  - .3 2 ½ to 4: Sched 40, continuous weld, beveled or grooved ends;
  - .4 5 and over: Sched 40, continuous electric weld, beveled or grooved ends.

### **2.2 PIPE JOINTS**

- .1 NPS 2 and under: screwed fittings with PTFE tape or lead-free pipe dope.
- .2 NPS 2-1/2 and over: welding fittings and flanges to CSA W48.
- .3 Roll grooved: rigid coupling to CSA B242 to be used where the system temperature does not exceed 110 °C.
- .4 Standard couplings shall be used to control expansion, movement and vibrations.
- .5 Flanges: plain raised face, or slip-on and weld neck to ANSI/AWWA C111/ A21.11.
- .6 Orifice flanges: slip-on raised face, 2100 kPa.
- .7 Flange gaskets: to ANSI/AWWA C111/ A21.11.
- .8 Pipe thread: taper.
- .9 Bolts and nuts: to ASME B18.2.1 ASME B18.2.2.

- .10 Roll grooved coupling gaskets: type EPDM designed to be used for service temperatures from -35 degrees C à 100 degrees C.

## **2.3 FITTINGS**

- .1 Screwed fittings: malleable iron, to ASME B16.3, Class 150.
- .2 Pipe flanges and flanged fittings:
  - .1 Cast iron: to ASME B16.1, Class 125.
  - .2 Steel: to ASME B16.5.
- .3 Butt-welding fittings: steel, to ASME B16.9.
- .4 Unions: malleable iron, to ASTM A47/A47M and ASME B16.3.
- .5 Fittings for roll grooved piping: malleable iron to ASTM A47/A47M, ductile iron to ASTM A536.

## **2.4 GATE VALVE: NPS 2 AND SMALLER: SCREWED ENDS.**

- .1 Rising stem type, to MSS-SP-80, Class 125, categorie 860 kPa, bronze body, solid wedge disc.
- .2 Acceptable product: Nibco fig. TE111 or approved equivalent.

## **2.5 CHECK OR BALANCING VALVES:**

- .1 NPS 2 and under:
  - .1 In accordance with MSS SP 110, category 4MPa, EHG type, 2 part brass body, screwed, TFE reinforced sealing gasket, full bore, chrome plated brass ball bearings.
  - .2 Provide tracking dials when used for balancing equipment.
  - .3 Acceptable product: Nibco fig. FP600 or T585-70 when tracking dials are required, or approved equivalent.

## **2.6 BUTTERFLY VALVES:**

- .1 Equal or less than 2 DN, screwed
- .2 In accordance with MSS-SP-67, class 150, category 1 MPa, EHG type, body in ductile iron, aluminum flapper, stainless steel rod, replaceable EPDM seat and gasket, locking handle, end of line insulation tap without flange downstream, and watertight in both directions.
- .3 Actuators:
  - .1 Valves DN 2 1/2 to DN 6: Locking lever type.
  - .2 Valves larger than 8 DN: gear type
  - .3 Acceptable product: Nibco fig. WD2000-3 (lever), WD2000-5 (gear), or approved equivalent.

## **2.7 GLOBE SHUT-OFF VALVES**

- .1 Globe shut off vale DN 2 or less, screwed



- .1 In accordance with MSS SP 80, class 150 category 1 035 kPa, bronze body, composite flapper, tapped and screwed cap, renewable. Suitable for fluid conveyed type.
- .2 Protected controls as indicated.
- .3 Acceptable product: Nibco fig. T235, or approved equivalent

## **2.8 SILENT CHECK VALVES:**

- .1 NPS 2-1/2 and over:
  - .1 Class 125, categorie 860 kpa, cast iron body, without flange (sandwich), internal parts in bronze, stainless steel spring (extra robust spring in the case of mounting on vertical pipes with downward flow), inline lift type.
  - .2 Acceptable product: Nibco fig. W910, Rite, Victaulic series 716 or approved equivalent.

## **2.9 CHECK VALVES**

- .1 2 DN and under, screwed:
  - .1 In accordance with MSS SP-80, class 125, categorie 860 kPa, bronze body, bronze flapper, threaded and screwed cap, Teflon seat.
  - .2 Acceptable product: Nibco fig. TE413Y or approved equivalent.

## **2.10 BALANCING VALVES:**

- .1 General: inclined body valves (y shape) designated to provide precise flow measurement and control, with tap type receptacles or differential pressure gauges.
- .2 Precision: the flow measured and displayed correspond, within 2% to the actual flow, under nominal design conditions.
- .3 DN2 or less:
  - .1 bronze body, threaded ends, threaded and screwed cap, capable of withstanding effective pressure of 1.7 MPa and a maximum temperature of 121 °C.
  - .2 flow regulator: at least 4 full wheel revolutions of the digital indicator type and with concealed and tamper-proof mechanical memory.
- .4 Reading device:
  - .1 Provide a portable flowmeter with direct differential pressure reading and convertible into the desired unit by master charters. The apparatus will be graduated in inches of water and pascal.
  - .2 Le débitmètre sera complet avec coffret, robinetteries, boyaux de 3 mètres et tous les accessoires nécessaires à son bon fonctionnement.
- .5 Acceptable products: Armstrong CBV, Tour and Anderson or approved equivalent.

## **2.11 AUTOMATIC FLOWMETER**

- .1 Combined flow meter, ball valve, automatic regulator, union and inspection ports.

- .2 Valves, with inclined body (Y-shaped), automatic, designed to permit measurement and to ensure accurate flow control, with tap-type receptacles for differential pressure gauges. Automatic or manual HVAC coil components that combine balancing, isolation, filter, extraction, drain, flow and temperature, and union functions, such as Victaulic TA Koil-Kit.
- .3 The body will be bronze and the regulating cartridge will be stainless steel, removable by the Y part, precision 5%.
- .4 Maximum pressure will be 2700 kPa, maximum operating temperature 121 ° C
- .5 Provide a differential pressure check assembly with pressure gauge and hoses
- .6 Permanent pressure loss will be 21 kPa
- .7 Acceptable Products: Victaulic, or approved equivalent

## **2.12 GLYCOLATED WATER LOAD**

- .1 Treated and ethylene glycol water solution, mixed as indicated in the plans with inhibitors, dosed as required prior to introduction into the system. Acceptable products: ethylene-glycol: Dowtherm SR-1, or approved equivalent.

## **Part 3 Execution**

### **3.1 PIPING INSTALLATION**

- .1 Install pipework in accordance with Section 23 05 05 - Installation of Pipe Work as well as the requirements in the present section.
- .2 Installation of the valves,
  - .1 All valves must be the same diameter as to the piping to which they are installed.
  - .2 Butterfly valves must be of the ear type when they are installed to isolate equipment or accessory that could be removed for maintenance or repair (heat exchangers, tanks, heating coils, pumps etc.).
  - .3 Butterfly valve disks must be partially open during installation.
  - .4 Butterfly valves must be installed so that the axis of rotation is on the horizontal.

### **3.2 CIRCUIT BALANCING VALVES**

- .1 Install flow measuring stations and flow balancing valves as indicated.
- .2 Remove handwheel after installation and when TAB is complete.
- .3 Tape joints in prefabricated insulation on valves installed in chilled water mains.
- .4 Respect the manufacturer's strict recommendations regarding clearances, minimum lengths and strait runs without obstructions.
- .5 In the case of automatic flowmeters, install 40 mesh screen filters for flows of less than 0,12 l/s and 20 mesh for over 0,12 l/s

### **3.3 CLEANING, FLUSHING AND START-UP**

- .1 Once pressure tests have been completed, proceed to cleaning, flushing and start up in accordance with Section 23 08 02 - Cleaning and Start-Up of Mechanical Piping Systems.

### **3.4 FILLING**

- .1 Fill the system with clean water and add treatment products as indicated or glycol water solution as appropriate.

### **3.5 TESTING**

- .1 Perform testing at pressure equal to 1 ½ times its service pressure, but in no case lower than 862 kPa.
- .2 Isolate any equipment or accessory with a nominal pressure of less than the testing pressure.
- .3 Testing pressure must be maintained for four (4) hours without falling.
- .4 Correct any leaks at joints and repeat the test.
- .5 In the case of a glycol system, carry out the test using water, then redo the test after having filled it with the prescribed quantity of glycol solution. Repair leaking joints, fittings or valves.

### **3.6 BALANCING**

- .1 In accordance with Section 23 05 93 - Testing, Adjusting and Balancing for HVAC for applicable procedures.
- .2 Provide connections and outlets required for balancing.
- .3 Reading devices shall be installed on each zone and location indicated on the plans and the dimension will be the same as the diameter of the piping.
- .4 The installation must respect the strict manufacturers' recommendations for minimum length, straight and without obstruction before and after the reading devices.

### **3.7 GLYCOL SYSTEM**

- .1 Provide for the filling of all equipment and piping with a solution of ethylene glycol and water plus 25% of the contents of the recovery tank.
- .2 Make the necessary arrangements to avoid leakage of ethylene glycol.
- .3 Ethylene glycol shall be manufactured for a maximum temperature of 116 ° C considering the "Inhibitors" used by the manufacturer.
- .4 A hydrometer will be given to the Owner to verify the density of the glycol solution.
- .5 All air traps in the glycol systems must be channeled to the funnel of the glycol recovery tank.
- .6 Provide complete shop drawings for glycol prior to initial fill with MSDS and corrosion inhibitor data. Failure to do so will result in the glycol being analyzed by an independent laboratory at the expense of this contractor.

**END OF SECTION**

**Part 1 General**

**1.1 REFERENCE STANDARDS**

- .1 ASME
  - .1 ASME Boiler and Pressure Vessel Code
- .2 ASTM International
  - .1 ASTM A 47/A 47M, Standard Specification for Ferritic Malleable Iron Castings.
  - .2 ASTM A 516/A 516M, Standard Specification for Pressure Vessel Plates, Carbon Steel, for Moderate - and Lower - Temperature Service.
  - .3 ASTM A 536, Standard Specification for Ductile Iron Castings.
  - .4 ASTM B 62, Standard Specification for Composition Bronze or Ounce Metal Castings.
- .3 CSA / CSA International
  - .1 CSA B51-09, Boiler, Pressure Vessel, and Pressure Piping Code.

**1.2 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with general requirements.

**1.3 CLOSEOUT SUBMITTALS**

- .1 Submit user and maintenance manuals in accordance with general requirements.

**Part 2 Products**

**2.1 AUTOMATIC AIR VENT**

- .1 Standard float vent: industrial type 1/2 connection and rated at 860 kPa working pressure.
  - .1 Acceptable product: Armstrong model 21 AR, Spirax-Sarco, Taco.
- .2 Float services temp. 115 °C.

**2.2 Piping Filters**

- .1 Filtres body bronze, class 125, selon ASTM B62, à raccords filetés : DN 1/2 à 2.
  - .1 Acceptable product: Armstrong, Spirax-Sarco, Mueller.
- .1 Filtres à corps en fonte, selon ASTM A278, classe 30, redesignated ASTM F278, à raccords à brides : DN 2 1/2 à 4.
  - .1 Produit acceptable : Armstrong, Spirax-Sarco, Mueller.
- .2 Diamètre : selon les indications.
- .3 Raccord de purge : DN 1.

- .4 Tamis : en acier inoxydable à perforations de 1,14 mm.
- .5 Pression de service : 860 kPa.

### **Part 3 Execution**

#### **3.1 GENERAL**

- .1 Run drain lines to terminate above nearest drain.
- .2 Maintain adequate clearance to permit service and maintenance.
- .3 Should deviations beyond allowable clearances arise, request and follow Departmental Representative's directive.
- .4 Check shop drawings for conformance of tappings for ancillaries and for equipment operating weights.

#### **3.2 STRAINERS**

- .1 Install in horizontal or down flow lines.
- .2 Ensure clearance for removal of basket.
- .3 Install ahead of each automatic control valve larger than NPS 25 mm and as indicated.

#### **3.3 AIR VENTS**

- .1 Install at high points of systems.
- .2 Install gate valve on automatic air vent inlet.

**END OF SECTION**

**Part 1 General**

**1.1 REFERENCES**

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

**1.2 ACTION AND INFORMATIONAL SUBMITTALS**

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

**1.3 DELIVERY, STORAGE AND HANDLING**

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

- .3 Storage and Handling Requirements:
  - .1 Store materials off ground and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect metal ducts from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.

## **Part 2 Products**

### **2.1 SEAL CLASSIFICATION**

- .1 Classification as follows:

Maximum Pressure Pa	SMACNA Seal Class
500	C
250	C
125	C
125	Unsealed

- .2 Seal classification:
  - .1 Class A: longitudinal seams, transverse joints, duct wall penetrations and connections made airtight with sealant and tape.
  - .2 Class B: longitudinal seams, transverse joints and connections made airtight with sealant tape or combination thereof.
  - .3 Class C: transverse joints and connections made air tight with gaskets or sealant tape or combination thereof. Longitudinal seams unsealed.
  - .4 Unsealed seams and joints.

### **2.2 SEALANT**

- .1 Sealant: oil resistant, water borne or polymer type flame resistant duct sealant. Temperature range of minus 30 degrees C to plus 93 degrees C.

### **2.3 TAPE**

- .1 Tape: polyvinyl treated, open weave fiberglass tape, 50 mm wide.

### **2.4 DUCT LEAKAGE**

- .1 In accordance with SMACNA HVAC Air Duct Leakage Test Manual.

### **2.5 FITTINGS**

- .1 Fabrication: to SMACNA.
- .2 Radiused elbows:
  - .1 Rectangular: standard radius, if space allows, or else short radius with single thickness turning vanes.
  - .2 Round: smooth radius, centreline radius: 1.5 times diameter.
- .3 Mitred elbows, rectangular:
  - .1 To 400 mm: with single thickness turning vanes.
  - .2 Over 400 mm: with double thickness turning vanes.



- .4 Branches:
  - .1 Rectangular main and branch: with radius on branch 1.5 times width of duct].
  - .2 Provide volume control damper in branch duct near connection to main duct.
  - .3 Main duct branches: with splitter damper.
- .5 Transitions:
  - .1 Diverging: 20 degrees maximum included angle.
  - .2 Converging: 30 degrees maximum included angle.
- .6 Offsets:
  - .1 As indicated radiused elbows.
- .7 Obstruction deflectors: maintain full cross-sectional area.
  - .1 Maximum included angles: as for transitions.

## **2.6 FIRE STOPPING**

- .1 Retaining angles around duct, on both sides of fire separation.
- .2 Fire stopping material and installation must not distort duct.

## **2.7 GALVANIZED STEEL**

- .1 Lock forming quality: to ASTM A653/A653M, Z90 zinc coating.
- .2 Thickness, fabrication and reinforcement: to ASHRAE and SMACNA.
- .3 Joints: Compliant with to ASHRAE and SMACNA

## **2.8 HANGERS AND SUPPORTS**

- .1 Hangers and Supports:
  - .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.
  - .2 Hanger configuration: to ASHRAE, SMACNA.
  - .3 Hangers: galvanized steel angle with galvanized steel rods to ASHRAE, SMACNA.
  - .4 Upper hanger attachments:
    - .1 For concrete: manufactured concrete inserts.
    - .2 For steel joist: manufactured joist clamp or steel plate washer.
    - .3 For steel beams: manufactured beam clamps:

## **Part 3 Execution**

### **3.1 EXAMINATION**

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for metal duct installation in accordance with manufacturer's written instructions.

- .1 Visually inspect substrate.
- .2 Inform Departmental representative of unacceptable conditions immediately upon discovery.
- .3 Proceed with installation only after unacceptable conditions have been remedied.

### **3.2 GENERAL**

- .1 Do work in accordance with ASHRAE and SMACNA .
- .2 Do not break continuity of insulation vapour barrier with hangers or rods.
- .3 Support risers in accordance with ASHRAE or SMACNA .
- .4 Install breakaway joints in ductwork on sides of fire separation.
- .5 Install proprietary manufactured flanged duct joints in accordance with manufacturer's instructions.
- .6 Manufacture duct in dimensions to accommodate installation of acoustic duct lining.

### **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, SMACNA.
- .4 The design of seismic protection devices and systems must be entrusted to an engineer specialized in earthquake engineering and recognized in the province of Quebec

### **3.4 SEALING AND TAPING**

- .1 Apply sealant in accordance with SMACNA and to manufacturer's recommendations.
- .2 Bed tape in sealant and recoat with minimum of 1 coat of sealant to manufacturers recommendations.

### **3.5 LEAKAGE TESTS**

- .1 Refer to Section 23 05 94 - Pressure Testing of Ducted Air Systems.

### **3.6 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

**END OF SECTION**

**Part 1 General**

**1.1 REFERENCES**

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

**1.2 ACTION AND INFORMATIONAL SUBMITTALS**

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

**1.3 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
  - .1 Store materials off ground and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect air duct accessories from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.

**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 1.6 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/m<sup>2</sup>.

**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 x 300 mm: two sash locks .
  - .2 301 to 450 mm: four sash locks.
  - .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.

## **2.4 TURNING VANES**

- .1 Factory or shop fabricated double thickness with trailing edge, to recommendations of SMACNA and as indicated.

## **2.5 INSTRUMENT TEST**

- .1 1.6 mm thick steel zinc plated after manufacture.
- .2 Cam lock handles with neoprene expansion plug and handle chain.
- .3 28 mm minimum inside diameter. Length to suit insulation thickness.
- .4 Neoprene mounting gasket.

## **2.6 SPIN-IN COLLARS**

- .1 Conical galvanized sheet metal spin-in collars with lockable butterfly damper.
- .2 Sheet metal thickness to co-responding round duct standards.

# **Part 3 Execution**

## **3.1 EXAMINATION**

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

## **3.2 INSTALLATION**

- .1 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:
    - .1 600 mm x 600 mm for person size entry.
    - .2 300 mm x 300 mm for servicing entry.
    - .3 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.
    - .7 In places required for the cleaning of the ventilation ducts.
- .3 Instrument Test Ports:
  - .1 General:
    - .1 Install in accordance with recommendations of SMACNA and in accordance with manufacturer's instructions.
  - .2 Locate to permit easy manipulation of instruments.
  - .3 Install insulation port extensions as required.
  - .4 Locations:
    - .1 For traverse readings:
      - .1 Ducted inlets to roof and wall exhausters.
      - .2 Inlets and outlets of other fan systems.
      - .3 Main and sub-main ducts.
      - .4 And as indicated.
    - .2 For temperature readings:
      - .1 At outside air intakes.
      - .2 In mixed air applications.
      - .3 At inlet and outlet of coils.
      - .4 Downstream of junctions of two converging air streams of different temperatures.
      - .5 And as indicated.
- .4 Turning Vanes:
  - .1 Install in accordance with recommendations of SMACNA and as indicated.

**3.3            CLEANING**

- .1        Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.

**END OF SECTION**

**Part 1 General**

**1.1 RELATED REQUIREMENTS**

- .1 Section 23 33 00 air duct accessories

**1.2 REFERENCE STANDARDS**

- .1 National Fire Protection Association (NFPA)
  - .1 NFPA 90A-12, Standard for the Installation of Air Conditioning and Ventilating Systems.
- .2 Underwriters Laboratories of Canada (ULC)
  - .1 CAN/ULC-S112-10, Standard Test Method of Fire Test of Fire Damper Assemblies.
  - .2 ULC-S505-1974, Standard for Fusible Links for Fire Protection Service.

**1.3 CLOSEOUT SUBMITTALS**

- .1 Submit in accordance with general requirements.

**1.4 MAINTENANCE MATERIAL SUBMITTALS**

- .1 Extra Materials:
  - .1 Submit maintenance materials in accordance with general requirements.
  - .2 Provide:
    - .1 Six (6) fusible links of each type.

**Part 2 Products**

**2.1 FIRE DAMPERS**

- .1 Fire dampers: arrangement Type B, listed and bear label of ULC meet requirements of authorities having jurisdiction and NFPA 90A Fire damper assemblies fire tested in accordance with CAN/ULC-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.
  - .2 Fire dampers: automatic operating type and have dynamic rating suitable for maximum air velocity and pressure differential to which it will be subjected.
- .3 Top hinged: offset single damper, round or square; multi-blade hinged or guillotine type; sized to maintain full duct cross section as indicated.
- .4 Airtight duct according to the duct classification where the damper is installed.

- .5 Fusible link actuated, weighted to close and lock in closed position when released or having negator-spring-closing operator for multi-leaf.
- .6 40 x 40 x 3mm retaining angle iron frame, on full perimeter of fire damper, on both sides of fire separation being pierced.
- .7 Complete set with factory installed (by manufacturer) minimum 20 caliber waterproof sleeve, built-in the register. Sleeves must exceed 75 mm (3") minimum on each side of the wall or from the floor.  
  
The sleeve will be fabricated by the contractor only in the case where the same opening requires more than one fire damper; in this case the sleeve will be 16 caliber.
- .8 Equip fire dampers with steel sleeve or frame installed disruption ductwork or impair damper operation.
- .9 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.
- .10 Design and construct dampers to not reduce duct or air transfer opening cross-sectional area.
- .11 Dampers shall be installed so that the centerline of the damper depth or thickness is located in the centerline of the wall, partition or floor slab depth or thickness.
- .12 Unless otherwise indicated, the installation details given in SMACNA Install Fire Damp
- .13 Quality required: « Controlled Air MFG » model A-S; « Nailor Ind. » series 0100 with sleeve; « NCA » with sleeve; « Ruskin » style A, with sleeve.

## **2.2 INSTALLATION**

- .1 Install in accordance with 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.
- .5 Co-ordinate with installer of fire stopping.
- .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 Place registers where indicated in firewalls and partitions.

**END OF SECTION**



**Part 1 General**

**1.1 REFERENCES**

- .1 ASTM International
  - .1 ASTM C423-Latest edition, Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.
  - .2 ASTM C916-Latest edition, Standard Specification for Adhesives for Duct Thermal Insulation.
  - .3 ASTM C1071-Latest edition, Standard specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material).
  - .4 ASTM C1338-Latest edition, Standard Test Method for Determining Fungi Resistance of Insulation Materials and Facings.
  - .5 ASTM G21-Latest edition, Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.
- .2 National Fire Protection Association (NFPA)
  - .1 NFPA 90A-Latest edition, Standard for the Installation of Air Conditioning and Ventilating Systems.
  - .2 NFPA 90B-Latest edition, Standard for the Installation of Warm Air Heating and Air Conditioning Systems.
- .3 North American Insulation Manufacturers Association (NAIMA)
  - .1 NAIMA AH116-Latest edition, Fibrous Glass Duct Construction Standards.
- .4 Sheet Metal and Air Conditioning Contractor's National Association (SMACNA)
  - .1 SMACNA, HVAC Duct Construction Standards, Metal and Flexible-Latest edition .
  - .2 SMACNA IAQ Guideline for Occupied Buildings Under Construction-Latest edition.
- .5 Underwriter's Laboratories of Canada (ULC)
  - .1 CAN/ULC-S102-Latest edition, Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.

**1.2 ACTION AND INFORMATIONAL SUBMITTALS**

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

**1.3 CLOSEOUT SUBMITTALS**

- .1 Operation and Maintenance Data: submit operation and maintenance data for duct liners for incorporation into manual.

**1.4 DELIVERY, STORAGE AND HANDLING**

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

- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
  - .1 Store materials off ground and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect duct liners from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.

## **Part 2 Products**

### **2.1 DUCT LINER**

- .1 General:
  - .1 Mineral Fibre duct liner: air surface coated mat facing.
  - .2 Flame spread rating shall not exceed 25. Smoke development rating shall not exceed 50 when tested in accordance with CAN/ULC-S102 and NFPA 90A or NFPA 90B.
  - .3 Fungi resistance: to ASTM C1338 or ASTM G21.
- .2 Rigid:
  - .1 Use on flat surfaces of the exits of the AHU up to the exit of the mechanical room and not less than 3,000 mm of duct length.
  - .2 25 mm thick, to ASTM C1071 Type 2, fibrous glass rigid board duct liner.
  - .3 Density: 48 kg/m<sup>3</sup> minimum.
  - .4 Thermal resistance to be minimum 0.76 (m<sup>2</sup>. degrees C)/W for 25 mm thickness when tested in accordance with ASTM C177, at 24 degrees C mean temperature.
  - .5 Maximum velocity on faced air side: 20.3 m/s.
  - .6 Minimum NRC of 0.70 at 25 mm thickness based on Type A mounting to ASTM C423.

### **2.2 ADHESIVE**

- .1 Adhesive: to NFPA 90A and NFPA 90B, ASTM C916.
- .2 Flame spread rating shall not exceed 25. Smoke development rating shall not exceed 50. Temperature range minus 29 degrees C to plus 93 degrees C.
- .3 Water-based fire retardant type.

### **2.3 FASTENERS**

- .1 Weld pins 2.0 mm diameter, length to suit thickness of insulation. Polymer or Nylon Metal retaining clips, 32 mm square.

### **2.4 JOINT TAPE**

- .1 Poly-Vinyl treated open weave fiberglass membrane 50 mm wide.

## **2.5 SEALER**

- .1 Meet requirements of NFPA 90A, NFPA 90B.
- .2 Flame spread rating shall not exceed 25. Smoke development rating shall not exceed 50. Temperature range minus 68 degrees C to plus 93 degrees C.

## **Part 3 Execution**

### **3.1 EXAMINATION**

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

### **3.2 GENERAL**

- .1 Do work in accordance with SMACNA HVAC Duct Construction Standard or NAIMA AH116 except as specified otherwise.
- .2 Line inside of ducts where indicated.
- .3 Duct dimensions, as indicated, are clear inside duct lining.

### **3.3 DUCT LINER**

- .1 Install in accordance with manufacturer's recommendations, and as follows:
  - .1 Fasten to interior sheet metal surface with 100% coverage of adhesive to ASTM C916.
    - .1 Exposed leading edges and transverse joints to be factory coated or coated with adhesive during fabrication.
  - .2 In addition to adhesive, install weld pins not less than 2 rows per surface and not more than 425 mm on centres; to compress duct liner sufficiently to hold it firmly in place.
    - .1 Spacing of mechanical fasteners in accordance with SMAC HVAC Duct Construction Standard or NAIMA AH116.
- .2 In systems, where air velocities exceeds 20.3 m/s, install galvanized sheet metal noising to leading edges of duct liner.

### **3.4 JOINTS**

- .1 Seal butt joints, exposed edges, weld pin and clip penetrations and damaged areas of liner with joint tape and sealer. Install joint tape in accordance with manufacturer's written recommendations, and as follows:

- .1 Bed tape in sealer.
- .2 Apply 2 coats of sealer over tape.
- .2 Replace damaged areas of liner at discretion of Departmental representative.
- .3 Protect leading and trailing edges of duct sections with sheet metal nosing having 15 mm overlap and fastened to duct.

### **3.5 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.

**END OF SECTION**

**Part 1 General**

**1.1 REFERENCES**

- .1 National Fire Protection Association (NFPA).
  - .1 NFPA 90A, Standard for the Installation of Air-Conditioning and Ventilating Systems.

**1.2 DOCUMENTS / SAMPLES TO SUBMIT FOR APPROVAL / INFORMATION AT SUBSTANTIAL COMPLETION.**

- .1 Submit required documents and samples in accordance with general conditions.
- .2 Technical data sheets and shop drawings must also include the following:
  - .1 Flow;
  - .2 Throw and terminal velocity.
  - .3 Noise criteria.
  - .4 Pressure drop.
  - .5 Neck velocity.

**Part 2 Products**

**2.1 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.

**2.2 GENERAL**

- .1 To meet capacity, pressure drop, terminal velocity, throw, noise level, neck velocity.
- .2 Frames:
  - .1 Full perimeter gaskets.
  - .2 Plaster frames
  - .3 Concealed fasteners.
- .3 Concealed manual volume control damper operators.
- .4 Colour: B15

**2.3 MANUFACTURED UNITS**

- .1 Grilles, registers and diffusers of same generic type, products of one manufacturer.

## **2.4 GRILLS, REGISTERS AND DIFFUSERS – GENERAL**

- .1 Dimensions are indicated in nominal values. Standard products with characteristics closely resembling the nominal characteristics with regards to range of jet, noise level and speed at the point of maximum shrinkage and at the exit.
- .2 Material : aluminum or steel.
- .3 Minimum 1,2 mm (0.05") steel collar installed at each diffuser, register and grill, these collars, which must extend to the register or fire damper, will suspend the elements to the building structure without making them separate from the membrane crossed, in order to maintain the degree of fire resistance of the membrane.
- .4 Firewall penetrations shall be provided with steel sleeves connected to the structure and fixed in accordance with NFPA 90A.
- .5 Frames:
  - .1 Primed steel frames with exposed welded joints, polished and perfectly sealed.
  - .2 Extruded aluminum frames with mechanical fasteners and perfectly sealed joints at the corners
  - .3 Foam rubber lining all around the frames
  - .4 Plaster frames to hold all racks in place when installed in a gypsum wallboard or ceiling.
  - .5 Concealed fasteners and manouvering devices.
  - .6 Acceptable Products: « Anemostat, E.H. Price., Nailor, Krueger, Titus ».

## **2.5 SUPPLY GRILLES AND REGISTERS**

- .1 General: with opposed blade dampers.

## **2.6 RETURN AND EXHAUST GRILLES AND REGISTERS**

- .1 General: with opposed blade dampers.

## **2.7 DIFFUSERS**

- .1 General: volume control dampers with flow straightening devices and blank-off quadrants and gaskets.

## **2.8 FINISH**

- .1 All grills and diffusers finished in baked enamel and will be in the colour chosen by the Departmental representative unless otherwise indicated.

## **2.9 SPECIFIC DESCRIPTION OF GRILLS, REGISTERS AND DIFFUSERS**

- .1 The specific description of this equipment is indicated on the plans.

**Part 3            Execution**

**3.1                INSTALLATION**

- .1        Install in accordance with manufacturer's instructions.
- .2        Install with oval head, flat head screws in countersunk holes where fastenings are visible.
- .3        Check the exact dimensions of the drop ceiling modules before proceeding with the purchase of grilles and diffusers.
- .4        Install gaskets on frames to prevent leakage and soiling.
- .5        Do not connect any flexible duct directly to a diffuser collar. Provide the diffusers with a soundproof enclosure of sufficient height to make the connection on the side to receive the flexible conduit

**END OF SECTION**

**Part 1 General**

**1.1 REFERENCES**

- .1 American National Standard Institute (ANSI)/American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE)
  - .1 ANSI/ASHRAE 52.2- Latest edition, Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particulate Size (ANSI approved).
- .2 Canadian General Standards Board (CGSB)
  - .1 CAN/CGSB-115.10- Latest edition, Disposable Air Filters for the Removal of Particulate Matter from Ventilating Systems.
  - .2 CAN/CGSB-115.11- Latest edition, Filters, Air, High Efficiency, Disposable, Bag Type.
  - .3 CAN/CGSB-115.12- Latest edition, Filters, Air, Medium Efficiency, Disposable, Bag Type.
  - .4 CAN/CGSB-115.13- Latest edition, Filter Media, Automatic Roll.
  - .5 CAN/CGSB-115.14- Latest edition, High Efficiency Cartridge Type Supported Air Filters for the Removal of Particulate Matter from Ventilating Systems.
  - .6 CAN/CGSB-115.15- Latest edition, High Efficiency Rigid Type Air Filters for Removal of Particulate Matter from Ventilating Systems.
  - .7 CAN/CGSB-115.16- Latest edition, Activated Carbon for Odor Removal from Ventilating Systems.
  - .8 CAN/CGSB-115.18- Latest edition, Filter, Air, Extended Area Panel Type, Medium Efficiency.
  - .9 CAN/CGSB-115.20- Latest edition, Polarized Media Air Filter.
- .3 International Organization of Standardization (ISO)
  - .1 ISO 14644-1- Latest edition, Clean Rooms and Associated Controlled Environments - Part 1: Classification of Air Cleanliness.
- .4 National Fire Protection Association (NFPA)
  - .1 NFPA 96- Latest edition, Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations.
- .5 Underwriters' Laboratories of Canada (ULC)
  - .1 ULC -S111- Latest edition, Standard Method of Fire Tests for Air Filter Units.
  - .2 ULC-S646- Latest edition, Exhaust Hoods and Related Controls for Commercial and Institutional Kitchens.
- .6 US Department of Defense - Test Method Standard
  - .1 MIL-STS-282- Latest edition , Filter Units, Protective Clothing, Gas-Mask Components and Related Products; Performance Test Methods.



**1.2 ACTION AND INFORMATIONAL SUBMITTALS**

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

**1.3 MAINTENANCE MATERIAL SUBMITTALS**

- .1 Extra Materials:
  - .1 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.
  - .2 Spare filters: in addition to filters installed immediately prior to acceptance by Departmental representative, supply one (1) complete set of filters for each.

**1.4 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
  - .1 Store materials off ground and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect HVAC filters from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.

**Part 2 Products**

**2.1 GENERAL**

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

**2.2 ACCESSORIES**

- .1 Holding frames: permanent channel section construction of galvanized steel, 1.6 mm thick, except where specified.
- .2 Seals: to ensure leak-proof operation.
- .3 Blank-off plates: as required, to fit all openings and of same material as holding frames.
- .4 Access and servicing: through doors/panels on each side and/or from upstream or downstream face of filter bank.

**2.3 FIBROUS GLASS PANEL FILTERS**

- .1 Disposable fibrous glass media: to CAN/CGSB-115.10 with adhesive.

- .2 Holding frame: 1.2 mm minimum thick galvanized steel with 3 mm diameter hinged wire mesh screen.
- .3 Performance: to ANSI/ASHRAE 52.2.
- .4 Fire rated: to ULC -S111.
- .5 Nominal thickness: 50 mm.

**Part 3 Execution**

**3.1 EXAMINATION**

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

**3.2 INSTALLATION GENERAL**

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

**3.3 REPLACEMENT MEDIA**

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

**3.4 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.

**END OF SECTION**

**Part 1 General**

**1.1 RELATED REQUIREMENTS**

- .1 Section 23 05 48 VIBRATION AND SEISMIC CONTROLS FOR HVAC PIPING

**1.2 REFERENCE STANDARDS**

- .1 American National Standards Institute/Air-Conditioning and Refrigeration Institute (ANSI/ARI)
  - .1 ANSI/ARI 210/240-2003, Unitary Air Conditioning and Air-Source Heat Pump Equipment.
  - .2 American National Standards Institute/American Society of Heating, Refrigeration and Air-Conditioning Engineers (ANSI/ASHRAE)
    - .1 ANSI/ASHRAE Standard 15-2010, Safety Standard for Refrigeration Systems.
  - .3 Air-Conditioning and Refrigeration Institute (ARI)
    - .1 ARI 320-1998, Standard for Water-Source Heat Pumps.
    - .2 ARI 325-98, Standard for Ground Water - Source Heat Pumps.
  - .4 CSA International
    - .1 CAN/CSA-C656-05(R2010), Performance Standard for Split-System and Single Package Central Air Conditioners and Heat Pumps.
    - .2 CAN/CSA-C13256-2001(R2011), Water-Source Heat Pumps-Testing and Rating for Performance, Part 1 Water-to-Air and Brine-to-Air Heat Pumps.
  - .5 Environment Canada, (EC) / Environmental Protection Services (EPS)
    - .1 EPS 1/RA/2-1996, Code of Practice for Elimination of Fluorocarbons Emissions from Refrigeration and Air Conditioning Systems.
    - .2 Environment Canada-1994, Ozone-Depleting Substances Alternatives and Suppliers List.
  - .6 National Fire Protection Association (NFPA)
    - .1 NFPA 90A-2009, Standard for Installation of Air Conditioning and Ventilating Systems.

**1.3 ACTION AND INFORMATIONAL SUBMITTALS**

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

**1.4 CLOSEOUT SUBMITTALS**

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

## **1.5 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle materials in accordance with Section with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
  - .1 Store materials indoors in dry location off ground and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect heat pumps from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.

## **1.6 WARRANTY**

- .1 12 months warranty period.

## **Part 2 Products**

### **2.1 DESCRIPTION**

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

### **2.2 REFRIGERANTS**

- .1 Type of Refrigerant: R410A

### **2.3 DRAIN PANS**

- .1 Design and construct condensate drain pans under indoor coils so that no water can accumulate and install to allow for easy cleaning.

### **2.4 INCREMENTAL WATER SOURCE HEAT PUMP**

- .1 General:
  - .1 Horizontal type, as indicated, consisting of factory-assembled package containing fan, air-to-refrigerant coil, compressor, 4-way reversing valve, water-to-refrigerant heat exchanger, controls for use with R410A
- .2 Performance: as indicated.
  - .1 Certified in accordance with CAN/CSA-C13256.
  - .2 Ratings in accordance with CAN/CSA-C13256.

### **2.5 Basic unit:**

- .1 TP-01
  - .1 Type of unit: heat pump
  - .2 R-410A refrigeration fluid

- .3 COP 4.4 EER 13.7
- .4 PAC
  - .1 Capacity: 10.6 kWh 3 tons
  - .2 External static pressure: 250 Pa
  - .3 Fan power: 0.373 Kw
  - .4 Constant air flow 472 L/s
  - .5 25 mm filter
  - .6 Flow rate 47 L/s
  - .7 Electricity: 208 VAC /1/60 – 17.7 Amp. MOP 30 Amp
  - .8 Unit: 4.4 lb refr.
  - .9 Glycol ethylene 50%
- .2 Comments on the selection of air handling and condensation units.
  - .1 The design of the new installation was made considering the air handling and condensing unit of the company Trane
  - .2 Equivalencies are acceptable on client approval.
  - .3 Tenders must indicate the brand name of air handling and condensing units considered in their proposal. Price difference shall be indicated Trane product and the manufacturer considered.
  - .4 The contractor shall ensure that the units can be installed in the premises and on the roof and have enough space to allow for maintenance.

### **Part 3 Execution**

#### **3.1 EXAMINATION**

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

#### **3.2 INSTALLATION**

- .1 Install where indicated and in accordance with manufacturer's instructions.
- .2 down bolts in accordance with manufacturer's recommendations.
- .3 Make duct connections through flexible connections.

- .4 Level unit with fans running. Align duct work, flexible connections. Misalignment with fan stopped not to strain or damage flexible connection.
- .5 Make piping connections.
- .6 Nothing to obstruct ready access to components or to prevent removal of components for servicing.

### **3.3 DRAIN PANS**

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

### **3.4 START-UP AND COMMISSIONING**

- .1 Have manufacturer certify installation.
- .2 Have manufacturer present during start-up and certify performance.
- .3 Submit written start-up and commissioning reports Departmental Representative.

### **3.5 CLOSEOUT ACTIVITIES**

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

### **3.6 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 11- Cleaning.
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11- Cleaning.

### **3.7 PROTECTION**

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

**END OF SECTION**

## **Part 1 General**

### **1.1 GENERAL**

- .1 All the necessary work will be done by a company specializing in automatic control and energy management, which will be responsible for the division 25.
- .2 Automatic control systems to be supplied must come from Distech or equivalent manufacturer and distributed and installed by ACCS Control-Tech Inc., Honeywell, Siemens, Regulvar or equivalent.
- .3 The control contractor will be a subcontractor of the main HVAC systems contractor.

### **1.2 SCOPE OF WORK**

- .1 The work will include labour, supply and installation of equipment, programming, warranty, commissioning, tools and other items necessary for the thorough and full execution of what is described for this project in this section and as shown on drawings and shall meet control sequences as described in this section.
- .2 All materials and equipment used should be standard components manufactured and not custom specifically designed for this project. All systems and components shall have been subjected to extensive testing and shall be in use on the market for at least two years.
- .3 The specific work includes, but not limited to:
  - .1 Supply, installation and connection of controllers, local control panels and actuators connected to the damper.
  - .2 Supply, installation and connection of temperature, humidity, static pressure, differential pressure sensors, coils controllers, as well as the necessary transmitters, etc.
  - .3 Supply, installation and connection of the communication cables between panels, local controllers and various controlled elements.
  - .4 The operator interface will include HVAC systems and distribution schematic.
  - .5 Staff training
  - .6 Power Supply (120 VAC) to controllers and local panels from circuit breakers as indicated in Division 26.
  - .7 Surface cable in mechanical rooms shall be installed into EMT conduit. Cable in ceilings may be of FT- 4 types.
  - .8 The automatic control subcontractor must provide WEB network manager with IP address provided by the client which will include the management of digital controllers and operator interface.
  - .9 All periphery controls components (sensors, actuators, etc.) will be new elements of the HVAC systems and rooms controls.
  - .10 Also, ensure to include required point of control for the exhaust systems.

### **1.3 SHOP DRAWING AND DIAGRAMS**

- .1 Contractor from division 25 will provide shop drawings and data sheets of components for approval.
- .2 The shop drawings must be sufficiently complete and detailed to assess the quality and efficiency of the proposed systems. They will include the drawings of the systems and their components, systems architecture, schematic and electrical diagram of each system.
- .3 Also provide complete diagrams of all control systems after the execution of the work. These diagrams will be wrapped in rigid transparent plastic and will be installed close to each panel.
- .4 Obtain, from divisions 23, 26 and others, all required documentation.
- .5 A list of control points will be provided by the contractor when presenting shop drawings; it will clearly indicate the points used and those available.

### **1.4 MATERIAL IDENTIFICATION AND INSTALLATIONS**

- .1 Execute all necessary identification work related to elements shown on drawings and control specifications and coordinate with other sections all identification works.

## **Part 2 Product**

### **2.1 GENERAL**

- .1 The control units will be chosen to ensure the best possible operation, stable while having adequate sensitivity.
- .2 Consult control diagrams and operating sequences on drawings and specifications and provide all the control components necessary for the systems operation.
- .3 Consult existing drawings of Parks Canada in order to take into consideration existing control elements.
- .4 Unless otherwise indicated, all similar devices such as thermostats, hygrometers, and others will come from a single manufacturer.
- .5 All temperature indication will be expressed in degrees Celsius (° C).

### **2.2 WEB INTERFACE**

- .1 The communication with the control system will be done using a fixed WEB IP address provided by the client. The system will allow the command input functions, information management, network alarm management and database management.

### **2.3 WEB NETWORK SUPERVISOR (SR)**

- .1 The network supervisor is software that makes the interconnection between all network managers (GR). It is installed on a server that will be used for all Project-Web graphics format. Among others, it should provide the following features:
  - .1 Global Access to Data: The SR must allow access to data distributed throughout the system
  - .2 Distributed Control: The SR must allow to execute overall strategy controls based on objects in any GR locally or remotely



- .3 The SR must manage all schedules in the GR and in the BACnet controllers
- .4 Each GR under the SR supervision must be able to archive historical data, alarms and its database in the SR and this should be performed automatically. The archive must allow data collection for a period of over 2 years.

## **2.4 DIRECT NUMERICAL CONTROLLERS (CND)**

- .1 Direct digital controllers (CND) must reside on the network on building level. Digital controllers of different types must use the same programming language and have the same help structure. The menus of the controllers must be in French and English and allow switching from one to another (the display language of the operator interface may be selected by the operator).
- .2 Acceptable Products: Distech Series ECB-203, ECB-300 or equivalent

## **2.5 TERMINAL EQUIPMENTS CONTROLLERS**

- .1 Each component controller must operate as a standalone controller capable of performing its own specific regulation, independently of the other controllers on the network. Each controller must be a numerical processor, multitasking, real-time, controlled by a microprocessor.
- .2 Controllers must include all required inputs and outputs for proper execution of specified control sequences. Analogue outputs must be standard signals, such as 24 V floating command, or 0 to 10 V, allowing interfacing with a variety of modulating servomotors.
- .3 All sequences and operation of the controller must provide closed loop control for the intended application.
- .4 Acceptable Products: Distech ECB-VAV or equivalent.

## **2.6 OPERATOR INTERFACE – WORKING STATION**

- .1 Description of the interface
  - .1 The operator interface software is new.
- .2 Dynamic color graphics displays
  - .1 The creation of floor level color graphics and schematics of each mechanical equipment components, including air handling units, and component terminals should be provided by the contractor of digital control system, as shown in the I/O (input/output) drawings and specifications, in order to optimize system performance analysis and speed up the alarms recognition.
  - .2 Operator interface must allow users to access various system diagrams and floor level via a graphic access plan, the selection by menus or text commands. The graphical software should allow to import scanned images to be used in the system or coming from AutoCAD.
  - .3 Dynamic temperature values, humidity values, flow values, indication status should be shown at their respective locations and be automatically updated to represent current conditions without operator intervention and without pre-set screen refresh interval.
    - .1 Bar graphs with definable dimensions must be available to monitor and control analog values. The high and low alarm settings should be

displayed on the analog scale. The user must be able to change the set-point by "clicking and dragging" the cursor.

## 2.7 CONTROL ELEMENTS

- .1 Supply and install all required instrumentation, for the monitoring control and optimization functions.
- .2 All control sensors to be used will be NIST certified.
  - .1 Temperature sensor:
    - .1 Room Temperature
      - .1 Room digital sensors must have a LCD display and manual slide adjustment.
      - .2 Range 13° to 35°C
      - .3 Output signal Modulating resistance
      - .4 Element Thermistor 10,000 ohms
      - .5 Calibration point Accuracy +/- 0.3 °C
      - .6 Acceptable Products: Distech EC-SMART or approved equivalent.
    - .2 Single point duct temperature
      - .1 Range -40° to 116°C
      - .2 Output signal Modulating resistance
      - .3 Element Platine 1000 ohms
      - .4 Calibration point Accuracy +/- 0.1%
      - .5 Acceptable Products : Siemens 544-339 or approved equivalent
    - .3 Average duct temperature
      - .1 Range -40 ° to 116 °C
      - .2 Output signal Modulating resistance
      - .3 Element Platine 1000 ohms
      - .4 Calibration point Accuracy +/- 0.1%
      - .5 Available cable lenght 7,6m, 45cm, 60cm, 1,2m
      - .6 Acceptable Products : Siemens 544-342/3/4/5 or approved equivalent
    - .4 Frost Thermostat
      - .1 Capillary controlled of "all or nothing" with manual reset, sensitive element of a suitable length to suit the box dimensions.
  - .2 Differential pressure transmitter for filters or two-way
    - .1 Output 4 to 20 ma
    - .2 Calibration settings Zéro and range (as per application)
    - .3 Accuracy +/-1% of the range, or 0,4% (BL-3)
    - .4 Linearity +/-0.96% of the range or +/-0.38%(BL-3)
    - .5 Hysteresis +/-0.2% of the range or 0,1% (BL-3)
    - .6 Acceptable Products : Setra model 264 or 264E(BL-3) or approved equivalent
  - .3 Air differential pressure switch:
    - .1 Range 250-3000kpa/12.5-250kpa
    - .2 Differential 62.5kpa/5kpa
    - .3 Electrical rating 15 amps
    - .4 Acceptable Products : Siemens SW141 or approved equivalent
    - .5 Humidity sensors

- .4 Humidity sensors
  - .1 Duct humidity sensors
    - .1 Range 0 to 100% d'HR
    - .2 Sensing element Capacitif Element
    - .3 Output signal 4 – 20 mA or 0-10Vdc
    - .4 Accuracy at 20°C + 2% d'HR
    - .5 Acceptable Products : Siemens Série QFM or approved equivalent
- .5 Limit Switches
  - .1 Unipolar contact bloc with quick action with appropriate sensing element for application.
- .6 Relay:
  - .1 Plug-in type relays with DPDT contact, 5 A at 240 VAC.
- .7 Electronic damper actuators
  - .1 Electrical control signal of damper must be provided by direct contact.
  - .2 Shutter actuators must be provided with brushless DC motors, with blocking protection, bidirectional, with integrated safety spring return, with metallic body, with manual override and when specified on drawings, a dual auxiliary switch, individually adjustable.
  - .3 All actuators must include necessary hardware, assembling and the proper connection for a standard 1/2 inch diameter axis or a damper blade.
  - .4 The actuators must be designed to be direct coupled on the damper shaft without connecting links.
  - .5 Damper actuators with output torque of more than 100 lb must have self centering axis clamps, to ensure concentric coupling alignment of the actuator and damper shaft. The self-centering clamp should have a pair of opposed « V » shaped toothed cradles with two rows of teeth for maximum retention force. A single clamping bolt must simultaneously bring the two cradles in contact with the damper shaft.
  - .6 All actuators with output torque of more than 100 lb must accept an axis of 1 inch in diameter, without the need for auxiliary adapters.
  - .7 All actuators must be designed and manufactured under ISO 9000 procedure, and must be approved according to UL873 standards and CSA22.2 No. 24-93.1.
  - .8 Acceptable Products: Belimo or Siemens Open-Air or approved equivalent.
- .8 Frigistats
  - .1 Install frigistats as indicated on drawings and provide protection for every square foot of the surface of the coil with a one foot linear element per square foot of coil. Provide a manual reset.
  - .2 Acceptable Products: Siemens 134-1504 or approved equivalent.
- .9 Current sensor relay :
  - .1 The current sensor with a binary output signal, self-powered and with an accuracy of 2%.
  - .2 Required in the absence of variable frequency drive.
  - .3 Required for motor without variable frequency drive.
  - .4 Acceptable Products : Veris H-908 or approved equivalent

- .10 Pressure switches (air)
  - .1 Pressure switches will be adjusted with the appropriate pressure differential range to suite the application. They will be of industrial grade.
  - .2 Acceptable Products :Greystone AFS series or approved equivalent

## **2.8 INDEPENDANT APPARATUS AND ACCESSORIES**

- .1 Supply all autonomous components with the following characteristics described below and any other device and accessory required even if not specifically described in this specification.
  - .1 Air pressure drop indicator for filters.
  - .2 Type dial indicators and provided with 2 outputs; 100 mm (4 ") diameter dial, minimum scale 0-500 Pa (0-2" of water) and suitable for the application; accuracy of  $\pm 2\%$ .
  - .3 The indicator will be provided with two static pressure sampling tubes and rigid connecting tubes. Indicator will be installed recessed in the door of the local control panel.
  - .4 Required quality: DWYER, 2000 series.
- .2 Electrical transformer and power supplies
  - .1 The current transformers will be provided with Class 2 current limiting or provided with overload protection on the primary and secondary circuits for Class Service 2. Output current will be design with a safety factor of 50%. The units will be approved ULC. Primary voltage 120V ca. and secondary voltage 24V ca. Capacities will be suitable for the applications.

## **2.9 ELECTRICAL WIRING**

- .1 Unless otherwise indicated on the drawings, electrical connection work from the electrical distribution panels including conduit, boxes and wiring for the supply of 120V control equipment or control panels are part of the division 25.
- .2 Legislation and Regulations: All installation described on the drawings and in this scope of work, temporary or permanent, must comply with the requirements of the Canadian Electrical Code and the Board of Electrical Examiners and the requirements of the scope of work of Division 26. On site, the standards C.C.Q. must be respected.
- .3 Approved parts: all components must be CSA approved or listed ULC where applicable.
- .4 Low voltage wiring in between ceilings and drywall will be orange FT-4 type, without metal reinforcement as recommended by the manufacturer of the control system.
- .5 In mechanical rooms, all wiring must be installed in EMT conduit.
- .6 Provide control wiring between the thermostats, motors, all the alarm wiring and control for all alarm and control devices for all sections of drawing and scope of work.

## **Part 3 Execution**

### **3.1 INSTALLATION**

- .1 The control contractor shall install all control elements related to this project. He must also install wiring between each controller and all sensors and control devices (dampers, flow control boxes, valves, etc.) and perform, if necessary, the 24 V AC power supply to controllers and control devices.
- .2 Electrical contractor shall install in the ceiling 120 volts feeding circuits for the connection of the controller.
- .3 Air supply terminal devices with reheat coils, air extraction terminal devices and valves are existing or to be installed by mechanical contractor.

### **3.2 START-UP**

- .1 Division 25 will be responsible for commissioning and complete programming of the systems.
- .2 Division 25 will use a specialist for programming centralized control for units before and during the commissioning. The units will be provided with the necessary software to perform the operations described in the drawing and scope of work.
- .3 Division 25 will ensure reliable and complete operation of the controller system, control of components and controlled of equipment.
- .4 Commissioning Report
  - .1 The supplier will provide to the owner a complete commissioning report dated, stating that he checked each item and each control loop. This report shall include a description of each point with the settings and alarms. For each item, there will be the following checks:
    - .1 physical point connection;
    - .2 point setting and calibration;
    - .3 point programming.
  - .2 For each audit, the officer shall affix his initials.
  - .3 Then, an operation simulation will be made for each system with signature of a representative of the owner and / or this section.

### **3.3 WARRANTY AND TESTS**

- .1 Be responsible of any defects that may occur in the first year after final acceptance of the work by the engineer, replacing as necessary, any defective equipment.
- .2 Operate systems in normal operation during cold and hot seasons, making all the necessary adjustments until the result is consistent with the engineer drawings and scope of work.
- .3 If for one reason, a device is not working properly, this contractor will be required, upon request of the client, to make necessary changes so that the system operates normally even if it meant thereby changing the connections, undo facilities, relocating control devices, repeat programming, etc. It shall provide all personnel and tools necessary to make these adjustments, and at his own expense.

### 3.4 STAFF TRAINING

- .1 Division 25 will also provide a French & English training courses to those concerned by the use of the newly installed system.
- .2 Training will be provided by competent instructors able to transmitting all the necessary knowledge to the staff assigned to the operation of the system. Instructors must know thoroughly all aspects of the subject they teach. All training participants will be provided with a loose-leaf binder containing specific training modules to the product for the newly installed system. All training must be provided during normal working hours from 8 am to 16 h 30, on week days.
- .3 Provide 8 hours of training to the client designated operating staff. Training should include as a minimum the following topics:
  - .1 Drawing, operating and maintenance manuals explanation
  - .2 Site visit to locate the control components
  - .3 Computer operator interface and devices
  - .4 Digital controller and operation of CPA
  - .5 Operator's control functions, including how to generating graphics and on site screen programming
  - .6 Use of mobile or remote operator interface if there are any.
  - .7 Explanation of how to do settings, calibration and components replacement
  - .8 Student binder with loose-leaf containing training modules
- .4 In addition to training, provide technical support for operating systems, according to the specific needs of the operator during the year of warranty.
- .5 Indicate in the annex to the submission hourly rate for additional hours of consultation hours in the contract.

## Part 4 OPERATING SEQUENCES

### 4.1 TYPICAL SEQUENCE FOR REGULATION

- .1 Low frost limit: air supply systems will be equipped with a frost detector with adjustable time delay relays. The system will be stopped at 4 °C. This time delay relay will be used at start-up of the system and will be temporary cancelling the effect of the frost detector. Frost protections should not be through the CND system.
- .2 Smoke detection
  - .1 The systems will be equipped with a smoke detector and will be arrested on smoke detection.
  - .2 Connections between the smoke detector, the fire alarm system and motor starters fall under division 26 (electricity). All other connections related to control to motor starters are covered by this section.
- .3 Filters: filters for air conditioning units will be equipped with pressure differential transmitter.
- .4 Running status: a running confirmation of the ventilation systems will be provided using a current relay.

- .5 Preventing duct damaging:
  - .1 Time delay must be programmed between the starting and stopping of the fans and the position of the associated dampers to protect duct against excessive static pressure. The position of all dampers will be confirmed with limit switches.
- .6 Flow Control of new constant volume system
  - .1 A static pressure sensor located at 2/3 of the most restrictive ventilation branch of the system, will allow the control of the air volume of the ventilation system.
  - .2 The air volume control system will be done by a modulating signal to the variable frequency drive of the supply fan.
  - .3 Return / exhaust fan must meet a volumetric deviation from that power.
- .7 Deviation alarm: for each control point (input), a minimum and / or maximum will be scheduled. If these values are reached, an alarm will be displayed / sent showing indication of the source of alarm.

#### **4.2 SYSTEM NO. 1 SEQUENCE OF OPERATION**

- .1 The system No. TP-01 must be in continuously operation. Outside normal operating hours of the site, it can operate at reduced speed (if the owner chooses).
- .2 When the system is off, the fans are stopped, the motorized fresh air intake and exhaust dampers are closed, and the return dampers are open.
- .3 When the system is running, the fans are running, the motorized fresh air intake and exhaust dampers are opened the return dampers are open.
- .4 The system supply temperature is kept at all times at the set point - 23 °C (ajustable)
- .5 Lower protections limit are needed in order to stop the fans. The supply air temperature transmitter also acts as a lower limit with the set point to 13 deg C.
- .6 Temperature reading in the common return duct will be connected to the Building Automation System.
- .7 A smoke detector in the air supply will stop fan upon detection. The building security officer will be consulted to determine the best sequence in case of fire, all consistent with existing building standards.
- .8 Data will be collected and kept in memory:
  - .1 The analogic inputs and outputs readings.
  - .2 The discreet inputs and outputs readings.
  - .3 The interval between data records will be definable by the operator.
  - .4 Proof of operation will be sent to the building system.
  - .5 Proof of operation of the UPS is sent to the building system.

**END OF SECTION**

## **Part 1        General**

### **1.1        DEFINITIONS**

- .1 ALR – Average Level of Reliability. Defined by the ratio of the duration of the test period minus any accumulated failure time during this period, to the test period.
- .2 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.

### **1.2        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.

### **1.3        ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submittals in accordance with general requirements

### **1.4        CLOSE-OUT SUBMITTALS**

- .1 Submit documentation, O & M manuals, and training plan for O & M Personnel in accordance with general requirements
- .2 Final Report: submit report to Departmental Representative.
  - .1 The format of the report must be approved by the departmental representative before start-up;



- .2 The final report must include the measured values, the final settings and the results of the certified tests.
- .3 Bear signature of commissioning technician and supervisor
- .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 general requirements.
- .5 Recommend additional changes and/or modifications deemed advisable in order to improve performance, environmental conditions or energy consumption.

## **1.5 COMMISSIONING**

- .1 Carry out commissioning under direction of Departmental Representative.
- .2 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.
- .3 Correct deficiencies, re-test in presence of Departmental Representative until satisfactory performance is obtained.
- .4 Acceptance of tests will not relieve Contractor from responsibility for ensuring that complete systems meet every requirement of Contract.
- .5 Load system with project software.
- .6 Perform tests as required.
- .7 The present section must ensure the reliable functioning of the complete system, controllers, control components.
- .8 Commissioning report and preoperational verification
  - .1 In Excel format
  - .2 Indicating that he has verified each point at each control loop
  - .3 Including the name, address, and description of each point with the adjustments and alarms.
  - .4 For each point, there should be the following verifications:
    - .1 Physical connection of the points;
    - .2 verification, adjustment and calibration of the reference point to another calibrated and certified measurement instrument
    - .3 programming related to this point.
  - .5 For each verification, the contractor must place his initials.
  - .6 When all the points of a system have been verified, an operation simulation will be done in the presence of the departmental representative.

## **1.6 COMPLETION OF COMMISSIONING**

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

## **1.7 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 6 months prior to tests.
- .4 The engineer reserves the right to request the calibration certificate. In the case on non compliance, the engineer could insist that the verification be restarted after re-calibration, without extra cost.
- .5 Locations to be approved, readily accessible and readable.
- .6 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 Verify the systems in normal operating conditions during the cold and warm seasons, making necessary adjustments until the result is in compliance with the plans and specifications.
- .3 Commission each system using procedures prescribed by the Departmental Representative.
- .4 Commission integrated systems using procedures prescribed by Departmental Representative.
- .5 Debug system software.
- .6 Optimize operation and performance of systems by fine-tuning PID values and modifying CDLs as required.
- .7 Test full scale emergency evacuation and life safety procedures including operation and integrity of smoke management systems under normal and emergency power conditions as applicable.

### 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 transmitters.
    - .2 VAV supply duct SP transmitters.
    - .3 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 metre at source
  - .7 After setting, test zero and span in 10 % increments through entire range while both increasing and decreasing pressure.
  - .8 Transmitters above 0.5% error will be rejected.
  - .9 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 Verify that each instrument, component, control accessory, support, group of tubes, cable multiconductors, junction box, control panel terminal, tube and wiring are correctly installed and connected, to the satisfaction of the departmental representative.
  - .3 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.
- .4 Final Startup Testing: Upon satisfactory completion of tests, perform point-by-point test of entire system under direction of Departmental Representative and provide:
  - .1 technical personnel capable of re-calibrating field hardware and modifying software.
  - .2 Detailed daily schedule showing items to be tested and personnel available.
  - .3 Commissioning to commence during final startup testing.
  - .4 O&M personnel to assist in commissioning procedures as part of training.
  - .5 Commissioning to be supervised by qualified supervisory personnel and Departmental Representative.
  - .6 Commission systems considered as life safety systems before affected parts of the facility are occupied.
  - .7 Operate systems as long as necessary to commission entire project.
  - .8 Monitor progress and keep detailed records of activities and results.
- .5 Final Operational Testing: to demonstrate that EMCS functions in accordance with contract requirements.
  - .1 Prior to beginning 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.
  - .2 Repetitive alarm conditions to be resolved to minimize reporting of nuisance conditions.
  - .3 Test to last at least 30 consecutive 24 hour days.
  - .4 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.
  - .5 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.
- .6 In event of failure to attain specified AEL during test period, extend test period on day-to-day basis until specified AEL is attained for test period.
- .7 Correct defects when they occur and before resuming tests.
- .6 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 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 training.

**END OF SECTION**

**Part 1 General**

**1.1 DEFINITIONS**

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

**1.2 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submittals in accordance with Section 01 33 00- Submittal Procedures, 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 anticipate 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 Phase 2 training program that has been satisfactorily completed.

**1.3 QUALITY ASSURANCE**

- .1 Provide bilingual, competent instructors thoroughly familiar with aspects of EMCS installed in facility.
  - .1 The trainer(s) must respond to the following conditions :
    - .1 Hold a certificate issued by the manufacturer confirming that the trainer has followed a course given by the manufacturer on the products and software for a minimum of 80 hours of training.
    - .2 Has at least two years experience giving trainings for the company of equivalent experience.
    - .3 Demonstrate good knowledge of the product and the field.
    - .4 Hold a certificate of accreditation as a trainer recognized by the Commission of Labor Market Partners (Emploi Quebec) would be an asset. Departmental Representative reserves right to approve instructors.

**1.4 INSTRUCTIONS**

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

**1.5 TIME FOR TRAINING**

- .1 Number of days of instruction to be as specified in this section
- .2 Provide the following durations:

- .1 Phase 1: 2 days
- .2 Phase 2: 2 days
- .3 The training will be held on the premises
- .4 The participants will be designated by the owner
- .5 Dates to be agreed upon by the Contractor, Consultant, Owner and the Commissioning Manager.

## **1.6 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 in detail the contents of the manual in order to explain the different aspects of the operation and maintenance
  - .2 The material must also include a PowerPoint presentation, a participant workbook (for exercises and evaluations) and a simulation environment
  - .3 The examples, exercises and case studies must be adapted to the specific equipment of the project.
  - .4 The course material and reference material must be in French.

## **1.7 TRAINING PROGRAM**

- .1 Training must be given in French in two distinct phases
- .2 Phase 1: Training given before the testing period
  - .1 Train O&M personnel in functional operations and procedures to be employed for system operation.( points, schedules, alarms etc.)
  - .2 The training must include an overview of the architecture, communications, functioning of the computer and peripherals, and the generation of reports
  - .3 It must also cover in detail the operator interface functions for command of the mechanical systems, command logic of each system and troubleshooting and preventative maintenance of the elements of the UPS, as well as maintenance and calibration of sensors and control / regulation devices.
- .3 Phase 2: training given after the acceptance of the system, intended for the operators and programmers.
  - .1 Training must cover in detail, the creation and changing of programmes, functions, schedules, graphics, history and trend curves etc.
  - .2 The learning strategy requires that the knowledge be spread over 3 levels, as presented in the following table:

Basic programming	Intermediate programming	Advanced programming
Create simple programs (ex. : feed pump).	Create complex programmes (ex. : double gain air conditionning system).	Create very complex programmes (ex. : load shedding system with priority).
Create Trend Logs	Create access profiles	Perform panoramas.
Manage access profiles		Perform summary changes in BACnet applications.

## **1.8 ADDITIONAL TRAINING**

- .1 Provide a list courses offered by name, duration and approximate cost per person per week. Note courses that are recommended for training supervisory personnel.

## **1.9 SUPPORT ADDITIONNEL**

- .1 In addition to the training, provide technical support to help the personnel, according to the specific need of the owner during the guarantee year.
- .2 To do this, allow for 41 hours of consultation, support or training not covered by the guarantee.

## **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        Section 25 05 54 - SGE – Material Identification.

**1.2            REFERENCE STANDARDS**

- .1    American National Standards Institute (ANSI)/The Instrumentation, Systems and Automation Society (ISA).
  - .1        ANSI/ISA 5.5, Graphic Symbols for Process Displays.
- .2    American National Standards Institute (ANSI)/ Institute of Electrical and Electronics Engineers (IEEE).
  - .1        ANSI/IEEE 260.1, 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, BACNET - Data Communication Protocol for Building Automation and Control Network.
- .4    Canadian Standards Association (CSA International).
  - .1        CAN/CSA-Z234.1, Canadian Metric Practice Guide.
- .5    Consumer Electronics Association (CEA).
  - .1        CEA-709.1, Control Network Protocol Specification.
- .6    Department of Justice Canada (Jus).
  - .1        Canadian Environmental Assessment Act (CEAA), c. 37.
  - .2        Canadian Environmental Protection Act (CEPA), c. 33.
- .7    Electrical and Electronic Manufacturers Association (EEMAC).
  - .1        EEMAC 2Y-1-[1958], Light Grey 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), c. 34.

**1.3            ABBREVIATIONS AND ACRONYMS**

- .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 Centre.
- .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 short forms 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 short form 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 SCOPE OF WORK

- .1 All articles in section 21 05 01 should be respected by this section.

- .2 The controls portion in the section 21, 22, 23 and 25 or plans must be included in this section
- .3 Work covered by sections referred to above consists of fully operational EMCS, including, but not limited to, following:
  - .1 Supply, install and connect new local control panels
  - .2 Supply, install and connect UPS
  - .3 Supply, install and connect cabling, conduits and tubes required
  - .4 Electrically power local controllers and panels from circuit breakers in Division 26
  - .5 Supply, install and connect all devices required to respect control sequences.
  - .6 Integrate all elements and equipment with BacNet interface of the mechanical systems in order for it all to be transparent and accessible from the client's network
  - .7 Supply and install all supports and hangers required
  - .8 Identify all components (panel, controllers, input & outputs, control valves, motorized control valves, cabling etc.) as required.
  - .9 Carry out all work required on the controls in order for the balancing contractor to perform the TAB works (positioning of the valves, shut-off etc.) at the request of the departmental representative.
  - .10 Supply all software, programmed and configure the system of optimal functioning, including graphics.
  - .11 Perform start-up of all control equipment.
  - .12 Supply certain equipment such as: valves, flow switches, pressure switches, etc., to the other sections for installation at the required locations, under the guidance of this section, and then connect them to the control system.
  - .13 Demolish the existing unused control equipment, as indicated.
- .4 Consult the table of contents for the list of sections applicable to automatic controls.

## **1.6 SYSTEM DESCRIPTION**

- .1 For the architecture of the system, refer to the control scheme diagram. The expression of metric units must comply with the CAN/CSA Z234.1 standard.
- .2 Signage and operating language
  - .1 Provide the appropriate access codes for the use of the system in French.
  - .2 All software and all information must be presented in French.
- .3 Control equipment are chosen to ensure the best functioning possible without oscillation while having sufficient sensitivity.
- .4 Only products of the latest generation should be quoted.
- .5 Control. Systems will be digital type according to what is specified on the plans and specifications. Certain protection may be electrical.

- .6 Acceptable Products: « DELTA, HONEYWELL, RELIABLE, SIEMENS, JOHNSON CONTROLS ».

## **1.7 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Make submittals in accordance with Section general requirements.
  - .1 Equipment list, systems manufacturers within 10 days after award of contract.
- .2 Quality Control:
  - .1 Submit proof of compliance to specified standards with shop drawings and product data in accordance with Section [25 05 02- EMCS: Shop Drawings, Product Data and Review Process]. Label or listing of specified organization is acceptable evidence.
  - .2 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.
  - .3 Where CSA certified equipment is not available submit such equipment to inspection authorities for special inspection and approval before delivery to site.
  - .4 Submit certificate of acceptance from authority having jurisdiction to Departmental Representative.
- .3 Drawings contain, specifically but not limited to:
  - .1 Technical information of the control systems as well as their components (controller, temperature gauge, transmitter etc.)
  - .2 Electrical diagrams for each control system produced with a standard drawing software
  - .3 Electrical diagrams of the starters (fan, pumps, etc.) and other control equipment (humidifier, generator, etc.)
  - .4 The complete architecture of the control system including all the controllers, communication modules etc.
  - .5 Plan views indicating the placement of each control panel.
  - .6 List of points clearly indicating the points used and those that are unused
  - .7 List of material
  - .8 Operation sequence
  - .9 Procedures, diagrams and troubleshooting guide.
  - .10 Preventative maintenance requirements.
- .4 Obtain from sections 21 to 26 and others, the electrical diagrams of the starters and other controllers required.
- .5 Indicate on the materials list to be used for the present works, the name of the manufacturer, the model number and the details relating to fabrication material of each element.
- .6 Consult the manufacturer's data and transmit the necessary information to the other sections so that they may foresee the space necessary for their installation.

## **1.8 DOCUMENTS TO SUBMIT AT SUBSTANTIAL COMPLETION OF THE WORKS**

- .1 Supply the documents required by the general conditions.
- .2 As built drawings, including all modifications done during the works:
  - .1 Sketches showing all control elements, including connections terminals of each apparatus, electrical diagrams etc.
  - .2 The architecture of the centralized management system showing the computer stations, controllers, communications network, including type of cables used, protocols, active components and UPS
  - .3 A physical plan showing the location of the control panels and the command centers, the routing of the conduits, wiring, and pneumatic control / command lines.
- .3 Also supply three paper copies of the complete diagrams of these control systems after execution of the works. These diagrams will be covered in rigid transparent plastic and will be installed near each of the systems, as required by the general requirements.
- .4 Operations and maintenance manuals
  - .1 Operations and maintenance manuals must be exhaustive, they must be written in concise language easy to understand by the operations personnel. The terminology used must be uniform for all operational and functional requirements. Do not presume that the operations personnel possess the knowledge of computers or electronics, or a deep theoretical knowledge of control / command systems.
  - .2 The manuals must include the following information:
    - .1 List of components, name of the fabricator, model used and its characteristics.
    - .2 List of all software, including version numbers, for each computer station of the building automation system.
    - .3 A copy for each controller of the programming implemented (organization chart, text or object type programming, as the case may be)
    - .4 For each control panel, a list of the entrance / exit points and indication of free points.
    - .5 The functional sequence
    - .6 The numbers of the distribution panels and the breakers associated to the regular and emergency power supply
    - .7 The name, address, telephone number of each sub-contractor having installed the material, local representatives of suppliers of the parts and this, for each system.
    - .8 The procedures and test reports, including the start up procedures, test procedures, control tests, and final commissioning reports, as per general requirements.
    - .9 Information on the functioning of the system must include the following;
      - .1 The operating principle;

- .2 The design philosophy
  - .3 The specific functions of the design philosophy of the system.
  - .4 The functioning of the peripheral devices, the input/output formats;
  - .5 The functions of the material, the characteristics of the components for each function and each mode of functioning of the system;
  - .6 The complete details of the communication of data, including the types and formats of data, the processing element and the linking of data, interfaces.
  - .7 The step by step procedures to follow for the functioning of the system, including the interventions required by each work station;
  - .8 The return to normal functioning after an emergency, an alarm or a power failure;
  - .9 The list of alarms programed
  - .10 The list of schedules programed
  - .11 An impression of the graphics
  - .12 detailed instructions concerning start up, the functioning of emergency material, the execution of all system functions and all operation modes, including each command, such that the operator has only to refer to those pages to know what he should push on the keyboard to see information or enter a command.
  - .13 All documentation related to the configuration of the system, including all changes required for modifications of material or software, required during the useful life of the system.
- .3 The documentation relative to software must include the following:
- .1 The necessary data concerning the theory, the design, the interface requirements, the different functions, including testing and verification procedures;
  - .2 Detailed descriptions of the capacities of the programmes and the conditions of their use;
  - .3 The necessary data to allow the modification, moving and programming and so that the program modules can react to changes of functional requirements of the system, without interrupting normal operations;
  - .4 The software modules, the source code with required annotations, the source code files exempt from errors and ready for loading using peripherals;
  - .5 All references between programmes and links, data exchanges required, lists of sub programmes required, the requirements related to data files, other necessary information for loading, integration, interfacing, and execution of the programmes;
  - .6 The software drivers for each controller and the description, in a separate section, of the functions and parameters common to all the controllers.

- .4 Maintenance:
  - .1 A list of maintenance tasks and the frequency with which these tasks must be carried out; for each component requiring it including, when applicable:
    - .1 Element to replace with the model and distributor name (batteries, fuses etc.)
    - .2 Tests and verifications to carry out on critical components.
    - .3 Calibration methods;
    - .4 Trouble-shooting methods for failures.
  - .5 A copy of the as-built drawings.
- .5 Following adjustments requested by the Ministerial representative, supply three paper copies and one digital copy (PDF) of the technical documents at the end of the project as well as an electronic modifiable copy in Excel, Visio, Word, etc. format as the case may be.
  - .1 This file must also be embedded in the work station at the site so that the user can access this information.
- .6 Also supply an extra copy of the necessary for the project.

## **1.9 TRANSPORT, STORAGE AND HANDLING**

- .1 Waste management and disposal
  - .1 Sort waste for their reuse and recycling as per general requirements
  - .2 Remove all packing materials from the site and bring them to the appropriate recycling facility.
  - .3 Place all corrugated cardboard. Polystyrene, plastic and paper packaging materials in appropriate on-site bins for recycling in accordance with the Waste Management Plan.
  - .4 Sort waste by steel, metal, and plastic for their reuse or recycling, and dispose of them in the designated containers, in accordance with the waste management plan.
  - .5 Place in designated containers, all substances that correspond to the definition of toxic or dangerous waste.
  - .6 Handle and eliminate dangerous materials in accordance with municipal regulations.
  - .7 Identify the location for storage of materials and recycled materials and protect them using fences and security measures.
  - .8 Ensure that the empty containers are sealed and stored in a safe manner.
  - .9 Route unused metal materials to approved metal recycling facilities.
  - .10 Fold metal and plastic strapping strips, flatten and place in the designated area for recycling.

## **1.10 EXISTING- CONTROL COMPONENTS**

- .1 Utilize piping existing control wiring as indicated.



- .2 Re-use field control devices that are usable in their original configuration provided that they conform to applicable codes, standards specifications.
  - .1 Do not modify original design of existing devices without written permission from Departmental Representative.
  - .2 Provide for new, properly designed device where re-usability of components is uncertain.
- .3 Inspect and test existing devices intended for re-use within 30 days of award of contract, and prior to installation of new devices.
  - .1 Furnish test report within 40 days of award of contract listing each component to be re-used and indicating whether it is in good order or requires repair by Departmental Representative.
  - .2 Failure to produce test report will constitute acceptance of existing devices by contractor.
- .4 Non-functioning items:
  - .1 Provide with report specification sheets or written functional requirements to support findings.
- .5 Submit written request for permission to disconnect controls and to obtain equipment downtime before proceeding with Work.
- .6 Assume responsibility for controls to be incorporated into EMCS after written receipt of approval from Departmental Representative
  - .1 Be responsible for items repaired or replaced by Departmental Representative.
  - .2 Be responsible for repair costs due to negligence or abuse of equipment.
  - .3 Responsibility for existing devices terminates upon final acceptance of EMCS applicable portions of EMCS as approved by Departmental Representative.
- .7 Remove existing controls not re-used or not required. Place in approved storage for disposition as directed.

## **Part 2 Products**

### **2.1 EQUIPMENT**

- .1 Data Communication Protocol Control Network Protocol: to CEA 709.1 ASHRAE STD 135.
- .2 Complete list of equipment and materials to be used on project and forming part of bid documents by adding manufacturer's name, model number and details of materials, and submit for approval.

### **2.2 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 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.

**3.3                FIELD QUALITY CONTROL**

- .1            Execute the quality control in accordance the general requirements sections.
- .2            The Departmental representative reserves the right to refuse the installation. The contractor will modify the work at is cost.

**END OF SECTION**

**Part 1 General**

**1.1 CONNECTED WORKS**

- .1 Section 23 05 53.01 Mechanical identification

**1.2 REFERENCES**

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

**1.3 SYSTEM DESCRIPTION**

- .1 Language Operating Requirements: provide identification for control items in French.

**1.4 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submittals in accordance with general requirements.
- .2 Submit to Departmental Representative for approval samples of nameplates, identification tags and list of proposed wording.

**Part 2 Products**

**2.1 NAMEPLATES FOR PANELS**

- .1 Identify by Plastic laminate, 3 mm thick, 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.

**2.2 NAMEPLATES FOR FIELD DEVICES**

- .1 Identify by [plastic encased cards]attached by [chain] [plastic tie].
- .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.

**2.3 NAMEPLATES FOR ROOM SENSORS**

- .1 Room sensors must be identified using a plasticized card held by a chain.
- .2 Dimensions: at least 50 mm x 100 mm.

- .3 Letter size: height of at least 5 mm, black produced by a laser printer.
- .4 Informtion: designation and address of the measurement point.
- .5 Cabinets: Interior components must be identified by means of plastic cards indicating the designation of the point and its address.

## **2.4 RELATED ELEMEN TS**

- .1 Use discrete plastified stickers
- .2 Information: designation (mneumonic) and address of the measurement point
- .3 Dimension of the letters: as needed, but must be clearly legible.

## **2.5 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.

## **2.6 WIRING**

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

## **2.7 PNEUMATIC TUBING**

- .1 Numbered tape markings on tubing to provide uninterrupted tracing capability.

## **2.8 CONDUIT**

- .1 Colour code EMCS conduit.
- .2 Pre-paint box covers and conduit fittings.
- .3 Coding: use fluorescent orange paint and confirm colour with Departmental Representative during "Preliminary Design Review".

## **Part 3 Execution**

### **3.1 NAMEPLATES AND LABELS**

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

**3.2            EXISTING PANELS**

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

**END OF SECTION**

**Part 1 General**

**1.1 REFERENCES**

- .1 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.
- .2 Reference Standards:
  - .1 CSA C22. 1, Canadian Electrical Code, Part 1 (21st Edition), Safety Standard for Electrical Installations.)
  - .2 CAN3-C235, Preferred Voltage Levels for AC Systems, 0 to 50,000 V.

**1.2 CONNECTED REQUIREMENTS**

- .1 The requirements and directives issued in general (Divisions 00 and 01) and other clauses relevant to the project (sequence of works, services to be maintained, special requirements, etc.) of the architect's and / or Owner's documents must be rigorously Contractor, whether incorporated by reference or not in this section.

**1.3 DEFINITIONS**

- .1 “CONTRACTOR” means the person, firm or successor who commits to providing all workforce, materials and equipment required to perform Work under this project.
- .2 “ENGINEERS” or “CONSULTANT” means:  
WSP Canada Inc.  
2525 Daniel-Johnson Blvd, Suite 525  
Laval (Quebec) H7T 1S9
- .3 “Ministry representative” means:  
Health Canada
- .4 “ARCHITECT” means:  
Architecture 49 Inc.
- .5 Terms
  - .1 An infinitive verb placed at the start of a sentence or clause implies the following words: Contractor shall provide, install and connect... (e.g. the phrase “provide and install or provide or install” will mean “Contractor shall provide, install and connect all equipment...”).

- .2 “INDICATE” means indicated on drawings or specifications included in contract.
- .3 “SPECIFICATIONS” means collectively the latest revisions of the specifications as well as additional or reviewed drawings provided afterward.
- .4 “IN THESE SPECIFICATIONS” means the content of a section or subsection where this term appears.
- .5 “CONTRACTOR” or “PRESENT CONTRACTOR”, which are terms that appear in sections of these specifications and in drawings, mean the firm in charge of the specification section or drawing where the term appears.

#### **1.4 DRAWINGS AND SPECIFICATIONS**

- .1 These specifications are provided with a series of drawings indicating all necessary devices.
- .2 Drawings indicate the general and approximate location of installed devices in accordance with this contract. Contractor shall make required modifications depending on architectural or structural constraints, including any deflection of piping, ductwork or jacket. Only rated sizing indicated on drawings shall prevail at time of mechanical and electrical work installation.
- .3 When piping, ductwork, etc., is indicated on drawings only as diagram, install as to maintain clearance and impede as little as possible on use of space such lines will run through.
- .4 Contractor shall seek all necessary clarification with Architect and Engineer before submittal of tender. Contractor shall also notify Engineer of any inconsistency between Engineer’s and Architect’s drawings and specifications.
- .5 Specifications do not necessarily include all material and equipment indicated on drawings, and vice versa. However, Contractor commits to providing and installing all materials as if mentioned on specifications and drawings.
- .6 When two descriptions of a same piece of equipment, material or system do not coincide, either on drawings or specifications, Contractor is required to take into consideration the most stringent description.
- .7 Note that drawings and specifications remain property of Engineer and are to be used for purposes for which they were prepared.

#### **1.5 INSURANCE**

- .1 Contractor shall provide insurance required by Owner in accordance with PWGSC’s project specification.

#### **1.6 MODIFICATIONS**

- .1 No modification is allowed without written authorization of Owner or Owner’s Representatives. Directive or change order shall then be issued.
- .2 All Work done to building which does not comply with drawings and specifications shall be undone at Contractor’s expense. Owner reserves the right to modify quantity, quality, type of work or device indicated on drawings and specified in specifications without

affecting the validity of contract. Adjustments required following such modification shall be approved by Owner (written approval) before proceeding.

## **1.7 MATERIALS AND WORKFORCE**

- .1 Contractor shall provide new materials of capacity and quality as indicated on drawings and specifications.
- .2 No defective material, or material of lower quality, shall be used in Work under these specifications.
- .3 Contractor will be required to include in tender all necessary Work and materials under good trade practices for a complete construction, even if such are not specifically indicated herein.

## **1.8 COORDINATION BETWEEN BUILDING TRADES**

- .1 Before start of any installation work, each building trade shall come to an understanding with other building trades having to complete installation work which could impact work of abovementioned building trade. Installation work shall be coordinated considering work conducted by other building trades, as well as architectural and structural constraints.
- .2 Each building trade shall notify others of openings, anchors, supports and other provisions required for the installation of indicated structures. Obtain required information on time as to prevent delay in execution of Work.
- .3 None of the foregoing relieves Contractor of responsibility in making openings, installing anchors, etc., at Contractor's own expense, which could be required afterward.

## **1.9 RESPONSIBILITY**

- .1 Contractor to exercise control over Work, as well as effectively manage and supervise Work as to ensure its compliance with contract documents. Contractor shall assume sole responsibility of means of construction, methods, techniques, sequences and procedures, as well as coordination of all parts of Work conducted under this contract.
- .2 Contractor shall bear responsibility regarding installation of own Work and any damage caused to Owner or facilities as a result of bad execution of work or of assembly at wrong location.
- .3 Contractor shall ensure Work is promptly carried out before pouring of concrete or execution of similar work. If cutting or repair to finished or unfinished Work is necessary, hire specialist regarding section of Work to make cuts and repairs at Contractor's expense.
- .4 Coordination to consider height of ceiling and maintain a minimum vertical clearance of 2,400 mm in equipment rooms and rooms without ceiling.
- .5 If materials provided by building trade must be included in Work by other building trade, Contractor shall coordinate the two building trades so that the former provides required material and sizing of necessary openings, and that other building trade incorporates material in accordance with provisions.
- .6 If Contractor covers or allows covering of any section of Work before tests and inspections are conducted, completed or tendered, C



- .7 Contractor shall, upon request, remove cover on said section and have inspections and tests performed in a satisfactory manner and restore section of Work at Contractor's expense.

#### **1.10 WARRANTY**

- .1 Contractor shall assess all his installation work and bear responsibility regarding any defect which could arise within one (1) year after interim acceptance or with reserve of works by Engineer.
- .2 If, for some reason, a device or system does not properly operate, Contractor will be required to make the necessary modifications, without additional costs, so that the device or system properly works even if to do so, it is required to change connections, undo ductwork or piping to realize that there is no obstruction, etc.

#### **1.11 CODES AND STANDARDS**

- .1 Unless otherwise specified, conduct work in accordance with edition in force of Quebec's Construction Code, Edition 2010 (QCC), and any other applicable provincial or local act, regulation, standard or code (latest applicable version), as well as with accepted good engineering practices in the construction industry.
- .2 Work must comply or exceed requirements of contract documents, acts, regulations, standards, codes and good engineering practices.
- .3 Most stringent requirements shall take precedence in case of omission or inconsistency between abovementioned documents.

#### **1.12 INSPECTION AND PERMITS**

- .1 Obtain required permits and pay all fees and costs so that work is conducted.
- .2 Upon completion of work, provide required certificates (certification of compliance) with copy to Engineer and Owner which certify that said Work was conducted in accordance with laws and regulations of the Province of Quebec and with requirements of Code. Contractor must pay all costs related to additional copies required by the Examination Board of given area of expertise.

#### **1.13 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with provisions in section 01 33 00 - Submittal Procedures.
- .2 Contractor shall plan for the preparation of shop drawings required in contract documents or that Engineer may reasonably request. Contractor shall prepare a list of shop drawings which will be annotated by Engineer. Contractor shall update the list once Engineer sends back shop drawings with comments.
- .3 Shop drawings to be clearly identified with title, terminology and symbols of present project as indicated in Engineer's drawings and specifications.
  - .1 Identify components referred to on documents provided by manufacturer, i.e. title and number of related specification section.
- .4 Shop drawings to allow minimum space of 75 mm x 75 mm for inspection stamp of Engineer.

- .5 Contractor to submit shop drawings for review by Engineer within reasonable time-frame and in logical order (per discipline) as to prevent delay in Work, or work of other Contractors. Contractor must notify Engineer, in writing, of any inconsistency between shop drawings and contract documents when submitting shop drawings to Engineer.
- .6 Do not send shop drawings using fax.
- .7 Once annotated, Engineer shall send back revised shop drawing (in PDF format) to General Contractor in charge of making required copies depending on project requirements (Subcontractors, Owner, Specialists).
- .8 Technical data from manufacturers' catalogues and literature must be reliable data confirmed through tests conducted by manufacturers or by independent laboratories on behalf of manufacturers. Tests shall certify compliance with provisions regarding physical characteristics, performance criteria and applicable Codes and standards requirements.
- .9 Shop drawings to be sufficiently complete and detailed to assess the quality and efficiency of proposed systems.
- .10 Shop drawings to show or indicate:
  - .1 Manufacturing materials.
  - .2 Construction details of internal and external parts.
  - .3 Assembly details and installation instructions.
  - .4 Accessories.
  - .5 Necessary clearance to allow operation and maintenance of devices.
- .11 Submit required product data and manufacturer's literature for each product.
  - .1 Product data to include product characteristics, performance criteria, physical size, finish and limitations, as well as description of devices and materials, manufacturer's name, type, model, manufacturing year, capacity and rating.
- .12 Submit following with shop drawings and product data:
  - .1 Installation instructions provided by manufacturer.
  - .2 Wiring and schematic diagrams.
  - .3 Certification of compliance with relevant standards and codes.
- .13 Review of shop drawings by Engineer is only intended to assess compliance of data indicated on shop drawings with general design.
  - .1 Abovementioned review does not mean Engineer accepts final design presented in shop drawings, which is responsibility of Contractor submitting said shop drawings, and does not relieve Contractor of obligation to submit complete and accurate shop drawings and to comply with all requirements of Work and contract documents.
  - .2 Without limiting the foregoing, it should be noted that Contractor is responsible for the accuracy of physical sizes confirmed in situ, for provision of information regarding shaping methods or building and installation techniques and for coordination of work conducted by all building trades.

#### **1.14 ACCEPTED PRODUCTS**

- .1 Subject to other provisions specified in this requirement, “accepted brands” are trademarks specified on drawings and specifications, either alone or with model or catalogue number.
- .2 “Specified product” is the trademark with at least manufacturer’s model and/or product number, as identified in specific product description.
- .3 “Name brands” are trademarks named after the product(s) specified on drawings and specifications and that do not come with manufacturer’s model or product number. Named brands are considered as representing the quality, style and type of product required. However, since design is conducted from specified products, Contractor shall be responsible for demonstrating the equivalency of product’s model for which the brand was named, in accordance with following article.
- .4 Tenders seeking to substitute a given part of equipment or material specified will be rejected when choosing a tenderer. Tenderer will be selected assuming that tender is based on products specified on drawings and specifications.
- .5 Subject to the following article, no substitute for brands other than those indicated on drawings and specifications can be submitted as equivalent during approval of shop drawings since these substitutes do not match the definition of “Acceptable Products”.
- .6 In cases where only one product brand presents the “or approved equivalent” indication, said brand becomes the specified brand for the product (with or without any kind of model). Other equivalent brands may be submitted for approval as long as they meet provisions of specified brand and that a credit is presented to the Owner (see following article).

#### **1.15 EQUIVALENT PRODUCTS AND METHODS**

- .1 Request for equivalency submitted to the Engineer by the Contractor shall be assessed only if a credit is presented to the Owner.
- .2 Requests for equivalency of products must be presented together with shop drawings. Requests for equivalency of methods must be presented as soon as possible. In any case, Contractor must provide for a possible delay of several days in the work schedule for the assessment of the request for equivalency. No delay in Work will be accepted related to such a request.
- .3 If such request is made, Contractor shall be responsible for proving equivalency using a table comparing characteristics of specified method or product with characteristics of equivalent proposed by Contractor.
- .4 Study shall be submitted in writing and consider the following criteria, among others: presented credit, purchasing policy specified in specifications, functionality, construction, efficiency, capacity, performance, physical size, weight, space requirements, minimum standards, availability of spare parts, maintenance issues, delivery deadlines, existence of similar and proven devices in use.
- .5 Engineer shall submit to Client and Contractor the engineering fees that changes will entail. Fees must be included on credit proposed by Contractor.

- .6 Following verification of proof of equivalency, Engineer shall make required recommendations to Owner. No order, nor installation of material or part of equipment shall be conducted before approval.
- .7 If a part of equipment or materials other than those specified in drawings and specifications is accepted, Contractor will be responsible and pay for the modifications and addition of equipment or materials, for all building trades, so that same functions than specified equipment and/or material are achieved.
- .8 Following refusal of first proposed equivalent, Contractor shall resubmit shop drawings of specified products or manufacturing drawing of specified method as indicated in drawings and specifications with no equivalent. Contractor shall bear the cost of delay in Work caused by additional verifications.

#### **1.16 CLOSEOUT SUBMITTALS**

- .1 Provide required operation and maintenance sheets and include in Manual mentioned in section "Closeout Submittals".
- .2 Provide Owner with number of copies of manufacturers' instructions booklet for each device which requires maintenance under general conditions, each with PDF copy on compact CD or USB key. Provide three (3) copies if no quantity is indicated in general conditions. Provide for additional copy on USB key for each specialist.
- .3 Manuals to be presented in binders. Each booklet to be separated in sections with a separator and coloured indicator bearing necessary identification. A table of contents will be inserted at the beginning of the booklet presenting the title of each section.
- .4 Booklets to be provided at interim acceptance of project or upon request by Engineer.
- .5 All booklets to be written in French.
- .6 Operation and Maintenance Manuals (soft and hard copy) to be specifically developed for the prescribed system and include information relevant to this project only.
- .7 Technical data taken from manufacturer's catalogues and literature, including model number, type and physical sizes for each component.
- .8 Maintenance sheets to include:
  - .1 Instructions for maintenance, repair, operation and troubleshooting of each component.
  - .2 Maintenance schedule which specifies frequency and duration of tasks, as well as tools necessary for execution.
  - .3 List of special tools required for setting, repair and replacement of parts.
  - .4 List of recommended spare parts.
  - .5 Name and address of suppliers of spare parts.
- .9 Approval
  - .1 Submit one (1) PDF copy of the preliminary version of Operation and Maintenance Manual to Consultant for approval. Unless otherwise directed by Consultant, do not submit sheets individually.
  - .2 When necessary, make required modifications to Operation and Maintenance Manual and submit to Consultant again.

.10 Additional information

- .1 Prepare additional information sheets and annex to Operation and Maintenance Manual if during training sessions previously mentioned the need for such sheets is noted.

**1.17 “AS BUILT” DRAWINGS**

.1 Documents to keep on site:

- .1 Consultant to provide one (1) set of reproducible drawings (PDF format).
- .2 Provide required quantity of sets of copies for each phase of Work and indicate all changes as Work progresses.
- .3 Precise location of buried or concealed ductwork or piping to be indicated in accordance with benchmarks taken from set points. Also indicate on this copy of drawings the location of all junction box inspection panels.
- .4 Report information noted on copies of reproducible drawings weekly so that they show electrical equipment as actually installed.
- .5 Use permanent pen of red colour. Use pen of different colour for every other network.
- .6 Keep drawings on site and make sure they are available to interested parties for reference and verification purposes.

.2 Post completion drawings pertaining to each system.

- .1 Once work is completed, but before final acceptance, submit complete set of post completion drawings pertaining to each system.
- .2 Identify each drawing in the lower right corner with 12 mm high letters (minimum) stating “POST COMPLETION DRAWINGS: THIS DRAWING WAS REVIEWED AND SHOW ELECTRICAL EQUIPMENT AS ACTUALLY INSTALLED.” (Contractor’s signature) (Date).
- .3 Submit drawings to Consultant for approval. Make necessary corrections as specified by Consultant.
- .4 Perform tests and commissioning.
- .5 Submit reproducible copies of completed post completion drawings with Operation and Maintenance Manual.

**1.18 REMAINING OR NON-CONFORMING WORK**

- .1 Engineer to conduct succinct verification of work upon request by Owner. Contractor shall notify Engineer with time of verifications prior to concealment of Work (closing of walls, ceilings, etc.). Engineer shall submit a list of remaining or non-conforming work.
- .2 Engineer reserves the right to collect samples of products for analysis and testing.
- .3 Following corrective by Contractor and written confirmation that corrections were made, Engineer shall perform verification. If it were found that corrective is still necessary, any additional verification required by Engineer for this Work shall be invoiced to the Contractor, based on a hourly basis, through the Owner.
- .4 Despite succinct verifications conducted by Engineer, Contractor remains fully responsible for compliance to drawings and specifications.

### **1.19 QUALITY ASSURANCE**

- .1 Quality assurance: to relevant sections of architectural documents and Owner's requirements.
- .2 Pre-installation meeting
  - .1 Hold a meeting before start of Work in accordance with relevant sections of architectural documents and Owner's requirements. Meeting to consist in the following:
    - .1 Verify Work requirements.
    - .2 Assess state of facilities.
    - .3 Coordinate Work with work conducted by other building trades.
    - .4 Assess manufacturer's instructions regarding installation and terms of warranty provided by manufacturer.

### **1.20 HEALTH AND SAFETY**

- .1 Contractor to ensure safety on worksite.
- .2 Take necessary construction health and safety measures in accordance with relevant sections of architectural documents and Owner's requirements.
- .3 Obtain all permits and approvals from CNESST regarding temporary scaffolding or any other structure required for work at height, as well as installation involving increased risks (e.g. confined space).

### **1.21 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle materials and equipment in accordance with products' general requirements.
- .2 Deliver, store and handle materials and equipment in accordance with manufacturer's written instructions.
- .3 Deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .4 Store materials and equipment in clean, dry and well-ventilated area.
- .5 Protect materials and equipment against weather and any damage.
- .6 Replace defective or damaged materials and equipment with new.

### **1.22 WASTE MANAGEMENT AND DISPOSAL**

- .1 Construction/demolition waste management and disposal: Separate waste for reuse/recycling, including return by manufacturer of pallets, crates, padding and other packaging materials as specified in relevant sections of architectural documents and Owner's requirements.
- .2 Remove waste from site and forward to appropriate facilities while prioritizing recycling and reuse.
- .3 Place toxic or hazardous substances in designated containers.

- .4 Handle and dispose of hazardous material in accordance with the Canadian Environmental Protection Act, Transportation of Dangerous Goods Act, as well as with regional and municipal regulations.
- .5 Do not discharge paint product, sealer, coating, adhesive or any other product in sewer, watercourse, lake, soil or in any other location where it could pose a threat to health or environment.

### 1.23 QUESTIONS

- .1 Present Engineer with any additional question, in writing, regarding engineering work within reasonable period so that Engineer can address such question. No delay in completion of project caused by delay in turnaround will be accepted.

## Part 2 Products

### 2.1 DESIGN REQUIREMENTS

- .1 Operating voltages: to CAN3-C235.
- .2 Motors, electric heating, control and distribution devices and equipment to operate satisfactorily at 60 Hz within normal operating limits established by above standard.
  - .1 Equipment to operate in extreme operating conditions established in above standard without damage to equipment.
- .3 Language operating requirements: provide for the identification and display of nameplates or labels for control items in French.

### 2.2 MATERIALS AND EQUIPMENT.

- .1 Factory assemble control panels and component assemblies.

### 2.3 WARNING SIGNS

- .1 Warning Signs: in accordance with requirements.

### 2.4 WIRING TERMINATIONS

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

### 2.5 EQUIPMENT IDENTIFICATION

- .1 Identify electrical equipment with nameplates or labels as follows:
  - .1 Nameplates: lamicoid 3 mm thick plastic engraving sheet with black melamine face, and white core, lettering accurately aligned and engraved into core.
  - .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 Labels: embossed plastic labels with 6 mm high letters unless specified otherwise.
- .3 Wording on nameplates or labels to be approved by the Consultant and the Ministry representative prior to manufacture.
- .4 Allow for minimum of twenty-five (25) letters per nameplate or label.
- .5 Nameplates for terminal cabinets and junction boxes to indicate system and/or voltage characteristics.
- .6 Identify equipment with Size 3 labels engraved "ASSET INVENTORY NO. XX "as directed by Ministry representative.
- .7 Disconnects, starters and contactors: indicate equipment being controlled and voltage.
- .8 Terminal cabinets and pull boxes: indicate system and voltage.
- .9 Transformers: indicate capacity, primary and secondary voltages.

## 2.6 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.

## 2.7 CONDUIT AND CABLE IDENTIFICATION

- .1 Colour code conduits, boxes and metallic sheathed cables.
- .2 For conduits with a diameter of 35 mm or less, the conduits must be ordered in the colour indicated in the table below.
- .3 For conduits with a diameter larger than 35 mm the band of prime colour must be 25 mm wide and the auxiliary colour must be 20 mm wide.

	Prime Colour	Auxiliary Colour
Other Communication Systems	Green	Blue
Fire Alarm	Red	
Emergency Voice	Red	Blue
Other Security Systems	Red	Yellow

## 2.8 FINISHES

- .1 Shop finish metal enclosure surfaces by application of rust resistant primer inside and outside, and at least two coats of finish enamel.



**Part 3 Execution**

**3.1 EXAMINATION**

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable and allow the work to be performed in accordance with manufacturer's written instructions.
  - .1 Visually inspect surfaces.
  - .2 Disclose unacceptable conditions immediately upon discovery.
  - .3 Proceed with installation only after unacceptable conditions have been remedied.

**3.2 INSTALLATION**

- .1 Do complete installation in accordance with CSA C22.3 N°1 except where specified otherwise.

**3.3 NAMEPLATES AND LABELS**

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

**3.4 MOUNTING HEIGHTS**

- .1 Mounting height of equipment is from finished floor to centreline of equipment unless specified or indicated otherwise.
- .2 Install electrical equipment at following heights unless indicated otherwise.
  - .1 Lighting switches: 1,200 mm.
  - .2 Wall receptacles:
    - .1 General: 400 mm.
  - .3 Panelboards: as required by Code or as indicated.

**3.5 CO-ORDINATION OF PROTECTIVE DEVICES**

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

**3.6 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 the article PART 1 - ACTION AND INFORMATIONAL 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.

**3.7            SYSTEM STARTUP**

- .1        Instruct personnel identified by the Health Canada in operation, care and maintenance of systems, system equipment and components.

**3.8            CLEANING**

- .1        Leave Work area clean at end of each day.
- .2        Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment.
- .3        Clean and retouch painted workshop surfaces that have been scratched or damaged during transport and installation, use a paint type and color identical to the original paint.

**END OF SECTION**

**Part 1 General**

**1.1 RELATED REQUIREMENTS**

- .1 Section 26 05 00 – General Requirements

**1.2 RELATED WORKS**

- .1 Section 26 05 32 – Outlet Boxes, Conduit Boxes and Fittings
- .2 Section 26 27 26 – Wiring Devices

**1.3 REQUIREMENTS**

- .1 Pressure connectors for cables and junction connectors for lighting fixtures must comply with CSA C22.2 No. 65.
- .2 Flanges and connectors must comply with CSA C22.2 No. 18.
- .3 National Electrical Manufacturers Association (NEMA).

**Part 2 Products**

**2.1 MATERIALS**

- .1 Pressure type wire connectors with current carrying parts of copper, sized to fit conductors as required.
- .2 Fixture type splicing connectors with current carrying parts of copper, sized to fit copper conductors 10 AWG or less.
- .3 Bushing stud connectors: to EEMAC 1Y-2 to consist of:
  - .1 Connector body and stud clamp for copper.
  - .2 Clamp for copper conductors.
  - .3 Wire clamps.
  - .4 Stud clamp bolts.
  - .5 Bolts for copper conductors
  - .6 Sized for conductors, bars as indicated.
- .4 Clamps or connectors for armoured cable, aluminum sheathed cable, mineral insulated cable, flexible conduit, non-metallic sheathed cable as required.

**Part 3 Execution**

**3.1 INSTALLATION**

- .1 Remove insulation carefully from ends of conductors and:

- .1 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.
- .2 Install lighting fixture type connectors and tighten. Replace insulating cap.
- .3 Install bushing stud connectors in accordance with EEMAC 1Y-2.
- .4 Install connectors for outlet boxes in accordance with section 26 05 32.

**END OF SECTION**

**Part 1            General**

**1.1               RELATED REQUIREMENTS**

- .1       Section 26 05 00 – General requirements

**1.2               SHOP DRAWINGS AND PRODUCT DATA SHEETS**

- .1       Submit shop drawings and product data sheets in accordance with sections 01 33 00 and 26 05 01.

**1.3               GENERAL**

- .1       Unless otherwise indicated, electrical conductors are not indicated on drawings.
- .2       Supply and installation of all electrical conductors as well as connection of all equipment shown on drawings must be included in the bid.

**Part 2           Products**

**2.1               BUILDING WIRES**

- .1       Conductors: in copper, unless otherwise indicated. Minimum size of 12 AWG except for power outlet circuits. Minimum size 10 AWG for power outlets. Twisted strand conductors for sizes larger than 12 AWG.
- .2       Conductors: chemically crosslinked thermosetting polyethylene insulation type RW 90, designed for 600 V for circuits of less than 250 V and designed for 1,000 V for 600 V circuits.

**2.2               TECK TYPE CABLE**

- .1       Conductors:
  - .1       Grounding conductor: in copper.
  - .2       Circuit conductors: in copper, size as indicated.
- .2       Insulation:
  - .1       Ethylene propylene rubber EP dielectric index of type RW-90, 1,000 V.
- .3       Inner jacket: polyvinyl chloride material.
- .4       Overall covering: thermoplastic polyvinyl chloride.
- .5       Fastenings:
  - .1       Single-hole malleable iron straps to secure surface cables 50 mm (2") and smaller. Two-hole steel straps for cables larger than 50 mm (2").
  - .2       Channel type supports for two or more cables at 100 mm centres.
  - .3       Threaded rods: 6 mm (1/4") diameter to support suspended channels.
- .6       Connectors:

- .1 Watertight approved for TECK cable.

## **2.3 ARMOURED CABLES**

- .1 Conductors: insulated, in copper, size as indicated.
- .2 Type: AC90 - including an insulated "green" continuity conductor of the same gauge as the phase conductors in addition to the uninsulated MALT conductor.
- .3 Armour: interlocking type fabricated from galvanized steel strapping.
- .4 Connectors: Spin-On, Thomas & Betts Series II Compound Closing SC4, SC7, NB Series Corrosion Protection Envelope.

## **2.4 CABLES FOR FIRE ALARM & DETECTION SYSTEM**

- .1 Twisted 18 gauge solid copper wire, shielded with No. 22 AWG drain and red PVC jacket, 300 V, FAS-105 °C, approved for fire alarm, such as Belden # 9574 or equivalent.
- .2 16 gauge twisted solid copper wire with red PVC jacket, 300 V, FAS 105 °C, approved for fire alarm, such as Belden # 9572 or equivalent.
- .3 Twisted copper 12 gauge wire with red PVC jacket, 300 V, 105 °C, such as Belden # 9412 or equivalent.
- .4 # 16 AWG gauge for detection devices (manual, detector etc.) and # 14 AWG min. for speakers.

## **2.5 NON-METALLIC SHEATHED CABLE**

- .1 Non-metallic sheathed cable type: are not permitted.

## **Part 3 Execution**

### **3.1 INSTALLATION OF BUILDING WIRES RW-90**

- .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 ducts in accordance with Section 33.
  - .3 In distribution channels in accordance with Section 26 05 31.
  - .4 Use RW 90 type copper cables under piping for the connection of outlets, lighting, main electrical, secondary, heating, motor connections and coils as indicated (above ground).
  - .5 Use bare cables for grounding conductors installed in a metal electrical pipe.

### **3.2 INSTALLATION OF TECK90 CABLE (0 -1000 V)**

- .1 Install cables as indicated.
- .2 Group cables wherever possible on channels.
- .3 Use Teck cables as indicated on drawings.

### **3.3            INSTALLATION OF ARMOURED CABLES**

- .1      Group cables wherever possible on channels.
- .2      Secure ends of cables in accordance with Section 26 05 20.
- .3      Cables must be attached to the ceiling structure using appropriate fasteners (no tywraps) cables must not rest on suspended ceiling.
- .4      AC-90 cables (BX) must not be installed in gypsum board ceilings.
- .5      AC-90 cable: use armoured cable for the connection of lighting fixtures in T-Bars in suspended ceilings under the following conditions:
  - .1      No surface mounted or apparent BX cable is accepted.
  - .2      BX cable is used only for the last connection to lighting fixtures (3 metres maximum) recessed in ceilings.
  - .3      Armoured cable AC-90 is not permitted in rooms where there is no suspended ceiling, such as ceiling of mechanical rooms, electrical rooms, telephone room, elevator rooms, etc.
- .6      Cable AC-90: in suspended ceiling only, cables must only be used between junction box (power provided by conductors in conduits) and connection of outlets. Cables are permitted for connection of power outlets under all following conditions:
  - .1      Maximum length permitted for BX cable is 6 metres.
  - .2      Cable must not be apparent.

### **3.4            INSTALLATION OF FIRE PROTECTION CABLES**

- .1      Install wiring in conduits in accordance with section 26 05 34.

**END OF SECTION**

**Part 1 General**

**1.1 RELATED REQUIREMENTS**

- .1 Section 26 05 00 – General Requirements

**1.2 CONNECTED WORKS**

- .1 Section 26 05 34 – Conduits, Conduit Fastenings and Conduit Fittings

**1.3 SHOP DRAWINGS AND PRODUCT DATA SHEETS**

- .1 Submit shop drawings and product data sheets in accordance with sections 01 33 00 and 26 05 01.

**1.4 REFERENCES**

- .1 Grounding equipment in compliance with CSA standard C.22.2 N°04 and IEEE 837-02.

**Part 2 Products**

**2.1 EQUIPMENT**

- .1 Grounding conductors for networks, circuits and equipment: bare stranded copper, soft annealed, size as indicated.
- .2 Insulated grounding conductors: green, RW-90 conductors in compliance with section 26 05 21.
- .3 Ground bus: copper, size as indicated, complete with insulated supports, fastenings, connectors.
- .4 Non-corroding accessories necessary for grounding system, type, size, material as indicated, including but not necessarily limited to:
  - .1 Grounding and bonding bushings.
  - .2 Protective type clamps.
  - .3 Bolted type conductor connectors.
  - .4 Pressure wire connectors.
  - .5 Bonding jumpers, straps.
  - .6 Cable clamps
- .5 List of connectors:
  - .1 Corner connectors: Burndy type YGL-C.
  - .2 Grounding rod connectors: type YGLR-C.
  - .3 Galvanized grounding rod connectors: Burndy type YGHR-CTN.
  - .4 Compression connector and tap: Burndy type YGHC-C and YGHR-CTN.
  - .5 Static grounding receptacle for equipment: Burndy type YGT and YTTAG.
  - .6 Grounding plate: Burndy type YGF.
  - .7 Structural steel grounding connector: Gurndy type GSTUD.
  - .8 Threaded connector to rod: Burndy type GAR.



- .9 Grounding connector to water pipe: Burndy type GAR-BU.
- .10 Ground connector for two cables: Burndy type GD.
- .11 Grounding connector to strap, braid or cable: Gurndy type GG.
- .12 Clamp connector: Gurndy type GIE-G.
- .13 Grounding braid: Gurndy type B.
- .14 Threaded connectors: Gurndy types GB, GBM, GC, GCM, KC, K2C, and GZ.

## **2.2 Manufacturers**

- .1 Recognized manufacturers: Burndy, Electrovert, Homac.

## **Part 3 Execution**

### **3.1 INSTALLATION**

- .1 Install complete permanent, continuous grounding system for networks, circuits and equipment including, electrodes, conductors, connectors, accessories as indicated, so as to comply with requirements of the engineer and local authority having jurisdiction.
- .2 Install connectors in accordance with manufacturer's instructions.
- .3 Protect exposed grounding conductors from mechanical injury.
- .4 Use mechanical connectors for grounding connections to equipment provided with lugs.
- .5 Soldered joints not permitted.
- .6 Install bonding wire for flexible conduit, connected at both ends to grounding bushing, solderless lug, clamp or cup washer and screw. Neatly cleat bonding wire to exterior of flexible conduit.
- .7 Bond single conductor, metallic armoured cables to cabinet at supply end, and provide non-metallic entry plate at the other end.
- .8 Ground secondary service pedestals.
- .9 Ground electrostatic screens of transformers.

### **3.2 SYSTEM AND CIRCUIT GROUNDING**

- .1 Install system and circuit grounding connections to neutral of primary 600 V system, secondary 120/208 V system as indicated.

### **3.3 EQUIPMENT GROUNDING**

- .1 Install grounding connections to typical equipment included in, but not necessarily limited to following list. Service equipment, transformers and distribution panels.

### **3.4 GROUNDING BUS**

- .1 Ground items of electrical equipment in electrical room to ground bus with individual bare stranded copper connections size 2/0AWG or as indicated.

**3.5 FIELD QUALITY CONTROL**

- .1 Perform tests in accordance with Section 26 05 00 – Common Work Results for Electrical.

**END OF SECTION**

**Part 1 General**

**1.1 RELATED REQUIREMENTS**

- .1 Section 26 05 01 – General Requirements

**1.2 RELATED WORKS**

- .1 Section 26 05 34 – Conduits, Fastenings and Fittings

**Part 2 Products**

**2.1 SUPPORTS**

- .1 U shape, threaded rods, preshaped flanges, etc., must be used for supports. No staples, pre-pierced bands or other material of that nature are acceptable as supports.
- .2 Main equipment to be used for supports are:
  - .1 3/8 "Cadmium-Finished Galvanized Steel Suspension Rods with Suspension Rod Accessories, Hex Nut, Flat Washer, Flexible Nut, Flexibar Spring Nut, Flexibar Washer, Shank Bushing, Profile Bracket (T1-4), vertical support 3A1 and shelf support (ATHC).
  - .2 U-shaped profiles Flexibar type by Burndy (3H, 4H, 5H, H3H, H4H, H5H).
  - .3 Pierced profiles (3H, 4H, 5H).
  - .4 Flexibar cadmium steel bolts (bolts, nuts, washers).
  - .5 Flat connection plates: (1P1, 2P1, 3P1, 3P3, 4P1, 5P1, 4P7, 4P8, 4P2).
  - .6 Beam clamps series 2Q2-1, 4-1Q9-1, 1Q1-1, 1Q13-1, 1Q1-2, 1Q and band type Q.
  - .7 Coupling brackets series 4HFC1, 5HFC1, suspension adapter, FP4 series.

**2.2 MANUFACTURERS**

- .1 Recognized manufacturers: Electrovert Ltd., Unistrut Ltd., Canstrut.

**Part 3 Execution**

**3.1 INSTALLATION**

- .1 Secure equipment to solid masonry, tile and plaster surfaces with lead anchors or 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 Secure surface mounted equipment with twist clip fasteners to inverted T bar ceilings. Ensure that T bars are adequately supported to carry weight of equipment specified before installation.

- .5 Support equipment, conduit or cables using clips, spring loaded bolts, cable clamps designed as accessories to basic channel members.
- .6 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 (2") and smaller.
  - .2 Two-hole steel straps for conduits and cables larger than 50 mm (2").
  - .3 Beam clamps to secure conduit to exposed steel work.
- .7 Suspended support systems.
  - .1 Support individual cable or conduit runs with 6 mm diameter threaded rods and spring clips.
  - .2 Support 2 or more cables or conduits on channels supported by 6 mm (1/4") diameter threaded rod hangers where direct fastening to building construction is impractical.
- .8 For surface mounting of two or more conduits use channels at 1.5 m (5' 0") 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 Consultant.
- .13 Install fastenings and supports as required for each type of equipment cables and conduits, and in accordance with manufacturer's installation recommendations.
- .14 Plywood is provided in architect's drawings and specifications for affixing electrical equipment on finished walls of gypsum, concrete block or poured concrete finish.
- .15 All metal parts of the supports are galvanized or painted aluminum colour.

**END OF SECTION**

**Part 1 General**

**1.1 RELATED REQUIREMENTS**

- .1 Section 26 05 01 – General Provisions

**1.2 CONNECTED WORKS**

- .1 Section 26 27 26 – Wiring Devices

**1.3 REQUIREMENTS**

- .1 Outlet boxes, conduit boxes and fittings in compliance with CSA C22.1.

**Part 2 Products**

**2.1 OUTLET AND CONDUIT BOXES GENERAL**

- .1 Size boxes in accordance with CSA C22.1.
- .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 Combination boxes with barriers where outlets for more than one system are grouped.
- .6 In all service rooms and mechanical rooms, boxes must be cast steel, dust-tight, with factory threaded openings, and mounting brackets for surface mounting.

**2.2 GALVANIZED STEEL OUTLET BOXES**

- .1 One-piece electro-galvanized construction.
- .2 Single and multi-gang flush device boxes for flush installation, minimum size 75 x 50 x 38 mm (3" x 2" x 1 1/2") or as indicated. 102 (4") 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 50 x 50 mm (4" x 2" x 2").
- .4 102 mm (4") square or octagonal outlet boxes for lighting fixture outlets.
- .5 102 mm (4") outlet boxes with extension and plaster rings for flush mounting of recessed devices in finished walls with ceramic tile plaster.

**2.3 WELDED STEEL OUTLET BOXES**

- .1 CSA 5769 approved, entirely welded steel outlet boxes, air and water tight. No precut knock outs, grounding lug. Boxes equipped with a plaster ring entirely welded equipped with opening at all four corners for mounting screws in the uprights. Single group or double group as appropriate.
- .2 Box as fabricated by Roger Girard RPG series or approved equivalent.

**2.4 MASONRY BOXES**

- .1 Electro-galvanized steel masonry single and multi-gang boxes for devices flush mounted in exposed block walls.

**2.5 CONCRETE BOXES**

- .1 Electro-galvanized sheet steel concrete type boxes for flush mount in concrete with matching extension and plaster rings as required.

**2.6 FLOOR BOXES**

- .1 Concrete tight electro-galvanized cast steel double floor boxes, concrete grout-sealed floor boxes with adjustable finishing rings to suit floor finish with brass faceplate. Device mounting plate to accommodate short or long ear duplex or single receptacles. Box must be 95 mm (3¾ ") deep Hubbell model B4233 and plates (2) S3625 or equivalent.

- 2.7 "Monument floor" box for power outlets and telephone and computer outlets: rectangular, modular, wellmark FM4 model, 3 duplex 15 / 20A jacks and a compartment for combined telephone & computer output.

**2.8 CONDUIT BOXES**

- .1 Cast FS or FD cast iron alloy or aluminum boxes with factory-threaded hubs and mounting brackets for surface wiring of switches and outlets.

**2.9 FITTINGS - GENERAL**

- .1 Bushing and connectors with nylon insulated throats.
- .2 Knock-out fillers to prevent entry of debris.
- .3 Conduit outlet bodies for conduits up to 32 mm (1½") in diameter and pull boxes for larger conduits.
- .4 Double locknuts and insulated bushings on sheet metal boxes.
- .5 Products: Thomas and Betts or approved equivalent.
  - .1 Steel lock nut series Nos. 140 to 153.
  - .2 MALT Locknut Series 4001 to 4042.
  - .3 Connection for joining two casings side to side serial Nos. 1942 to 1954.
  - .4 Nylon insulated sleeves for rigid metal conduit series Nos. 8123 or 8973.
  - .5 Sealing ring with stainless steel retaining ring series Nos. 5302 to 5311.
  - .6 Nylon Insulated Lock Screw Connection Series Nos. 8125 to 8975.
  - .7 Malleable cast iron coupling series Nos. 674 to 687.
  - .8 Male enlarger series Nos. 1245 to 1247.
  - .9 BX single-wire cable coupling series 440 to 442.
  - .10 Nylon insulated concrete pressure screw connections series 8125 to 8975.
  - .11 Pressure screw coupling for concrete-tight TEM series 8124 to 8974.
  - .12 TEM threaded rigid steel combined coupling series Nos. 530 to 532.
  - .13 TEM Series 480 to 482 Series Rigid Pressure Screw Couplings.

- .14 Eccentric coupling series 1186 to 1188.
- .15 Power Cable Connector and Single Leads Series Nos. 2520 to 2596.
- .16 Waterproof Connector for LT38M LT200M Series Non-Metallic Flexible Conduit.
- .17 Sealed Fittings for Flexible Metal Conduit, Straight Fittings with Insulated Nylon Throat Series Nos. 5331 to 5386, 45 Degree Fittings, Series Nos. 5341 to 5350, 90 Degree Fittings, Series Nos. 5351 to 5360.
- .18 Waterproof adapter, rigid conduit with flexible conduit series Nos. 5271 to 5277.

## **2.10 SERVICE FITTINGS**

'High tension' receptacle fitting made of 2 piece stainless steel with brushed aluminum housing finish for one single, one duplex or two duplex receptacles as indicated. Bottom plate with two knockouts for centered or offset installation. 12 x 102 mm (4") extension piece as indicated.

- .1 Pedestal type 'low tension' fitting made of 2 piece stainless steel with brushed aluminum housing finish to accommodate two amphenol jack connectors, as indicated.

## **Part 3 Execution**

### **3.1 INSTALLATION**

- .1 Support boxes independently of connecting conduits.
- .2 Fill boxes with paper, sponges or foam or similar approved material to prevent entry of debris during construction. Remove upon completion of work.
- .3 For flush installations mount outlets flush with finished wall using plaster rings to permit wall finish to come within 6 mm (1/4") of opening.
- .4 Provide correct size of openings in boxes for conduit, mineral insulated and armoured cable connections. Do not install reducing washers.
- .5 Pedestal
  - .1 Protect the finish of boxes with a sheet of paper or plastic that will not be removed until all work is completed.
  - .2 Coordinate final location of boxes with Owner's Representative.

**END OF SECTION**

**Part 1        General**

**1.1            RELATED REQUIREMENTS**

- .1        Section 26 05 01 – General Requirements

**1.2            REFERENCES**

- .1        Canadian Standards Association (CSA International)
  - .1        CAN/CSA C22.2 No. 18, Outlet Boxes, Conduit Boxes, Fittings and Associated Hardware, A National Standard of Canada.
  - .2        CSA C22.2 No. 45, Rigid Metal Conduit.
  - .3        CSA C22.2 No. 56, Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit.
  - .4        CSA C22.2 No. 83, Electrical Metallic Tubing.
  - .5        CSA C22.2 No. 211.2, Rigid PVC (Unplasticized) Conduit.

**1.3            PLACEMENT OF CONDUITS**

- .1        Unless otherwise indicated, distribution conduits are not indicated on the plans. The supply and installation of the electrical cable network, as well as the connection of all the electrical equipment shown on the plans, must be included in the bid.

**1.4            SHOP DRAWINGS AND PRODUCT DATA SHEETS**

- .1        Provide shop drawings and product data in accordance with Sections 01 33 00 and 26 05 01.

**Part 2        Products**

**2.1            CONDUITS**

- .1        Rigid metal conduit: conform to CSA C22.2 No. 45, galvanized steel threaded.
- .2        Epoxy coated conduit: conform to CSA C22.2 No. 45, with zinc coating and corrosion resistant epoxy finish inside and outside.
- .3        Thin-walled electrical metallic tubing EMT: conform to CSA C22.2 N°83, with couplings to the size indicated.
- .4        Flexible metal conduit: conform to CSA C22.2 No. 56, liquid-tight flexible metal - steel.



## **2.2 CONDUIT FASTENINGS**

- .1 One-hole malleable iron straps to secure surface conduits with a diameter of 50 mm (2"), and smaller. Two-hole steel straps for conduits larger than diameter of 50 mm (2").
- .2 Beam clamps to secure conduits to exposed steel work.
- .3 Channel type supports for two or more conduits at 1.5 m (5'-0") on centre.
- .4 Threaded rods, 6 mm (1/4") mm diameter, to support suspended channels.
- .5 Expandable fastenings for poured concrete: series 3400-3 from Star.

## **2.3 CONDUIT FITTINGS**

- .1 Fittings: manufactured for use with conduit specified. Coating: same as conduit.
- .2 Ensure factory "ells" where 90 degrees bends for 27 mm (1") and larger conduits.
- .3 Watertight connectors and couplings for EMT.
- .4 Catalog numbers given hereunder are for conduits of 21 mm (3/4"). For all other caliber, fittings are of same series.
  - .1 Rigid fittings:
    - .1 Locknut T & B no 141.
    - .2 Sleeves T & B no 222.
  - .2 Metallic tubes "TEM":
    - .1 Zinc connectors: Iberville no 5006 IT.
    - .2 Zinc couplings: Iberville no 5106.
    - .3 Equivalent: O Z/Gedney.
  - .3 Flexible Conduits with PVC sheathes: fittings T & B no 5332, Appleton no STB 50.
  - .4 Flexible conduits: fittings T & B no 302, Appleton no 7230V.

## **2.4 EXPANSION FITTINGS FOR RIGID CONDUIT**

- .1 Weather-resistant expansion fittings, capable of withstanding linear expansion of 200 mm (8'-0 " ), and ensuring continuity of grounding system, 0 Z type EX and TX.
- .2 Watertight expansion fittings with integral bonding jumper suitable for linear expansion and 19 mm (3/4") deflection in all directions, and ensuring continuity of grounding network, 0 Z type EXE.

## **2.5 FISH CORD**

- .1 Polypropylene.

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**Part 3      Execution**

**3.1      INSTALLATION**

- .1 All work in division 26 must be in conduits responding to the following characteristics:
  - .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 Use rigid galvanized steel threaded conduit in locations where there is risk of damage.
- .4 Use epoxy coated conduit underground in corrosive areas.
- .5 Use electrical metallic tubing (EMT):
  - .1 For feeders of service and distribution panels.
  - .2 For branch circuit and auxiliary systems, low voltage lighting control.
  - .3 In suspended ceilings, masonry walls.
  - .4 For telephony, computer.
  - .5 For feeding of driving force.
  - .6 For fire alarm system.
- .6 Use rigid PVC conduit in the case of underground exterior installations and in the case of conduits installed under slab for buildings with slab on grade.
- .7 Use flexible metal conduit for connection to recessed incandescent fixtures without prewired outlet box, or connection to surface or recessed fluorescent fixtures in movable metal partitions.
- .8 Use liquid tight flexible metal conduit for connection to motors.
- .9 Use explosion proof flexible connection for connection to explosion proof motors.
- .10 Install conduit sealing fittings in hazardous areas. Fill with compound.
- .11 Bend conduit cold. Replace conduit if kinked or flattened more than 1/10th of its original diameter.
- .12 Mechanically bend steel conduit over 19 mm (3/4") diameter.
- .13 Field threads on rigid conduit must be of sufficient length to draw conduits up tight.
- .14 Install fish cord in empty conduits.
- .15 Run two (2) 50 mm (2") diameter (free) spare conduits up to ceiling. Terminate these conduits in 150 x 150 x 102 mm (6" x 6" x 4") junction boxes in ceiling space housed in the ceiling.

- .16 Remove and replace blocked conduit sections.
- .17 Dry conduits out before installing wire.

### **3.2 SURFACE CONDUITS**

- .1 Run parallel or perpendicular to building lines.
- .2 Locate conduits behind infrared or gas fired heaters with 1.5 m (5'-0") clearance.
- .3 Run conduits in flanged portion of structural steel if necessary.
- .4 Group conduits wherever possible on surface mounted channels.
- .5 Do not pass conduits through structural members except as indicated.
- .6 Do not locate conduits less than 75 mm (3") parallel to steam or hot water lines with minimum of 25 mm (1") at crossovers.

### **3.3 CONCEALED CONDUITS**

- .1 Do not install horizontal runs in masonry walls.
- .2 Do not install conduits in terrazzo or concrete toppings.
- .3 In drywall, horizontal ducting may be accepted provided that it travels at a minimum height of 2,440 mm (8'-0 ") from the floor and a maximum length of 2,540 mm (10'-0 ").

### **3.4 CONDUITS IN CAST-IN-PLACE CONCRETE**

- .1 Conduits in cast-in-place concrete are not permitted.

### **3.5 CONDUITS UNDERGROUND**

- .1 Slope conduits to provide drainage at lowest point. Pierce conduits and provide bed of gravel to ensure drainage.
- .2 Waterproof joints (PVC excepted) with heavy coat of bituminous paint.

**END OF SECTION**

**Part 1 General**

**1.1 RELATED REQUIREMENTS**

- .1 Section 26 05 01 – General Requirements

**1.2 CONNECTED WORKS**

- .1 Section 26 24 196.02 – Moulded Case Circuit Breakers

**1.3 SHOP DRAWINGS AND PRODUCT DATA**

- .1 Submit shop drawings and product data sheets in accordance with sections 01 33 00 and 26 05 01.
- .2 Shop drawings must indicate electrical characteristics of panelboards, type and number of branch circuit breakers, ampacity and dimensions of cabinet.

**1.4 FACTORY ASSEMBLY**

- .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.

**1.5 REQUIREMENTS**

- .1 Panelboards in accordance with CSA C22.2 No 29 and must be equipped with sprinkler angles.

**Part 2 Product**

**2.1 PANELBOARDS**

- .1 Panelboards: product of one manufacturer.
- .2 Panelboards with articulated trim (door to door option).
- .3 250 V panelboards: bus and breakers rated for 10 000 A (symmetrical) interrupting capacity or as indicated on drawings (select higher value).
- .4 600 V panelboards: bus and breakers with rated breaker capacity or as indicated on drawings.
- .5 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.
- .6 Panelboards: mains, number of circuits, and number and size of branch circuit breakers as indicated.
- .7 All panelboards must be equipped with same locking system. Provide two keys for each panelboard.
- .8 Copper bus and neutral bar of same nominal ampere rating of mains.

- .9 Mains: suitable for bolt-on breakers.
- .10 Trim and door finish: grey baked enamel.
- .11 Isolated ground bus.
- .12 Table with additional grounding busbar for connecting isolated grounding connectors to computer network when indicated on drawings.

## **2.2 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 If indicated, main breaker separately mounted on top or bottom of panel to suit cable entry. When mounted vertically, down position should open breaker.
- .4 Lock-on devices for receptacles, fire alarm circuit, emergency exit lights mechanical room circuits and elevator shafts and all emergency circuits as indicated on drawings.

## **2.3 EQUIPMENT IDENTIFICATION**

- .1 Provide equipment identification in accordance with Section 26 05 01.
- .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, mounted in plastic envelope at inside of panel door.

## **Part 3 Execution**

### **3.1 INSTALLATION**

- .1 Locate panelboards as indicated and mount securely, plumb, true and square, to adjoining surfaces.
- .2 Install surface mounted panelboards on fireproof and painted plywood backboard. Whenever possible, group boards on common fastening panel.
- .3 Mount panelboards to height specified in Section 26 05 01, or as indicated on drawings.
- .4 Connect loads to circuits as indicated.
- .5 Connect neutral conductors to common neutral bus when indicated on drawings.
- .6 Install circuit breakers as indicated.
- .7 Connect isolated grounding conductors to additional grounding bar of panelboard as indicated on drawings.
- .8 From each flush mounted panel, up to ceiling void, two (2) 50 mm (2") diameter (free) supply ducts must terminate in 150 mm x 150 mm x 102 (6"x 6" x 4") junction boxes housed in ceiling.

**END OF SECTION**

## **Part 1 General**

### **1.1 REFERENCES**

1.1.1 Canadian Standards Association (CSA) / CSA International.

- .1 CSA-C22.2 No. 5, Molded Case Circuit Breakers and Circuit Breaker Enclosures (UL 489, Tenth Edition, and NMX-J-266-ANCE, Second Edition).

### **1.2 SUBMITTALS / SUBMITTALS FOR APPROVAL / INFORMATION**

- 1.2.1 Submit data sheets in accordance with Section 20 33 00 Submittal Procedures.
- 1.2.2 Include current time characteristic curves for circuit breakers with a current rating of 100 A or greater or with a breaking capacity of 22,000 amps symmetric and greater, at line voltage.

## **Part 2 Products**

### **2.1 GENERAL REQUIREMENTS.**

- 1.2.2 Molded Case Circuit Breakers: Complies with CSA C22.2 Number 5.
- 1.2.3 Molded case circuit breakers, bolted to busbars: fast-closing, snap-action type, manual and automatic, with ambient temperature compensation of 40 ° C.
- 1.2.4 Common trigger circuit breakers: fitted with a single handle on multipole circuits.
- 1.2.5 Circuit breakers with instantaneous magnetic trip units, acting only when the current reaches the setting value.
- 1.2.6 Circuit breakers with trip units adjustable between 3 and 8 times rated current.
- 1.2.7 Circuit breakers with adjustable trip units, as indicated.
- 1.2.8 Breaking capacity according to that of the panel containing it or explicitly indicated.
- 1.2.9 Calibrated for continuous service at 100% of their rated current where stated explicitly.
- 1.2.10 Type certified as a switch when used as a lighting switch: for any lighting circuit not equipped with a light switch outside the electrical panel (type identified as SWD).

### **2.2 THERMAL MAGNETIC BREAKERS**

- 1.2.11 Molded case circuit breakers, automatic, actuated by thermal and magnetic trip units providing protection with time delay inversely proportional to the overload and instantaneous protection in the event of a short circuit.

### **2.3 MAGNETIC BREAKERS**

- 1.2.12 Automatic molded case circuit breakers, actuated by instant-acting magnetic trip units providing short-circuit protection: for special applications such as motor protection, if explicitly stated.
- .1 Install in all magnetic starters for protection of motors.

## **2.4 SHORT CIRCUIT CAPACITY**

- .1 C Due to the low impedance of modern transformers and harmonics, the minimum short-circuit capacity of circuit breakers will be as follows:
  - Secondary of a transformer from 0 to 45 KVA: 10 KA SYM at 120V.
  - At the secondary of a 75 KVA transformer: 14 KA SYM at 120V.
  - At the secondary of a transformer of 150 KVA: 22 KA SYM at 120V.

## **2.5 MANUFACTURERS**

- .1 Recognized manufacturers: Schneider Electric, Cutler-Hammer, GE and Siemens.

## **Part 3 Execution**

### **3.1 INSTALLATION**

- .1 Install circuit breakers as indicated.
- .2 Identify circuit breakers in accordance with requirements of Section 26 05 01.

### **3.2 COORDINATION**

- .1 Adjust magnetic and electronic trip units according to short circuit coordination diagram made by circuit breaker manufacturer.

**END OF SECTION**

**Part 1 General**

**1.1 RELATED REQUIREMENTS**

- .1 Section 26 05 01 – General Requirements

**1.2 CONNECTED WORKS**

- .1 Section 26 05 32 – Outlet Boxes

**1.3 SHOP DRAWINGS AND PRODUCT DATA SHEETS**

- .1 Submit in accordance with sections 01 33 00 and 26 05 01.

**1.4 REQUIREMENTS**

- .1 Universal Manual Switches: to CSA C.22.2 No. 111 for 120 V AC Switches.
- .2 Snap action switches: in accordance with CSA C.22.2 No. 55 for 347 V AC Switches.
- .3 Sockets and other wiring components: in accordance with CSA C.22.2 No. 42.
- .4 UL20 Listed with NEMA-WD-1 configuration.

**Part 2 Products**

**2.1 SWITCHES 120 V**

- .1 20 A, 120 V, single pole, double pole, three-way, four-way switches with a quiet operating system.
- .2 Manually operated general purpose AC switches with following features:
  - .1 Terminal holes approved for No. 10 AWG wire.
  - .2 Contacts: silver completely protected in an enclosure.
  - .3 Urea or melamine moulding for parts subject to carbon tracking.
  - .4 Suitable for back and side wiring.
  - .5 Toggle operated industrial quality.
  - .6 As indicated, supply a switch with a light indicator.
  - .7 Supplied in a case of polymerized material resistant to electric arcs.
  - .8 White colour.
- .3 Rocking operation, of adequate power for tungsten filament and fluorescent lamps, and used at 80% of the rated power of the motor loads.
- .4 Switches that control emergency equipment must be red.
- .5 Switches for low voltage control are such as model LMSW-101W or equivalent approved.
- .6 One manufacturer used for switches throughout project.
- .7 Approved manufacturers: Hubbell, Pass & Seymour and Leviton, wattstopper.



## **2.2 RECEPTACLES**

- .1 Duplex receptacles, CSA type 5-15 R, 125 V, 15 A, U ground, with following features:
  - .1 Nylon moulded housing.
  - .2 Suitable for No. 10 AWG for back and side wiring.
  - .3 Break-off links for use as split receptacles.
  - .4 Eight (8) back wired entrances, four side wiring screws.
  - .5 Industrial service, very robust, with flange captive and copper alloy captive, integrated grounding contacts, (neither riveted nor mechanically fixed).
  - .6 Acceptable products: Hubbell series HBL5262 or equivalent Bryant, Pass & Seymour.
- .2 Receptacles of one manufacturer throughout project.
- .3 Choice of colours for receptacles and line switches
  - .1 Normal circuit: brown unless otherwise indicated.
  - .2 Emergency circuit: red.
  - .3 Maintenance receptacle in corridor: yellow.
  - .4 In mechanical room: brown.

## **2.3 SPECIAL WIRING DEVICES**

- .1 Special wiring devices:
  - .1 Electrical Outlet: 15 amp or 15/20 A, 125 volt, ground fault, Hubbell manufacturer # GF-5252-I, or approved equivalent from recognized manufacturers.
  - .2 Pilot lights as indicated, with neon type 0.04 W, 125 V lamp and red plastic recessed type indicator.

## **2.4 COVER PLATES**

- .1 Equip all wiring devices with cover plates.
- .2 All cover plates must come from a single manufacturer.
- .3 Sheet steel utility box cover for wiring devices installed in surface mounted utility boxes.
- .4 Stainless steel 304, vertically brushed, 1 mm thick cover plates for recessed installation in bulkheads or monuments.
- .5 Cast cover plates for wiring devices mounted in surface mounted FS or FD type conduit boxes.

## **Part 3 Execution**

### **3.1 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 01, or as indicated.
- .4 Only screw connections are acceptable.
- .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 01, or as indicated.
  - .3 Where split receptacle has one portion switched, mount vertically and switch upper portion.
  - .4 Only screw connections are acceptable.
- .3 Cover plates:
  - .1 Protect finish of stainless steel cover plates with a sheet of paper or plastic not to be removed until all painting and other work are finished.
  - .2 Install suitable common cover plates where wiring devices are grouped.
  - .3 Do not use cover plates meant for flush outlet boxes on surface mounted boxes.
  - .4 Use 4 screws for weatherproof or heavy duty cover plates.
  - .5 When wiring devices are installed in walls with ceramic tiles, glazed blocks or other similar materials, install them centered on these blocks or tiles. Wiring devices should never be installed on the line separating dao from finished wall.

**END OF SECTION**

## **Part 1 General**

### **1.1 SUMMARY**

- .1 This specification describes a three-phase, in-line, double-conversion, uninterruptible power supply for 160 kVA/144 kW decommissioned to 120 kW load, permanent service and semiconductor, here referred to as UPS. UPS must be operated in conjunction with existing electrical system in building by providing conditioned backup power and distribution of power supply to critical loads. UPS includes main UPS module, backup battery between 8 and 10 at full load, service/bypass cabinet, and other features described in this document.

### **1.2 UPS SYSTEM DESCRIPTION**

- .1 UPS System Components: UPS system shall consist of the following main components:
  - .1 UPS module containing a Rectifier, Inverter, Battery Charger, Static Bypass, and associated Control and Monitor Panel.
  - .2 One or several Battery sealed type without release of gas and without addition of electrolyte string(s) in Line-and-Match Battery Cabinets.
  - .3 A bypass circuit with appropriate transformer integrated into a matching cabinet.

### **1.3 REFERENCES**

- .1 UL 1778 (Underwriters Laboratories) – Standard for Uninterruptible Power Supply Equipment. Product safety requirements for the United States.
- .2 CSA C22.2 No 107.1 (Canadian Standards Association) – Commercial and Industrial Power Supplies. Product safety requirements for Canada.
- .3 NEMA PE-1 – (National Electrical Manufacturers Association) – Uninterruptible Power Systems standard.
- .4 IEC 62040-1-1 (International Electrotechnical Commission) – Uninterruptible power systems (UPS) – Part 1-1: General and safety requirements for UPS used in operator access areas.
- .5 IEC 62040-1-2 (International Electrotechnical Commission) – Uninterruptible power systems (UPS) – Part 1-2: General and safety requirements for UPS used in restricted access locations.
- .6 IEC 62040-3 (International Electrotechnical Commission) – Uninterruptible power systems (UPS) – Part 3: Method of specifying the performance and test requirements.
- .7 IEEE 587 (ANSI C62.41) Category A & B (International Electrical and Electronics Engineers) – Recommended practices on surge voltages in low voltage power circuits.
- .8 CISPR 22: FCC Rules and Regulations 47, Part 15, Class A (Federal Communications Commission) – Radio Frequency Devices (prior to Feb 16, 2006).
- .9 MIL-HDBK-217E (Military Handbook) – Reliability prediction of electronics equipment

#### **1.4 SUBMITTALS**

- .1 UPS must be supplied with adequate documentation, including following manuals:
  - .1 Installation and operations manual: a copy of the installation and operations manual must be provided. It must be sufficiently detailed and clear to allow technicians or representatives to install and use UPS equipment. Manual to include the following elements:
    - .1 Description of UPS.
    - .2 Planning of UPS uncrating site.
    - .3 Installation of UPS.
    - .4 Installation of optional accessories.
    - .5 Operating principles of UPS.
    - .6 Operating procedures.
    - .7 Event log.
    - .8 Maintenance of UPS.
    - .9 Technical specifications.
    - .10 Wiring requirements and recommendations.
    - .11 Requirements and physical characteristics.
    - .12 Dimension of cabinets.

#### **1.5 QUALIFICATIONS**

- .1 UPS manufacturer shall have ISO 9001 certification for engineering/R&D, manufacturing facilities and service organization.
- .2 UPS manufacturer shall maintain a call center staffed 24 hours a day, seven days a week, all year (7 x 24 x 365) for technical and emergency support.
- .3 Field Engineering Support: UPS manufacturer shall directly employ a nationwide field service department staffed by factory-trained field service engineers dedicated to startup, maintenance, and repair UPS equipment. Organization shall consist of local offices managed from a central location. Field engineers shall be deployed in key populated areas to provide on-site emergency response within 24 hours. A map showing location of all field service offices must be submitted with proposal. Third-party maintenance will not be accepted.
- .4 Spare Parts Support: parts supplied shall be located in the field to provide 80% of all emergency needs. Factory shall serve as central stocking facility where a dedicated supply of all parts shall be available within 24 hours.
- .5 Product Enhancement Program: UPS manufacturer shall make available feature upgrade service offerings to all users as they are developed. These upgrades shall be available as optional field-installable kits.
- .6 Maintenance Contracts: A complete range of preventative and corrective maintenance contracts shall be provided and offered with proposal. Under these contracts, manufacturer shall maintain user's equipment to the latest factory revisions.

## **1.6 ENVIRONMENTAL REQUIREMENTS**

- .1 UPS shall withstand any combination of the following external environmental conditions without operational degradation.
  - .1 Operating Temperature: 0 °C to + 40 °C (32 °F to 104 °F) without derating (excluding batteries).
  - .2 Storage Temperature: - 25 °C to + 60 °C (- 13 °F to 140 °F). Prolonged storage above + 40 °C (104 °F) will cause rapid battery self-discharge.
  - .3 Relative Humidity (operating and storage): 95% maximum non-condensing.
  - .4 Elevation:
    - .1 Operational: 6,600 ft (2,000 m) maximum without derating.
    - .2 Transportation: capable of air transport.

## **1.7 SAFETY**

- .1 UPS shall be certified by Underwriters Laboratories in accordance with UL 1778.
- .2 UPS shall be certified by the Canadian Standards Association in accordance with CSA C22.2 No. 107.1-M91.

## **Part 2 Products**

### **2.1 UPS MODULE STANDARD FEATURES**

- .1 UPS module shall consist of following standard components:
  - .1 Rectifier/Charger: Rectifier/charger shall convert incoming AC power to regulated DC output for supplying inverter and for charging battery. Rectifier/charger shall be a high-frequency PWM design, using Insulated Gate Bi-polar Transistors (IGBTs). Modular design of UPS shall permit safe and fast removal and replacement of rectifier/charger module. Mean time to repair (MTTR) for module shall be no more than 30 minutes in order to return UPS to normal mode.
- .2 Monitoring and control components: following components shall provide monitor and control capability of UPS:
  - .1 Control panel with status indicators.
  - .2 Alarm and metering display.
  - .3 Building alarm monitoring.
  - .4 Control of inverter and bypass contactor.
  - .5 Communication ports.
- .3 Battery management system: UPS shall contain a battery management system
- .4 UPS module must be equipped with the following accessories:
  - .1 Integrated Service Bypass: a bypass and maintenance cabinet including transformers must be available. It must also include the following:
    - .1 All hardware and interconnecting wiring for connection to UPS module.
    - .2 Manual maintenance bypass switch to isolate UPS module from commercial AC input and critical load. Switch shall provide complete isolation of UPS for

servicing and, if necessary, complete removal and replacement of UPS while still providing bypass power to critical load. Cabinet must be one of two or three circuit breakers, with overlap and inter-damming by key or electric to prevent any false operation or loss of power supply to protected equipment.

- .2 SNMP Network Adapter and UPS Power Monitoring Software: SNMP adapters shall provide a communication interface between UPS module and SNMP-compatible network management systems. This capability shall allow unit to be monitored remotely over an Ethernet network using a standard web browser.
  - .1 UPS Power Monitoring Software: This system shall continuously monitor critical power elements associated with UPS, using communications port on each module and a customer furnished PC. System shall automatically give an alarm if any problems arise and notify local or remote personnel of alarm condition via email, pager, or text message as well as notifying onsite personnel.
- .3 UPS manufacturer must offer, without additional cost, a monthly report showing operating parameters and amount of information needed for remote monitoring at all times. It will be possible to provide notification of possible system failure and make necessary corrections (such as the eNotify program from Eaton).
  - .1 Note: to benefit from this function, user must possess an Ethernet network with access to one or several email addresses, and necessary permissions to send data collected, on a daily basis, to Powerware monitoring centre. A monthly report will then be sent to the client.
- .4 Battery Cabinet: battery cabinet shall feature valve regulated, high-rate discharge, lead-acid batteries which provide energy to critical load during a momentary loss of input power to rectifier. Batteries shall be flame-retardant in accordance with UL 94V2 requirements.
  - .1 Expected battery life: 200 complete full load discharge cycles when operated and maintained within specifications.
- .5 Battery voltage characteristics: UPS battery system must have the following characteristics:
  - .1 UPS module will automatically adjust battery shutdown based upon loading and battery capacity remaining.
  - .2 UPS module shall automatically adjust final discharge voltage between 1.67 and 1.75 V per cell based on existing load and rate and length of discharge.
  - .3 Absolute minimum operational voltage must be 1.67 V per cell (adjustable).
  - .4 Nominal Float Voltage: 2.25 V per cell.
  - .5 Equalizing Voltage: 2.38 V maximum per cell (adjustable).

## **2.2 NOMINAL CHARACTERISTICS OF UPS**

- .1 Nominal continuous power of UPS. Nominal power of UPS must be:
  - .1 160 kVA/144 kW stepped down to 120 kW.
  - .2 Maximum power factor for a charge of 0.9 lagging to 0.9 leading.
- .2 Rectifier/charger input:

- .1 Nominal three-phase input voltage: 600 volts VAC:
- .2 Four (4) wires, plus ground.
- .3 Operating range: + 10%, - 15% of the average rated input voltage, without battery discharge.
- .4 For 60 Hz systems, operating range for input voltage is between 55 and 65 Hz.
- .5 Power factor at input of 0.99 lagging.
- .6 Normal input current limit: UPS shall have the following programmable input current limit settings while operating in normal mode:
  - .1 Rectifier/charger input current limit shall be adjustable from 100% to 115% of full-load input current.
  - .2 Battery input current limit shall be adjustable from 10% to 15% of UPS full load input current regardless of actual load on UPS.
- .7 On generator input current limit: UPS shall have the following programmable input current limit settings while operating in normal mode on generator:
  - .1 Rectifier/charger input current limit shall be adjustable from 100% to 115% of full-load input current.
  - .2 Battery recharge input current limit shall be adjustable from 10% to 15% of UPS full load input current regardless of actual load on UPS.
- .8 Input current total harmonic distortion (THD) shall be less than 4.5%.
- .9 Power walk-in: ramp-up to full utility load adjustable from 3 seconds to 60 seconds.
- .3 Bypass input:
  - .1 Synchronizing bypass voltage range shall be +/- 10% of average nominal input voltage.
  - .2 Synchronizing bypass frequency range is centered on nominal frequency.
  - .3 Input surge withstand capability: UPS shall be in compliance with IEEE 587 (ANSI C62.41), category A & B (6 kV).
  - .4 Rectifier/charger output:
    - .1 Output voltage shall be 120/208 V AC., 3-phase, 4-wire, double neutral.
    - .2 Steady state voltage must be regulated at +/- 0.5%.
    - .3 Voltage ripple must be less than 0.5% (peak-to-peak).
  - .5 Capacity: rectifier/charger shall support a fully loaded inverter and recharge battery to 90% of its full capacity within 10 times the discharge when input current limit is set at maximum.
  - .6 Low line operation: rectifier/charger shall be capable of sharing DC load with battery when input voltage falls below specified operation input voltage range, battery indicator shall enunciate operation in this mode.
  - .7 Battery equalizing: it must be possible to equalize battery system automatically or manually.
  - .8 DC sensing: redundant DC voltage sensing methods shall be incorporated for providing battery over-voltage protection.

- .4 UPS output in normal mode:
  - .1 Nominal output voltage: 208 V AC, three-phase, 3-wire or 4-wire (or 480 V, three-phase, 3-wire or 4-wire) plus ground at output of Integrated Distribution and Bypass cabinet. Output wiring configuration is based upon input wiring configuration for systems without internal transformers.
  - .2 Steady-state voltage regulation (in inverter): shall be within  $\pm 1\%$  average from nominal output voltage.
  - .3 Transient voltage response: shall be  $< \pm 5\%$  from nominal voltage for 100% load step, full load re-transfers and full load drop on battery.
  - .4 Transient voltage recovery: 25 ms to within  $\pm 1\%$  of steady state.
  - .5 Linear load harmonic distortion capability: output voltage THD of less than 2% for 100% linear load.
  - .6 Non-linear load harmonic distortion capability: output voltage THD of less than 5% for 100% non-linear load when tested using non-linear load described in IEC 62040-3 connected line to neutral.
  - .7 Manual output voltage adjustment: shall be  $\pm 3\%$  from nominal.
  - .8 Line synchronization range: shall be  $\pm 3$  Hz, adjustable to  $\pm 5$  Hz.
  - .9 Frequency regulation: shall be  $\pm 0.01$  Hz free running.
  - .10 Frequency slew rate: shall be 1 Hz/second maximum (adjustable).
  - .11 Phase angle control:
    - .1 Balanced linear load: shall be  $\pm 1$  degree from nominal 120 degrees.
    - .2 Unbalanced linear loads: shall be less than  $\pm 5$  degrees from average phase voltage for 100% load unbalance.
  - .12 Phase voltage control:
    - .1 Balanced linear loads: shall be  $\pm 1\%$  from average phase voltage.
    - .2 Unbalanced linear loads: shall be less than  $\pm 5\%$  for 100% load unbalanced.
  - .13 Overload current capability (with nominal line and fully charged battery): unit shall maintain voltage regulation for up to 110% of resistive/inductive load for 10 minutes, up to 125% for 30 seconds, and up to 150% for 10 seconds.
  - .14 Fault clearing current capability: 150% phase-to-phase for 10 cycles; 300% phase-to-neutral for up to 10 cycles.
  - .15 Static transfer time: no break, completed in less than 4 ms.
  - .16 Common mode noise attenuation:
    - .1 -65 dB up to 20 kHz, -40 db up to 100 kHz.
    - .2  $> 100$  dB with isolation transformer.
  - .17 Acoustical noise: noise generated by UPS under normal operation shall not exceed 65 dbA one meter from any operator surface, measured at 25 °C (77 °F) and full load.
  - .18 EMI Suppression: UPS shall meet FCC rules and regulation 47, part 15, for Class A devices prior to Feb 16, 2006, CISPR.



.19 Electrostatic discharge (ESD): UPS shall meet IEC 801-2 specifications. UPS shall withstand a 25 kV pulse without damage and with no disturbance or adverse effect to critical load.

.20 Efficiency: UPS efficiency shall be up to 94%.

## **2.3 CONTROLS AND INDICATORS**

- .1 Microprocessor controlled circuitry: UPS controls shall have the following design and operating characteristics:
  - .1 Fully automatic operation of UPS shall be provided through use of microprocessor controlled Digital Signal Processing. DSP shall eliminate variances from component tolerance or drift, and provide consistent operational responses.
  - .2 All operating and protection parameters shall be firmware controlled, thus eliminating the need for manual adjustments. Logic shall include system test capability to facilitate maintenance and troubleshooting. Printed circuit board replacement shall be possible without requiring calibration.
  - .3 Start-up and transfers shall be automatic functions.
- .2 Digital Front Panel Display: UPS control panel shall be a digital front panel display that features an 8 x 40 (8 lines, each with 40 characters) backlit LCD display. LCD shall display UPS status, metering, battery status, alarm/event queue, active alarms and UPS configurations. Front panel display shall show a system mimic diagram with an outlined power path, current operating mode and event logs.
- .3 Control Panel Indicators: UPS control panel shall provide the following monitoring functions with indicator LEDs:
  - .1 NORMAL: indicates that commercial AC utility or generator source is supplying power to rectifier and inverter is supporting critical load. A text message shall indicate if bypass line is not within tolerance.
  - .2 BYPASS: indicates that UPS has transferred load to bypass circuit.
  - .3 BATTERY: indicates that commercial AC utility or generator source has failed and battery is supplying power to inverter, which is supporting load. A text message shall indicate if battery charge is low or if battery is installed, but disconnected.
  - .4 ALARM: indicates that UPS detects an alarm condition, outlined in detail in operator's manual.
- .4 Control Panel Controls: UPS control panel shall provide the following functions from front panel push buttons:
  - .1 EVENTS: displays list of Active System Events and a historical log of system events. Historical logs shall include a detailed time stamped list of latest 128 events.
  - .2 METERS: displays performance meters for system or critical load. When selected, front display shall show individual screens of input parameters, output parameters or bypass parameters including: voltage, current and frequency. In addition, battery display shall show runtime remaining.
  - .3 CONTROLS: displays a System Controls screen. Allows selection of operating mode, normal, bypass, charger on/off and Power Module on/off.
  - .4 SETUP: allows display contrast, date and time information serial communication port configuration and display of firmware revision numbers.

- .5 RETURN: confirms selection or returns to previous screen.
- .5 Interface panel: UPS shall be equipped with an interface panel, located behind a protective cover, which provides the following signals and communication features in a Class 2 environment:
  - .1 Alarm contact: a dry contact for annunciating a summary alarm shall be provided for customer use. This contact shall be Form "C" capable of supplying both N/O and N/C contacts. Contact ratings shall be 5A max at a voltage not to exceed 28 V DC or 120 V AC.
  - .2 RS232 (EIA/TIA-232) communications interface: circuitry shall be provided for one RS232 (EIA/TIA-232) communication port for connection to automated service department diagnostic tools. This port may be used with simple ("dumb") terminals to gain remote access to all unit operation information.
  - .3 Building alarms: two inputs shall be provided for monitoring status of external dry contacts. Building alarms shall be set up through UPS configuration mode function on RS232 (EIA / TIA-232) port.
  - .4 External EPO contacts: provided to connect an external remote emergency power off switch to shutdown UPS and de-energize critical load.
  - .5 Battery control contacts: contacts shall be provided to connect battery UVR and auxiliary signals from a battery breaker or battery disconnect switch.
  - .6 External bypass indicator connection: a connection point shall be provided to acknowledge that an external maintenance bypass has been closed around UPS, placing critical load on utility power.

## **2.4 COMMUNICATION**

- .1 Communications Bay: UPS shall be equipped with field configurable communications bays that will accommodate two (2) communication devices. A communication bay upgrade shall be available to increase quantity of communication devices up to four (4).
- .2 Remote Monitoring:
  - .1 Optional WEB/SNMP communication capabilities will be available for all systems.
  - .2 UPS shall be able to be monitored remotely via communications devices. UPS manufacturer shall provide optional communications devices capable of communicating via various industry standard protocols such as RS232 and ModBus. Monitoring of UPS status may also be performed through isolated dry contact Form C relays.
  - .3 Remote monitoring of UPS shall also be possible through status indicators elsewhere in same facility through device that replicates these indicators.
- .3 UPS communication capability should be able to integrate into any industry standard Building Management System (BMS) and/or Network Management System (NMS). UPS must also be able to be monitored via any standard Internet browser (i.e. Internet Explorer and Netscape).
- .4 All optional hardware interfaces shall be "Hot-swappable" (UPS maintains power to critical applications while changing interfaces).
- .5 Shutdown:

- .1 There shall be a mechanism that provides graceful, orderly, unattended, sequential shutdown of one or multiple computers powered by one UPS. This shutdown shall be performed via in-network or out-of-network means. Order of shutdown shall be user-defined, allowing maximization of runtime on battery for more critical systems.
- .2 Shutdown of AS/400 computers shall be possible through open-collector relay contacts or isolated, dry contact, Form-C relays.
- .3 UPS shall also be capable of interfacing with an operating system's built-in shutdown routine, e.g. Windows NT. This shall be done through a cable connection to optional serial port on UPS.
- .6 Notification:
  - .1 There shall be a mechanism to send alerts to key personnel via email or SNMP traps. An alarm notification may also be sent through network message.
  - .2 Dial-out to a computer for alarm notification may be performed. User may respond by dialing-in to retrieve alarm history and summary of current meter status.
- .7 Management: a remote battery test may be performed via an Ethernet network. UPS shall be tested through invoking a single command.

## **2.5 GROUNDING**

- .1 Neutral AC output must be electrically isolated from UPS console. UPS console must have an equipment grounding terminal.

## **Part 3 Execution**

### **3.1 START-UP**

- .1 Factory start-up shall be provided on a 5 x 8 basis (7 x 24 optional). Start-up service shall be provided at no extra charge and shall include one visit to perform all procedures and tests specified within UPS Installation and Operation manual. UPS manufacturer shall also offer the following optional services:
  - .1 Pre-energize visit to inspect installation and provide guidance to installers as required.
  - .2 Post-start-up visit for alarm notification configuration, operator training, generator testing, etc.
- .2 The following procedures and tests shall be performed by Field Service personnel during UPS start up:
  - .1 Visual Inspection:
    - .1 Visually inspect all equipment for signs of damage or foreign materials.
    - .2 Observe type of ventilation, cleanliness of room, use of proper signs, and any other safety related factors.
  - .2 Mechanical Inspection:
    - .1 Check all power connections for tightness.
    - .2 Check all control wiring terminations and plugs for tightness or proper seating.
  - .3 Electrical Pre-check:

- .1 Check DC bus for possible short circuit.
  - .2 Check input and Bypass power for proper voltages and phase rotation.
  - .3 Check all lamp test functions.
- .4 Initial UPS Start-up:
  - .1 Verify that all alarms are in a “go” condition.
  - .2 Energize UPS module and verify proper DC, walk-up, and AC phase on.
  - .3 Check DC link holding voltage, AC output voltages, and output waveforms.
  - .4 Check final DC link voltage and Inverter AC output. Adjust if required.
  - .5 Check for proper synchronization.
  - .6 Check for voltage difference between Inverter output and Bypass source.
  - .7 Optional on site full-load, step-load, and battery discharge tests using supplier furnished load bank, shall also be offered.
- .3 Operational Training: before leaving site, field service engineer shall familiarize responsible personnel with the operation of UPS. UPS equipment shall be available for demonstration of modes of operation.

### **3.2 WARRANTY**

- .1 All components of UPS system shall be covered by a standard one-year limited factory warranty and service protection package.
- .2 One-year limited factory warranty shall include repair/replacement coverage without charge on site (parts and labour) during normal operating hours (8 AM to 5 PM) within 250 km of nearest service centre.
- .3 One-year service protection package shall include free of charge 7x24 on-site repair/replacement labor for UPS parts and batteries during normal office hours (8 AM to 5 PM), one (1) performance and preventative visit for UPS unit, one (1) performance and preventative visit for UPS unit. 7x24 technical support coverage; and 7x24 remote monitoring service (with monthly reports for UPS and battery performance). Standard response time shall be 8 hours from receipt of call. Manufacturer shall also offer, as an option, 7x24 on-site service support with guaranteed response times of 4, or 2 hours in certain major metropolitan areas. Additional preventive maintenance visits shall be available as an option for both UPS and battery components. Optional 7x24 maintenance must include minor maintenance for the 100 to 160 kVA appliances.
- .4 Manufacturer shall also include start-up services consisting of: UPS start-up service and battery(s) during normal business hours (8 AM to 5 PM), user training at installation site, auditing of the site, installing and setting up monitoring service and validating manufacturer's limited warranty for a period of two years.
- .5 In order to provide additional protection, manufacturer must also offer an optional maintenance plan for UPS and battery system(s) in the form of preventative and corrective work, guaranteed response time, option for remote supervision, internet access allowing user to consult maintenance history onsite, yearly inspection of site, preventative maintenance visit of UPS and battery system(s) as well as discount on technical upgrades and modifications. Manufacturer must also provide a partial or

complete, optional and distinct maintenance plan for battery systems offering replacement protection through preventative maintenance or replacement.

- .6 7x24 warranty on 100 to 160 models also includes one minor preventative maintenance visit per year.

### **3.3 MANUFACTURES**

- .1 Recognized Manufacturer: Eaton, Schneider and Liebert.

**END OF SECTION**

**Part 1 General**

**1.1 CONTENT OF SECTION**

- .1 Emergency lighting system materials and equipment, and installation of such products.

**1.2 REFERENCES**

- .1 CSA International
  - .1 CSA C22.2 No. 141-10, Emergency Lighting Equipment.

**1.3 MANUFACTURERS**

- .1 Manufacturers likely to provide equivalent products: Lumacell and AimLite.

**Part 2 Products**

**2.1 EQUIPMENT**

- .1 Emergency lighting equipment: to CSA C22.2 No. 141.
- .2 Supply voltage: 347 V, AC.
- .3 Output voltage: 12 V DC.
- .4 Operating time: 30 minutes.
- .5 Battery: sealed, maintenance free, power of battery must be determined according to load connected to 80% of rated power of battery for 30 minutes of operation.
- .6 Charger: solid state, multi-rate, voltage/current regulated, inverse temperature compensated, short circuit protected with regulated output of plus or minus 0.01 V for plus or minus 10% input variations.
- .7 Solid state transfer circuit.
- .8 Low voltage disconnect: solid state, modular, operates at 80% battery output voltage.
- .9 Signal lights: solid state, for 'AC Power ON' and 'High Charge'.
- .10 Lamp heads: integral on unit, 360 degrees horizontal and 180 degrees vertical adjustment. Lamp type DEL.
- .11 Cabinet: suitable for direct or shelf mounting to wall and c/w knockouts for conduit. Removable or hinged front panel for easy access to batteries.
- .12 Finish: white.
- .13 Accessories:
  - .1 Ammeter.
  - .2 Voltmeter.
  - .3 Test switch.
  - .4 Time delay relay.

- .5 Battery disconnect device.
- .6 AC input and DC output terminal blocks inside cabinet.
- .7 Cord and plug connection for AC.
- .8 RFI suppressors.
- .9 Silent monthly self-test devices that meet requirements of National Code of Canada.

**2.2 WIRING OF REMOTE HEADS**

- .1 Conduit: type EMT, in accordance with Section 26 05 34 – Conduits, Conduit Fastenings and Conduit Fittings.
- .2 Conductors in accordance with Section 26 05 21 – Wires and Cables (0-1000 V), sized in accordance with manufacturer's recommendations.

**Part 3 Execution**

**3.1 INSTALLATION**

- .1 Install self-contained lighting units as well as remotely mounted projectors as indicated.
- .2 Orient projectors as indicated.

**END OF SECTION**