



**Publics Works and Government  
Services Canada (PWGSC)**

**Saint-Anne-Des-Plaines Establishment**

**Pumping Station  
Modifications - Ventilation**

**# R.066564.001/342-4203**

**SR4 – FOR TENDER**

**Technical specifications**  
**Mechanical/Electrical**

October 24, 2014

O/Réf.: 056-P-0004293-0300-GN-0002-00

**DESSAU**

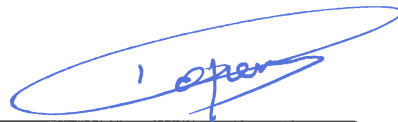


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**Technical specifications  
Mechanical/Electrical**

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REGISTRE DES RÉVISIONS ET ÉMISSIONS		
N° DE RÉVISION	DATE	DESCRIPTION DE LA MODIFICATION ET/OU DE L'ÉMISSION
00	2014-10-24	SR4 – For Tender "This document shall not be used for construction"
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**Division 01 / Generalities**

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## **PARTIE 1 - GENERAL**

### **1.1 RELATED SECTIONS**

- .1 This section is general in nature and refers to information that can be connected to each section of the tender documents.

### **1.2 WORK COVERED BY CONTRACT DOCUMENTS**

- .1 The work covered by this contract includes the improvement of the ventilation systems in the chlorine room and at the pumping station at the Sainte-Anne-des-Plaines penitentiary complex.

### **1.3 COORDINATING WORK**

- .1 During construction, the Owner may allow other contractors or workers to travel or work near the areas covered by this mandate.
- .2 The contractor shall coordinate its own work as well as his signs so they do not conflict with other contractors or workers and carry out the instructions of the Ministerial Representative.

### **1.4 WORK SEQUENCE**

- .1 During construction, coordinate the progress schedule according to the occupancy by the Owner.
- .2 Execute work by phases, so that the Owner can use the premises continuously during construction. Maintain the site traffic lanes available at all times.
- .3 Maintain access for the fire fighters as well as a means to fight fires.
- .4 Delays in completion of the work are 8 weeks (56 calendar days) from the authorization to start the work.
- .5 To meet deadlines, the Contractor must provide the necessary working teams.

### **1.5 CONTRACTOR USE OF PREMISES**

- .1 The use of the premises is restricted to areas needed for the work or storage and access to allow:
  - .1 The occupation of the premises by the Owner
  - .2 The performance of work by other contractors;
  - .3 The use of the premises by the public;

- .2 Coordinate use of premises as directed by the Ministerial Representative.
- .3 Find an additional area for work or storage required for execution of work under this contract and pay the cost.
- .4 Removing or modify existing structures to prevent damage to the parts that must remain in place.
- .5 Repair or replace, as directed by the Ministerial Representative, for connection to the existing structure or an adjacent structure, or to harmonize with them, those parts of the existing structure that have been changed during construction.
- .6 Once the work is completed, the existing structure must be returned to its original or better condition.

## **1.6 OWNER OCCUPANCY**

- .1 The building Owner will occupy the premises for the duration of the construction and will continue normal operations during this period.
- .2 Cooperate with the Owner of the facility for the scheduling of work, so as to reduce conflict and facilitate the operation of premises.

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

- .1 Execute work in minimal disruption to the operation of the building occupants, the public and the normal use of the premises. Make arrangements with the Ministerial Representative to facilitate the work.

## **1.8 EXISTING SERVICES**

- .1 Prior to cutting services to utilities, notify the Ministerial Representative at least 48 hours before the scheduled time of interruption, and the utility companies involved, and obtain the necessary permits.
- .2 If performing connections on existing utility lines, give the Ministerial Representative prior notice of 48 hours before the planned interruption of electrical and mechanical services. Ensure that the duration of interruptions is as short as possible. Perform the work hours set by local authorities in minimizing interference with pedestrian and vehicular traffic.
- .3 Before work begins, define the extent and location of utility lines that are in the work area and notify the Ministerial Representative.
- .4 Submit for approval by the Ministerial Representative a schedule for the shutdown or closure of facilities or assets of books, including the interruption of communications services or

electricity supply. Respect the agreed timetable and inform the parties affected by these drawbacks.

- .5 Provide temporary utilities, as directed by the Ministerial Representative, so that critical systems are maintained to the building.
- .6 Where systems not listed are discovered, immediately notify the Ministerial Representative and write them down.

## **1.9 DOCUMENTS REQUIRED**

- .1 Maintain on site a copy of each of the following documents.
  - .1 Contract Drawings;
  - .2 Work;
  - .3 Addenda;
  - .4 Shop Drawings reviewed;
  - .5 List of shop drawings unedited;
  - .6 Change Orders;
  - .7 Other changes to the contract;
  - .8 Reports of tests conducted on site;
  - .9 Copy of approved implementation schedule;
  - .10 Map of health and safety and other documents relating to safety;
  - .11 Schedule;
  - .12 Other documents indicated.

**END OF SECTION**





## **PARTIE 1 - GENERAL**

### **1.1 RELATED SECTIONS**

- .1 This section is general in nature and refers to information that can be connected to each section of the tender documents.

### **1.2 USE OF SITE AND FACILITIES**

- .1 Execute work with least possible interference or disturbance to normal use of premises. Make arrangements with Ministerial Representative to facilitate work as stated.
- .2 Maintain existing services to building and provide for personnel and vehicle access.
- .3 Where security is reduced by work, provide temporary means to maintain security.
- .4 Provide and maintain sanitary facilities and allow access for Ministerial Representative.
- .5 The work carried out at the Regional Reception Centre (zone of maximum security) must always allow traffic on the way to the perimeter and access to the entrance of the CRR. Provide temporary planning in accordingly.

### **1.3 ALTERATIONS, ADDITIONS OR REPAIRS TO EXISTING BUILDING**

- .1 Execute work with least possible interference or disturbance to building operations, occupants, public and normal use of premises. Make arrangements with the Ministerial Representative to facilitate work as stated.

### **1.4 EXISTING SERVICES**

- .1 Advise the Ministerial Representative and the utility companies from any interruption of services and obtain the required authorisation.
- .2 Notify the Ministerial Representative at least 48 hours before stitching on existing networks. Ensure that the duration of interruptions is as short as possible. Make interruptions after normal working hours, preferably on weekends.
- .3 Ensure the movement of personnel, pedestrians and vehicles.

### **1.5 SPECIAL REQUIREMENTS**

- .1 Sequencing work based on achieving the following constraints:

- .1 The full access to technical rooms must be maintained at all times during the construction.
- .2 Work must be executed as specified in Section 01 35 13 – Safety requirements.
- .2 Submit a work schedule according to the method of work scheduling - Bar (GANTT).
- .3 Ensure that staff working on site is aware of and comply with regulations, including regulations for fire safety, traffic and safety.
- .4 The vehicle access to the site of the entrepreneur is limited to the planned construction trailers and parking areas.
- .5 In times of work on the access road that require lane restrictions, ensuring that traffic is ensured by flaggers during peak hours between 7:15 and 8:15 and between 15:30 and 16:15.
- .6 Ensure that materials/equipment is delivered outside peak hours, between 7:15 and 8:15 and between 15:30 and 16:15, unless otherwise directed by the Representative the Department.
- .7 In the area of Regional Reception Centre (RRC), a maximum of two (2) teams work is allowed: one inside the security perimeter and the other one outside. In any case, the Contractor will be allowed to operate two (2) teams working in the same security zone in the area of RRC.

## **1.6 SECURITY**

- .1 In addition to the section 01 35 13.
- .2 Provide temporary means to maintain security if it was reduced because of the work covered by this contract.
- .3 Security clearances:
  - .1 Personnel employed on this project will be subject to security check.
  - .2 Obtain the required authorization from the Ministry, as indicated, for those who must be present on the work site.
  - .3 Within the secure area, the workers and staff members will be monitored daily at the beginning of the work period, and we will give a pass they must carry with them at all times and return at the end of the work period after checkout.
  - .4 The Contractor personnel must pass a security check before they go on site to perform the work. The form to be filled will be provided to the contractor and should be given at least seven days before the scheduled start of work.

## **1.7 BUILDING SMOKING ENVIRONMENT**

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

**END OF SECTION**



## **PARTIE 1 - GENERAL**

### **1.1 RELATED SECTIONS**

- .1 This section is general in nature and refers to information that can be connected to each section of the tender documents.

### **1.2 ADMINISTRATIVE**

- .1 Submit to Ministerial 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 thus 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 Ministerial 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 Ministerial Representative, in writing at time of submission, identifying deviations from requirements of contract documents stating reasons for deviations.
- .7 Verify field measurements and affected adjacent work are co-ordinated.
- .8 Contractor's responsibility for errors and omissions in submission is not relieved by Ministerial Representative's review of submittals.
- .9 Contractor's responsibility for deviations in submission from requirements of Contract Documents is not relieved by Ministerial Representative's review.
- .10 Keep one reviewed copy of each submission on site.

### **1.3 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 a professional engineer member of Ordre des ingénieurs du Québec.
- .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 10 days for Ministerial Representative's review of each submission.
- .5 Adjustments made on shop drawings by Ministerial Departmental are not intended to change contract price. If adjustments affect value of work, state such in writing to Ministerial Representative prior to proceeding with work.
- .6 Make changes in shop drawings as Ministerial Representative may require, consistent with contract documents. When resubmitting, notify Ministerial Representative in writing of revisions other than those requested.
- .7 Accompany submissions with transmittal letter 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 Ministerial Representative's review, distribute copies.
- .10 Submit six (6) paper copies of shop drawings for each requirement requested in specification Sections and as Ministerial Representative may reasonably request.
- .11 Submit six (6) paper copies of product data sheets or brochures for requirements requested in specification Sections and as requested by Ministerial Representative where shop drawings will not be prepared due to standardized manufacture of product.
- .12 Submit six (6) paper copies of test reports for requirements requested in specification Sections and as requested by Ministerial Representative.
  - .1 Report signed by authorized official of testing laboratory that material, product or system identical to material, product or system to be provided has been tested in accord with specified requirements.
  - .2 Testing must have been within 3 years of date of contract award for project.

- .13 Submit six (6) paper copies of certificates for requirements requested in specification Sections and as requested by Ministerial 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 six (6) paper copies of manufacturers instructions for requirements requested in specification Sections and as requested by Ministerial 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 six (6) paper copies of manufacturer's field reports for requirements requested in specification Sections and as requested by Ministerial 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 six (6) paper copies of operation and maintenance data for requirements requested in specification Sections and as requested by Ministerial Representative.
- .18 Delete information not applicable to project.
- .19 Supplement standard information to provide details applicable to project.
- .20 If upon review by Ministerial Representative, no errors or omissions are discovered or if only minor corrections are made, copies will be returned and fabrication and installation of work may proceed. If shop drawings are rejected, noted copy will be returned and resubmission of corrected shop drawings, through same procedure indicated above, must be performed before fabrication and installation of work may proceed.

#### **1.4 SAMPLES**

- .1 Submit for review samples in duplicate as requested in respective specification Sections. Label samples with origin and intended use.
- .2 Deliver samples prepaid to Ministerial Representative's business address.
- .3 Notify Ministerial Representative in writing, at time of submission of deviations in samples from requirements of contract documents.
- .4 Where colour, pattern or texture is criterion, submit full range of samples.



- .5 Adjustments made on samples by Ministerial Representative are not intended to change contract price. If adjustments affect value of work, state such in writing to Ministerial Representative prior to proceeding with work.
- .6 Make changes in samples Ministerial Representative may require, consistent with contract documents.
- .7 Reviewed and accepted samples will become standard of workmanship and material against which installed Work will be verified.

## **1.5 CERTIFICATES AND TRANSCRIPTS**

- .1 Immediately after award of contract, submit Workers' Compensation Board status.

**END OF SECTION**



## **PARTIE 1 - GENERAL**

### **1.1 RELATED SECTIONS**

- .1 This section is general in nature and refers to information that can be connected to each section of the tender documents.
- .2 Ensure that both the construction project and institutional operations may proceed without undue disruption or hindrance and that the security of the Institution is maintained at all times.

### **1.2 DEFINITIONS**

- .1 "Contraband" means:
  - a) an intoxicant, including alcoholic beverages, drugs and narcotics,
  - b) a weapon or a component thereof, ammunition for a weapon, and anything that is designed to kill, injure or disable a person or that is altered so as to be capable of killing, injuring or disabling a person, when possessed without prior authorization,
  - c) an explosive or a bomb or a component thereof,
  - d) currency over any applicable prescribed limit (\$25.00),
  - e) and any item not described in paragraphs (a) to (d) that could jeopardize the security of a Penitentiary or the safety of persons, when that item is possessed without prior authorization.
- .2 "Unauthorized Smoking Items" means all smoking items including, but not limited to, cigarettes, cigars, tobacco, chewing or snuffing tobacco, cigarette making machines, matches and lighters.
- .3 "Commercial Vehicle" means any motor vehicle used for the shipment of material, equipment and tools required for the construction project.
- .4 "CSC" means Correctional Service Canada.
- .5 "Director" means Director or Warden of the Institution as applicable or their representative.
- .6 "Construction employees" means persons working for the general contractor, the sub-contractors, equipment operators, material suppliers, testing and inspection companies and regulatory agencies.

- .7 "Ministerial Representative" means the Public Works and Government Services Canada (PWGSC) or the Correctional Service Canada (CSC) project manager depending on project.
- .8 "Perimeter" means the fenced or walled area of the institution that restrains the movement of the inmates.
- .9 "Construction zone" means the area as shown on the contract drawings where the contractor will be allowed to work. This area may or may not be isolated from the security area of the institution.

### **1.3 PRELIMINARY PROCEEDINGS**

- .1 Prior to the commencement of work, the contractor shall meet with the Director to:
  - .1 Discuss the nature and extent of all activities involved in the Project.
  - .2 Establish mutually acceptable security procedures in accordance with this instruction and the institution's particular requirements.
- .2 The Contractor will:
  - .1 Ensure that all construction employees are aware of the CSC security requirements.
  - .2 Ensure that a copy of the CSC security requirements is always prominently on display at the job site.
  - .3 Co-operate with institutional personnel in ensuring that security requirements are observed by all construction employees.

### **1.4 CONSTRUCTION EMPLOYEES**

- .1 Submit to the Director a list of the names with date of birth of all construction employees to be employed on the construction site and a security clearance form for each employee.
- .2 Allow two (2) weeks for processing of security clearances. Employees will not be admitted to the Institution without a valid security clearance in place and a recent picture identification such as a provincial driver's license. Security clearances obtained from other CSC institutions are not valid at the institution where the project is taking place.

- .3 The Director may require that facial photographs may be taken of construction employees and these photographs may be displayed at appropriate locations in the institution or in an electronic database for identification purposes. The Director may require that Photo ID cards be provided for all construction workers. ID cards will then be left at the designated entrance to be picked upon arrival at the institution and shall be displayed prominently on the construction employees clothing at all time while employees are at the institution.
- .4 Entry to Institutional Property will be refused to any person there may be reason to believe may be a security risk.
- .5 Any person employed on the construction site will be subject to immediate removal from Institutional Property if they:
  - .1 appear to be under the influence of alcohol, drugs or narcotics.
  - .2 behave in an unusual or disorderly manner.
  - .3 are in possession of contraband.

## **1.5 VEHICLES**

- .1 All unattended vehicles on CSC property shall have windows closed; doors and trunks shall be locked and keys removed. The keys shall be securely in the possession of the owner or an employee of the company that owns the vehicle.
- .2 The director may limit at any time the number and type of vehicles allowed within the Institution.
- .3 Drivers of delivery vehicles for material required by the project shall not require security clearances but must remain with their vehicle the entire time that the vehicle is in the Institution. The director may require that these vehicles be escorted by Institutional staff or Commissionaires while in the Institution.
- .4 If the Director permits trailers to be left inside the secure perimeter of the Institution, these trailer doors will be locked at all times. All windows will be securely locked when left unoccupied. All trailer windows shall be covered with expanded metal mesh. All storage trailers inside and outside the perimeter must be locked when not in use.

## **1.6 PARKING**

- .1 The parking area(s) to be used by construction employees will be designated by the Director. Parking in other locations will be prohibited and vehicles may be subject to removal.

## **1.7 SHIPMENTS**

- .1 All shipments of project material, equipment and tools shall be addressed in the Contractor's name to avoid confusion with the institution's own shipments. The contractor must have his own employees on site to receive any deliveries or shipments. CSC staff will **NOT** accept receipt of deliveries or shipments of any material equipment or tools for the contractor.

## **1.8 TELEPHONES**

- .1 There will be no installation of telephones, Facsimile machines and computers with Internet connections permitted within the perimeter of the institution unless prior approval of the Director.
- .2 The Director will ensure that approved telephones, Facsimile machine and computers with Internet connections are located where they are not accessible to inmates. All computers will have an approved password protection that will stop an Internet connection to unauthorized personnel.
- .3 Wireless cellular and digital telephones, including but not limited to devices for telephone messaging, pagers, iPhone, BlackBerries, telephone used as 2-way radios, and MP3 players, are not permitted within the perimeter of the Institution unless approved by the Director. If wireless cellular telephones are permitted, the user will not permit their use by any inmate.
- .4 The Director may approve but limit the use of two way radios.

## **1.9 WORK HOURS**

- .1 Work hours within the Institution are: Monday to Friday from 07:30 to 16:00 daily. Work may be permitted until 17:00 if they have no chance of causing damage to existing facilities. The management of working hours will be coordinated on meeting.
- .2 Work will not be permitted during weekends and statutory holidays without the permission of the Director. A minimum of seven days advance notice will be required to obtain the required permission. In case of emergencies or other special circumstances, this advance notice may be waived by the Director.

## **1.10 OVERTIME WORK**

- .1 No overtime work will be allowed without permission of the Director. Give a minimum forty-eight (48) hours advance notice when overtime work on the construction project is necessary and approved. If overtime work is required because of an emergency such the completion of a concrete pour or work to make the construction safe and secure, the contractor shall advise the Director

as soon as this condition is known and follow the directions given by the Director. Costs to Canada for such events may be attributed to the contractor.

- .2 When overtime work, weekend statutory holiday work is required and approved by the Director, extra staff members may be posted by the Director or his designate, to maintain the security surveillance. The actual cost of this extra staff may be attributed to the contractor.

### **1.11 TOOLS AND EQUIPMENT**

- .1 Maintain on site a complete list of all tools and equipment to be used during the construction project. Make this inventory available for inspection when required.
- .2 Throughout the construction project maintain an up-to-date list of tools and equipment specified above.
- .3 Keep all tools and equipment under constant supervision, particularly power-driven and cartridge-driven tools, cartridges, files, saw blades, rod saws, wire, rope, ladders and any sort of jacking device (jacks, cylinders, etc.).
- .4 Store all tools and equipment in approved secure locations.
- .5 Lock all tool boxes when not in use. Employees of the contractor shall keep the keys with them at all times. Set and lock scaffolding unorganized: when erected, scaffolding must be secured safely to the satisfaction of the representative of the institution
- .6 Scaffolding shall be secured and locked when not erected and when erected, shall be secured in a manner agreed upon with the director.
- .7 All missing or lost tools or equipment shall be reported immediately to the Director.
- .8 The Director will ensure that the security staff members carry out checks of the Contractor's tools and equipment against the list provided by the Contractor. These checks may be carried out at the following intervals:
  - .1 At the beginning and conclusion of every construction project.
  - .2 Weekly, when the construction project extends longer than a one week period.
- .9 Certain tools/equipment such as cartridges and hacksaw blades are highly controlled items. The contractor will be given at the beginning of the day, a quantity that will permit one day's work. Used blades/cartridges will be returned to the Director's representative at the end of each day.

- .10 If propane or natural gas is used for heating the construction, the institution will require that an employee of the contractor supervise the construction site during non-working hours.

## **1.12 KEYS**

- .1 Security Hardware Keys
  - .1 The Contractor shall arrange with the security hardware supplier/installer to have the keys for the security hardware to be delivered directly to Institution, specifically the Security Maintenance Officer (SMO).
  - .2 The SMO will provide a receipt to the Contractor for security hardware keys.
  - .3 The Contractor will provide a copy of the above-mentioned receipt to the Departmental Representative.
- .2 Other Keys
  - .1 The Contractor will use standard construction cylinders for locks for his use during the construction period.
  - .2 The Contractor will issue instructions to his employees and sub-trades, as necessary, to ensure safe custody of the construction set of keys.
  - .3 Upon completion of each phase of the construction, the CSC representative will, in conjunction with the lock manufacturer:
    - .1 Prepare an operational keying schedule;
    - .2 Accept the operational keys and cylinders directly from the lock manufacturer;
    - .3 Arrange for removal and return of the construction cores and install the operational core in all locks.
  - .4 Upon putting operational security keys into use, the CSC construction escort shall obtain these keys as they are required from the SMO and open doors as required by the Contractor. The Contractor shall issue instructions to his employees advising them that all security keys shall always remain with the CSC construction escort.

## **1.13 SECURITY HARDWARE**

- .1 Turn over all removed security hardware to the Director of the Institution for disposal or for safekeeping until required for re-installation.



#### **1.14 PRESCRIPTION DRUGS**

- .1 Employees of the contractor who are required to take prescription drugs during the workday shall obtain approval of the Director to bring a one day supply only into the Institution.

#### **1.15 SMOKING RESTRICTIONS**

- .1 Contractors and construction employees are not permitted to smoke inside correctional facilities or outdoors within the perimeter of a correctional facility and must not possess unauthorized smoking items within the perimeter of a correctional facility.
- .2 Contractors and construction employees who are in violation of this policy will be requested to immediately cease smoking or dispose of any unauthorized smoking items and, if they persist, will be directed to leave the institution.
- .3 Smoking is only permitted outside the perimeter of a correctional facility in an area to be designated by the Director.

#### **1.16 CONTRABAND**

- .1 Weapons, ammunition, explosives, alcoholic beverages, drugs and narcotics are prohibited on institutional property.
- .2 The discovery of contraband on the construction site and the identification of the person(s) responsible for the contraband shall be reported immediately to the Director.
- .3 Contractors should be vigilant with both their staff and the staff of their sub-contractors and suppliers that the discovery of contraband may result in cancellation of the security clearance of the affected employee. Serious infractions may result in the removal of the company from the Institution for the duration of the construction.
- .4 Presence of arms and ammunition in vehicles of contractors, sub-contractors and suppliers or employees of these will result in the immediate cancellation of security clearances for the driver of the vehicle.

#### **1.17 SEARCHES**

- .1 All vehicles and persons entering institutional property may be subject to search.
- .2 When the Director suspects, on reasonable grounds, that an employee of the Contractor is in possession of contraband or unauthorized items, he may order that person to be searched.

- .3 All employees entering the Institution may be subject to screening of personal effects for traces of contraband drug residue.

### **1.18 ACCESS TO AND REMOVAL FROM INSTITUTIONAL PROPERTY**

- .1 Construction personnel and commercial vehicles will not be admitted to the institution after normal working hours, unless approved by the Director.

### **1.19 MOVEMENT OF VEHICLES**

- .1 Escorted commercial vehicles will be allowed to enter or leave the institution through the vehicle access gate during the following hours:
  - .1 07:45 a.m. to 11:00 a.m.
  - .2 1:00 p.m. to 3:30 p.m.

Construction vehicles shall not leave the Institution until an inmate count is completed.

- .2 The contractor shall advise the Director twenty four (24) hours in advance to the arrival on the site of heavy equipment such as concrete trucks, cranes, etc.
- .3 Vehicles being loaded with soil or other debris, or any vehicle considered impossible to search, must be under continuous supervision by CSC staff or Commissionaires working under the authority of the Director.
- .4 Commercial vehicles will only be allowed access to institutional property when their contents are certified by the Contractor or his representative as being strictly necessary to the execution of the construction project.
- .5 Vehicles shall be refused access to institutional property if, in the opinion of the Director, they contain any article which may jeopardize the security of the institution.
- .6 Private vehicles of construction employees will not be allowed within the security perimeter of medium or maximum security institutions without the authorization of the Director.
- .7 With prior approval of the Director, a vehicle may be used in the morning and evening to transport a group of employees to the work site. This vehicle will not remain within the Institution the remainder of the day.
- .8 With the approval of the Director, certain equipment may be permitted to remain on the construction site overnight or over the weekend. This equipment must be

securely locked, with the battery removed. The Director may require that the equipment be secured with a chain and padlock to another fixed object.

## **1.20 MOVEMENT OF CONSTRUCTION EMPLOYEES ON INSTITUTIONAL PROPERTY**

- .1 Subject to the requirements of good security, the Director will permit the Contractor and his employees as much freedom of action and movement as is possible.
- .2 However, notwithstanding paragraph above, the Director may:
  - .1 Prohibit or restrict access to any part of the institution.
  - .2 Require that in certain areas of the institution, either during the entire construction project or at certain intervals, construction employees only be allowed access when escorted by a member of the CSC security staff or a commissionaire.
- .3 During the lunch and coffee/health breaks, all construction employees will remain within the construction site. Construction employees are not permitted to eat in the officer's lounge or the dining room of the institution.

## **1.21 SURVEILLANCE AND INSPECTION**

- .1 Construction activities and all related movement of personnel and vehicles will be subject to surveillance and inspection by CSC security staff members to ensure that established security requirements are met.
- .2 CSC staff members will ensure that an understanding of the need to carry out surveillance and inspections, as specified above, is established among construction employees and maintained throughout the construction project.

## **1.22 STOPPAGE OF WORK**

- .1 The director may order at any time that the contractor, his employees, sub-contractors and their employees to not enter or to leave the work site immediately due to a security situation occurring within the Institution. The contractor's site supervisor shall note the name of the CSC staff member giving this instruction, the time of the request and obey the order as quickly as possible.
- .2 The contractor shall advise the Ministerial Representative of this interruption of the work within 24 hours.

## **1.23 CONTACT WITH INMATES**

- .1 Unless specifically authorized, it is forbidden to come into contact with inmates, to talk with them, to receive objects from them or to give them objects. Any

construction employee doing any of the above will be removed from the site and his security clearance revoked.

- .2 It is to be noted that cameras are not allowed on CSC property.

**SPECIAL NOTE** : If the project involves the Corcan workforce and inmates, check with the institution's policy on contact with inmates.

- .3 Notwithstanding the above paragraph, if the director approves of the usage of cameras, it is strictly forbidden to take pictures of inmates, of CSC staff members or of any part of the Institution other than those required as part of this contract.

#### **1.24 COMPLETION OF CONSTRUCTION PROJECT**

- .1 Upon completion of the construction project or, when applicable, the takeover of a facility, the Contractor shall remove all remaining construction material, tools and equipment that are not specified to remain in the Institution as part of the construction contract.

### **PARTIE 2 - PRODUCTS**

#### **2.1 NOT USED**

- .1 Not Used.

### **PARTIE 3 - EXECUTION**

#### **3.1 NOT USED**

- .1 Not Used.

**END OF SECTION**

## **PARTIE 1 - GENERAL**

### **1.1 RELATED SECTIONS**

- .1 This section is general in nature and refers to information that can be connected to each section of the tender documents.

### **1.2 CONTENT**

- .1 Contractor shall manage his operations so that safety and security of the public and of site workers always take precedence over cost and scheduling considerations.

### **1.3 REFERENCES**

- .1 Canada Labour Code - Part II, Canadian Occupational Safety and Health Regulations.
- .2 Canadian Standards Association (CSA)
- .3 Workplace Hazardous Materials Information System (WHMIS)
- .4 Act Respecting Occupational Health and Safety, R.S.Q. Chapter S-2.1.
- .5 Construction Safety Code, S-2.1, r.6.

### **1.4 SUBMITTALS**

- .1 Submit the documents required according to section 01 33 00 - Documents and samples to be submitted.
- .2 Submit to Ministerial Representative the site-specific safety program, as outlined in 1.9 at least 10 days prior to start of work. The Contractor must review his program during the course of the project if any change occurs in work methods or site conditions. The Ministerial Representative may, after receiving the program or at any time during the project, ask the Contractor to update or modify the program in order to better reflect the reality of the construction site and activities. The Contractor must make the required changes before work begins.
- .3 Submit to Ministerial Representative the site inspection sheet, duly completed, at the intervals indicated in 1.13.1.
- .4 Submit to Ministerial Representative within 24 hours a copy of any inspection report, correction notice or recommendation issued by federal or provincial inspectors.

- .5 Submit to Ministerial Representative within 24 hours an investigation report for any accident involving injury and any incident exposing a potential hazard.
- .6 Submit to Ministerial Representative all safety data sheets for hazardous material to be used at the site at least three days before they are to be used.
- .7 Submit to Ministerial Representative copies of all training certificates required for application of the safety program, in particular:
  - .1 General construction site safety and health courses;
  - .2 Safety officer attestations;
  - .3 First aid in the workplace and cardiopulmonary resuscitation;
  - .4 Work likely to release asbestos dust;
  - .5 Work in confined spaces;
  - .6 Lockout procedures;
  - .7 Wearing and fitting of individual protective gear;
  - .8 Forklift truck;
  - .9 Positioning platform;
  - .10 Any other requirement of Regulations or the safety program.
- .8 Medical examinations: Wherever legislation, regulations, directives, specification or a safety program require medical examinations, Contractor must:
  - .1 Prior to start-up, submit to Ministerial Representative certificates of medical examination for all concerned supervisory staff and employees who will be on duty when the site opens.
  - .2 Thereafter, submit without delay certificates of medical examination for any newly hired concerned personnel as and when they start work at the site.
- .9 Emergency plan: The emergency plan, as defined in 1.9.3, shall be submitted to Ministerial Representative at the same time as the site-specific safety program.
- .10 Notice of site opening: Notice of site opening shall be submitted to the Commission *de la santé et de la sécurité du travail* (CSST) before work begins. A copy of such notice shall be submitted to Ministerial Representative at the same time and another posted in full view at the site. During demobilization, a notice of site closing shall be submitted to the CSST, with copy to Ministerial Representative.

- .11 Plans and certificates of compliance : Submit to the CSST and to Ministerial Representative a copy signed and sealed by engineer of all plans and certificates of compliance required pursuant to the Construction Safety Code (S-2.1, r. 6), or by any other legislation or regulation or by any other clause in the specifications or in this contract. Copies of these documents must be on hand at the site at all times.
- .12 Certificate of compliance delivered by the CSST: The certificate of compliance is a document delivered by the CSST confirming that the contractor is in rule with the CSST, i.e. that he had pay out all the benefits concerning this contract. This document must be delivered to Departmental Representative at the end of the work.

## **1.5 HAZARDS ASSESSMENT**

- .1 The Contractor must identify all hazards inherent in each task to be carried out at the site.
- .2 The Contractor must plan and organize work so as to eliminate hazards at source or promote mutual protection so that reliance on individual protective gear can be kept to a minimum. Where individual protection against falling is required, workers shall use safety harness that meets standard Can - CSA- Z-259.10 - M90. Safety belts shall not be used as protection against falling.
- .3 Equipment, tools and protective gear which cannot be installed, fitted or used without compromising the health or safety of workers or the public shall be deemed inadequate for the work to be executed.
- .4 All mechanical equipment shall be inspected before delivery to the site. Before using any mechanical equipment, submit to Ministerial Representative a certificate of compliance signed by a qualified mechanic. Whenever he suspects a defect or accident risk, Ministerial Representative may at any time order the immediate shut-down of equipment and require a new inspection by a specialist of his own choosing.

## **1.6 MEETINGS**

- .1 Contractor decisional representative must attend any meetings at which site safety and health issues are to be discussed.
- .2 Set up a site safety committee, and convene meetings as required by the Construction Safety Code (S-2.1, r.6).

## **1.7 LEGAL AND REGULATORY REQUIREMENTS**

- .1 Comply with all legislation, regulations and standards applicable to the site and its related activities.
- .2 Comply with specified standards and regulations to ensure safe operations at site containing hazardous or toxic materials.

- .3 Regardless of the publication date shown in the construction safety code, always use the most recent version.

## **1.8 SITE-SPECIFIC CONDITIONS**

- .1 At the site, the Contractor must take account of the following specific conditions:
  - .1 Possibility to have other activities in proximity of the project; the Contractor should coordinate work with the other contractors.
  - .2 Utilities cables and piping could be confined in the worksite, before starting any excavation; the Contractor should coordinate with the responsible of the establishment to verify the existing facilities.
  - .3 Some work will be done in operational areas of the establishment; the Contractor should respect the security requirements.

## **1.9 SAFETY AND HEALTH MANAGEMENT**

- .1 Acknowledge and assume all the tasks and obligations which customarily devolve upon a principal Contractor under the terms of the Act Respecting Occupational Health and Safety (R.S.Q., chapter S-2.1) and the Construction Safety Code (S-2.1, r.6).
- .2 Develop a site-specific safety program based on the hazards identified and apply it from the start of project work until close-out is completed. The safety program must take account of all information appearing in 1.7 and must be submitted to all parties concerned, in accordance with the provisions set forth in 1.4. At a minimum, the site-specific safety program must include:
  - .1 Company safety and health policy.
  - .2 A description of the work, total costs, schedule and projected workforce curve.
  - .3 Flow chart of safety and health responsibility.
  - .4 The physical and material layout of the site.
  - .5 First-aid and first-line treatment standards.
  - .6 Identification of site-specific hazards.
  - .7 Risk assessment for the tasks to be carried out, including preventive measures and the procedures for applying them.
  - .8 Training requirements.
  - .9 Procedures in case of accident/injury



- .10 Written commitment from all parties to comply with the prevention program.
- .11 A site inspection schedule based on the preventive measures.
- .3 The Contractor must draw up an effective emergency plan based on the characteristics and constraints of the site and its surroundings. Submit the emergency plan to all parties concerned, pursuant to the provisions of 1.4. The emergency plan must include:
  - .1 Evacuation procedure;
  - .2 Identification of resources (police, firefighters, ambulance services, etc.);
  - .3 Identification of persons in charge at the site;
  - .4 Identification of those with first-aid training;
  - .5 Training required for those responsible for applying the plan;
  - .6 Any other information needed, in the light of the site characteristics.

#### **1.10 RESPONSIBILITIES**

- .1 No matter the size of the construction site or how many workers are present at the workplace, designate a competent person to supervise and take responsibility for health and safety. Take all necessary measures to ensure the health and safety of persons and property at or in the immediate vicinity of the site and likely to be affected by any of the work.
- .2 Take all necessary measures to ensure application of and compliance with the safety and health requirements of the contract documents, applicable federal and provincial regulations and standards as well as the site-specific safety program, complying without delay with any order or correction notice issued by the Commission de la santé et de la sécurité du travail.
- .3 Take all necessary measures to keep the site clean and in good order throughout the course of the work.

#### **1.11 COMMUNICATIONS AND POSTING**

- .1 Make all necessary arrangements to ensure effective communication of safety and health information at the site. As they arrive on site, all workers must be informed of their rights and obligations pertaining to the site specific safety program. The Contractor must insist on their right to refuse to perform work which they feel may threaten their own health, safety or physical integrity or that of other persons at the site. The Contractor must keep and update a written record of all information transmitted with signatures of all affected workers.
- .2 The following information and documents must be posted in a location readily accessible to all workers:

- .1 Notice of site opening;
- .2 Identification of principal Contractor;
- .3 Company OSH policy;
- .4 Site-specific safety program;
- .5 Emergency plan;
- .6 Data sheets for all hazardous material used at the site;
- .7 Minutes of site committee meetings;
- .8 Names of site committee representatives;
- .9 Names of those with first-aid training;
- .10 Action reports and correction notices issued by the CSST.

#### **1.12 UNFORESEEN CIRCUMSTANCES**

- .1 Whenever a source of danger not defined in the specifications or identified in the preliminary site inspection arises as a result of or in the course of the work, immediately suspend work, take appropriate temporary measures to protect the workers and the public and notify Ministerial Representative, both verbally and in writing. Then the Contractor must modify or update the site specific safety program in order to resume work in safe conditions.

#### **1.13 INSPECTION OF SITE AND CORRECTION OF HAZARDOUS SITUATIONS**

- .1 Inspect the work site and complete the site inspection sheet at least once a week.
- .2 Immediately take all necessary measures to correct any lapses from legislative or regulatory requirements and any hazards identified by a government inspector, by the Ministerial Representative, by the site safety and health coordinator or during routine inspections.
- .3 Submit to Ministerial Representative written confirmation of all measures taken to correct lapses and hazardous situations.
- .4 Give the safety officer or, where there is no safety officer, the person assigned to safety and health responsibilities, full authority to order interruption and resuming of work as and when deemed necessary or desirable in the interests of safety and health. This person should always act so that the safety and health of the public and site workers and environmental protection take precedence over cost and scheduling considerations.

- .5 Without limiting the scope of this section, Ministerial Representative may order cessation of work if, in his/her view, there is any hazard or threat to the safety or health of site personnel or the public or to the environment.

#### **1.14 BLASTING**

- .1 Blasting and other use of explosives are forbidden unless authorized in writing by Ministerial Representative.
- .2 Any operation involving explosives must be carried out under the supervision of a qualified shot firer.
- .3 The purchase, carriage, storage and use of explosives must comply with all applicable federal and provincial legislation:
  - .1 Canada: Explosives Act (E-17), Explosives Regulations (C.R.C. CH. 599), Standard for Storage of Blasting Charges and Detonators, Transportation of Dangerous Goods Act and Regulations.
  - .2 Quebec: Explosives Act (E-22), Explosives Regulations (E-22, r.1), Safety Code for the Construction Industry (S-2.1, r.6), Transportation of Dangerous Goods Regulations.
- .4 Contractor shall obtain all permits required pursuant to the legislation and regulations referred to above and keep copies on hand at the site.
- .5 Contractor shall facilitate inspection of the site, stored explosives and vehicles used to transport explosives by any government representatives or police officers whose jurisdiction encompasses explosives.

#### **1.15 POWDER ACTUATED DEVICES**

- .1 Use of power hammers and other explosive-actuated devices must be authorized by Ministerial Representative.
- .2 Any person using a power hammer shall hold a training certificate and meet all requirements of Section 7 of the Construction Safety Code (S-2.1, r. 6).
- .3 Any other explosive-actuated device shall be used in accordance with the manufacturer's directions and applicable standards and regulations.

#### **1.16 SPECIAL REQUIREMENTS IN HEALTH AND SAFETY SPECIFIC TO THE PROJECT**

- .1 Excavating and trenching
  - .1 Contractor must follow the CSST guidelines on excavation.

- .2 Lockout
  - .1 For every work on energized equipment or equipment that may be started accidentally, the Contractor shall draw up and implement a lockout procedure and complete the Request for Electrical Isolation Form provided by the Manager in Charge of Worksite.
  - .2 Although the hereunder list is not exhaustive, here are some examples for which the use of the form is obligatory:
    - .1 main building power feeders;
    - .2 feeder supply panels and sub-panels;
    - .3 bus ducts;
    - .4 motor control centres;
    - .5 emergency power circuits;
    - .6 fire alarm and fire protection equipment;
    - .7 mechanical protective equipment;
    - .8 alarm circuit for building services, including all heating, ventilating and air conditioning equipment;
    - .9 circuits supplying more than one (1) piece of equipment;
    - .10 circuits affecting one (1) single piece of equipment used in a cooling or heating system.
  - .3 After having completed the form, the Contractor, shall have it countersigned by the Manager in Charge of Worksite before starting work.
  - .4 Notwithstanding the previous paragraphs, the Contractor shall, in emergency situation, receive an oral guarantee of isolation of the Manager in Charge of Worksite and immediately countersign the request of electrical isolation.
  - .5 The procedure requested at paragraph 1 must comply with the principles listed in the "Le cadenassage" pamphlet published by the Association paritaire pour la santé et la sécurité du travail secteur construction (ASP Construction).
  - .6 Supervisors and all workers concerned must have followed ASP Construction's "Les techniques de cadenassage" course (514 355-6190 or 1 800 361-2061) or an equivalent course given by another firm.

- .7 Identify every work that must absolutely be done on live equipment and establish the safety measures that will be applied, including the personal protective equipment.
- .3 Changing light bulbs and lighting tubes
  - .1 In addition to the other safety requirements set out in this document, the Contractor has to comply with the following requirements to prevent electric shock when changing light bulbs and lighting tubes:
    - .1 Ensure that the workers assigned to the work have received all of the information needed to carry out the work safely and that they at least apply the following safety measures.
    - .2 Check the condition of the work area before beginning the work. If the area is very humid, if there is water in the vicinity or if the electrical system is explosion-proof, do not carry out the work and notify the Ministerial Representative.
    - .3 Check the condition of the light bulbs and fluorescent tubes to be changed. If a light bulb or fluorescent tube shows signs of damage or wear, if it is difficult to remove or if there are traces of a ballast leak, do not carry out the work and notify the Ministerial Representative.
    - .4 Wear leather gloves. Ensure that they do not show signs of damage or wear every time such work is to be performed.
    - .5 Wear safety goggles.
    - .6 The ladders and stepladders used have to be made of fiberglass.
    - .7 Block off areas where climbing equipment is being used.
    - .8 Insulate light switches whenever possible (switch off).
    - .9 Stick a danger label on the switch indicating that it should not be switched on.
    - .10 Replace the light bulbs and fluorescent tubes with the same type of bulbs and tubes of the same size and wattage. If there is a doubt, notify the Ministerial Representative.
- .4 Work in height
  - .1 The Contractor must ensure that any person carrying out work that poses a risk of falling more than 2,4 m use fall protection equipment.
  - .2 Plan and organize work so as to eliminate the danger at source or ensure collective protection, thereby minimizing the use of personal protective

equipment. When personal fall protection is required, workers must use a safety harness that complies with CSA standard CAN/CSA Z-259.10 M90. A safety belt must not be used as fall protection.

- .3 Every person using an elevating platform must have a training regarding this equipment.
  - .4 Wearing of safety harness is obligatory in any elevating platform with telescopic, articulated or rotary boom.
  - .5 Delimit a danger zone in any place where equipment for work in height is used.
- .5 Specific conditions for confined spaces
- .1 Class 1
    - .1 Regarding all class 1 (low-risk) confined spaces, all persons involved shall have followed a basic training. Though it is not necessary to implement special work practices in low-risk confined spaces, the Contractor shall implement methods that ensure the health and general safety of persons who must work in these spaces.
    - .2 Before having access to confined spaces, the manager responsible for the workplace shall be informed of the expected date and time of entry and exit.
    - .3 Persons who have access to low-risk confined spaces must record the relevant information in the Confined Space Entry Log (ELF 103 form), i.e., all persons entering this class of confined space shall record each entry and each exit.
  - .2 Class 2 and 3
    - .1 Regarding all class 2 and 3 confined spaces (medium- and high-risk), the following measures shall be strictly applied.
    - .2 The Contractor's prevention program shall include a written procedure which identifies:
      - .1 Necessary work tools;
      - .2 Instruments, installed or to be installed in the confined space, and measures to take for their installation, use, maintenance, protection and moving;
      - .3 Pipes and conduits entering the confined space;

- .4 Risks and security measures to be taken depending on the work to be carried out;
  - .5 Hazardous material that may be found in the confined space;
  - .6 Appropriate rescue methods and equipment as well as emergency plan.
- .3 The Contractor shall complete an access permit (ELF 101 form). The permit shall be valid for the duration of a work shift and shall take into account information contained in the assessment report and special conditions related to the work to be carried out. The Contractor may use his own form if it provides all the information that appears on the appended form.
  - .4 The Contractor shall complete a Hot Work Permit when the work to be carried out includes operations such as welding, cutting or any other activity that creates flames or sparks (ELF form 102).
  - .5 All persons having access to the confined space shall have the following training certificates:
    - .1 Safety for work in PWGSC confined spaces (ASP Construction or equivalent training);
    - .2 Workplace First Aid and CPR (organization recognized by the CSST);
    - .3 Use of ventilating equipment (ASP Construction or equivalent training);
    - .4 Use of safety harness (ASP Construction or equivalent training);
    - .5 Use and maintenance of respiratory protection equipment (ASP Construction or equivalent training);
    - .6 Gas detection equipment (ASP Construction or equivalent training);
    - .7 When the use of air adduction equipment or autonomous respirators is planned for, thorough training in the preparation, maintenance and use of such equipment (Manufacturer, supplier or recognized organization);
    - .8 In remote areas where no local rescue and emergency intervention unit is available, the Contractor shall designate persons who are capable of carrying out rescue operations in confined spaces. First-aid attendant designated by the Contractor shall have relevant training in the use of rescue equipment.

- .6 All persons having access to a confined space shall present a medical certificate confirming that they are fit to work in a closed space. This certificate shall be valid for two years.
- .7 Employees who are required to work in sewage collection systems or other similar systems shall be immunized against infectious diseases, in compliance with the immunization program prescribed by Health Canada, which is, against diphtheria and tetanus and for work to be done at the Correctional Service Canada, against hepatitis « B ».
- .8 The antidiphtheria-tetanus vaccination is strongly recommended, though it is not mandatory.
- .9 The Contractor shall establish emergency and rescue procedures in co-operation with municipal and ambulance services. These procedures, together with the relevant phone numbers and the whereabouts of the nearest phone shall be conspicuously posted near the work station.
- .10 Before entry into a confined space, and every 15 minutes thereafter, the Contractor shall take readings of oxygen concentration, flammable gases and all toxic gases likely to be present, carbon monoxide and hydrogen sulphide in particular. These readings shall be recorded in a register, unless the detecting devices are equipped with an alarm and operate on a continuous basis. Detecting devices that are used shall be calibrated and adjusted by a competent person according to the manufacturer's directives, so that the alarms comply with the limits set out on the permit. NOTE: for welding and cutting tasks, readings of concentration must be done on a continuous basis.
- .11 The Contractor is responsible for the provision and maintenance of gas detecting devices. The Engineer may at any time require the Contractor's equipment to be checked for accuracy by a qualified person. In the event of failure of a detecting device, work shall be suspended immediately and all workers shall leave the confined space. In these circumstances, no claim for time lost shall be accepted.
- .12 If a detecting device alarm is set off, all workers shall leave the confined space. The Contractor shall then find the source of contamination, neutralize it, ventilate the confined space to eliminate contaminant residues and authorize access to the confined space only when concentrations of oxygen and gas have returned to normal.
- .13 Compressed gas cylinders or welding equipment shall not be brought into confined spaces: this equipment shall remain outside and shall not block entrances or exits; all cylinders shall be properly secured.



- .14 Tools and electrical devices used to gain access to confined spaces shall be grounded and, when necessary, designed to be explosion-proof. All equipment must be connected to a ground fault interrupter outlet or to a step-down transformer. The Contractor shall, at his own cost, hire a qualified electrician to adjust power receptacles and/or circuit breakers that he intends to use which do not meet these criteria.
- .15 The Contractor shall provide a ventilation system to keep concentrations of contaminants below admissible limits.
- .16 The Contractor shall put up posters to prevent unauthorized persons from entering the confined space.
- .17 When it is impossible to maintain the noise level under 85 dB, the Contractor shall provide all workers with ear protection adapted to the desired level of attenuation and work to be carried out.
- .18 The Contractor shall ensure that all workers wear the required personal protection equipment.
- .19 The Contractor shall assign a competent person to assume the function of safety guard. The safety guard shall:
  - .1 Be properly informed of work procedures in a confined space.
  - .2 Ensure constant communication with all workers in the confined space. The instructions that are applied shall be adapted to confined spaces. The Contractor shall choose means of communication according to identified risks and other relevant factors, which is the protection equipment the workers must wear, noise levels in confined spaces and surrounding areas, remoteness, lighting conditions, etc.
  - .3 Be familiar with gas detecting devices and see to their proper functioning for the duration of the work.
  - .4 Be familiar with auxiliary ventilation systems and see to their proper functioning for the duration of the work.
  - .5 Be familiar with emergency procedures.
  - .6 Ensure that:
    - .1 All workers who enter the confined space respect the Contractor's work procedure.
    - .2 The working conditions and the environment inside the confined space are in no way detrimental to workers' health and safety.

- .20 The safety guard shall, at all times, be posted at the entrance of the confined space and shall not leave his station as long as there is a worker inside the confined space.
- .21 The Contractor shall designate a person to be in charge of the safety of the confined space. This person shall be present at all times on the job site. The same person may act as a security guard and be responsible for the safety of confined spaces, provided all requirements of both functions are met.

**END OF SECTION**

## **PARTIE 1 - GENERAL**

### **1.1 RELATED SECTIONS**

- .1 This section is general in nature and refers to information that can be connected to each section of the tender documents.

### **1.2 REFERENCES**

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

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

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Before commencing construction activities or delivery of materials to site, submit Environmental Protection Plan for review and approval by Ministerial Representative.
- .3 Environmental Protection Plan must include comprehensive overview of known or potential environmental issues to be addressed during construction.
- .4 Address topics at level of detail commensurate with environmental issue and required construction tasks.
- .5 Include in Environmental Protection Plan:
  - .1 Names of persons responsible for ensuring adherence to Environmental Protection Plan.
  - .2 Names and qualifications of persons responsible for manifesting hazardous waste to be removed from site.
  - .3 Names and qualifications of persons responsible for training site personnel.
  - .4 Descriptions of environmental protection personnel training program.

- .5 Drawings indicating locations of proposed temporary excavations or embankments for haul roads, stream crossings, material storage areas, structures, sanitary facilities, and stockpiles of excess or spoil materials including methods to control runoff and to contain materials on site.
  - .6 Traffic Control Plans including measures to reduce erosion of temporary roadbeds by construction traffic, especially during wet weather. Plans to include measures to minimize amount of material transported onto paved public roads by vehicles or runoff.
  - .7 Work area plan showing proposed activity in each portion of area and identifying areas of limited use or non-use. Plan to include measures for marking limits of use areas and methods for protection of features to be preserved within authorized work areas.
  - .8 Spill Control Plan to include procedures, instructions, and reports to be used in event of unforeseen spill of regulated substance.
  - .9 Non-Hazardous solid waste disposal plan identifying methods and locations for solid waste disposal including clearing debris.
  - .10 Air pollution control plan detailing provisions to assure that dust, debris, materials, and trash, are contained on project site.
  - .11 Contaminant Prevention Plan identifying potentially hazardous substances to be used on job site; intended actions to prevent introduction of such materials into air, water, or ground; and detailing provisions for compliance with Federal, Provincial, and Municipal laws and regulations for storage and handling of these materials.
  - .12 Waste Water Management Plan identifying methods and procedures for management or discharge of waste waters which are directly derived from construction activities, such as concrete curing water, clean-up water, dewatering of ground water, disinfection water, hydrostatic test water, and water used in flushing of lines.
  - .13 Historical, archaeological, cultural resources biological resources and wetlands plan that defines procedures for identifying and protecting historical, archaeological, cultural resources, biological resources and wetlands.
  - .14 Pesticide treatment plan to be included and updated, as required.
- 
- .6 A plan for the management and disposal of contaminated soils, which defines how they will be stored, analyzed, transported, disposed type BC soil as defined in Section 31 00 00.01 and the way will be managed type AB soil as defined in Section 31 00 00.01 (storage, transport, placing embankment, drainage, etc.).
  - .7 A management plan for disposal of drilling muds specifying the storage methods, analysis of transport and disposal of this sludge.

## **1.4 FIRES**

- .1 Fires and burning of rubbish on site is not permitted.
- .2 Provide supervision, attendance and fire protection measures as directed.

## **1.5 SITE CLEARING AND PLANT PROTECTION**

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

## **1.6 WORK ADJACENT TO WATERWAYS**

- .1 Construction equipment to be operated on land only.
- .2 Use waterway beds for borrow material only after written receipt of approval from Ministerial Representative.
- .3 Waterways to be kept free of excavated fill, waste material and debris.
- .4 Design and construct temporary crossings to minimize erosion to waterways.
- .5 Do not skid logs or construction materials across waterways.
- .6 Avoid indicated spawning beds when constructing temporary crossings of waterways.
- .7 Blasting is allowed only above water and 500 m minimum from indicated spawning beds.

## **1.7 POLLUTION CONTROL**

- .1 Maintain temporary erosion and pollution control features installed under this Contract.
- .2 Control emissions from equipment and plant in accordance with local authorities' emission requirements.

- .3 Prevent sandblasting and other extraneous materials from contaminating air and waterways beyond application area.
  - .1 Provide temporary enclosures where indicated and directed by Ministerial Representative.
- .4 Cover or wet down dry materials and rubbish to prevent blowing dust and debris. Provide dust control for temporary roads.

## **1.8 NOTIFICATION**

- .1 Ministerial Representative will notify Contractor in writing of observed noncompliance with Federal, Provincial or Municipal environmental laws or regulations, permits, and other elements of Contractor's Environmental Protection plan.
- .2 Contractor: after receipt of such notice, inform Ministerial Representative of proposed corrective action and take such action for approval by Ministerial Representative.
  - .1 Take action only after receipt of written approval by Ministerial Representative
- .3 Ministerial Representative will issue stop order of work until satisfactory corrective action has been taken.
- .4 No time extensions granted or equitable adjustments allowed to Contractor for such suspensions.

## **PARTIE 2 - PRODUCTS**

### **2.1 NOT USED**

## **PARTIE 3 - EXECUTION**

### **3.1 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
  - .1 Leave Work area clean at end of each day.
- .2 Bury rubbish and waste materials on site where directed after receipt of written approval from Ministerial Representative.
- .3 Ensure public waterways, storm and sanitary sewers remain free of waste and volatile materials disposal.

- .4 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.
- .5 Waste Management: separate waste materials for reuse / reuse and recycling in accordance with Section 01 74 21 - Management and Disposal of construction / demolition.
  - .1 Remove bins and recycling bins from site and dispose of materials at appropriate facilities.

**END OF SECTION**





## **PARTIE 1 - GENERAL**

### **1.1 RELATED SECTIONS**

- .1 This section is general in nature and refers to information that can be connected to each section of the tender documents.

### **1.2 MEASUREMENT FOR PAYMENT**

- .1 The work related to quality control is not measurable for payment and must be included in the cost of work for which it is required.

### **1.3 INDEPENDENT INSPECTION AGENCIES**

- .1 Independent Inspection/Testing Agencies will be engaged by Ministerial Representative for purpose of inspecting and/or testing portions of work. Cost of such services will be borne by Ministerial Representative except in the following cases:
  - .1 Inspection and testing required by various laws, ordinances, rules, regulations or public policy.
  - .2 Inspection and testing performed solely for the convenience of the contractor.
  - .3 Testing and maintenance of equipment.
  - .4 Factory tests and certificates of compliance.
  - .5 All tests to be performed by the contractor under the supervision of the Ministerial Representative.
- .2 Provide equipment required for executing inspection and testing by appointed agencies.
- .3 Employment of inspection/testing agencies does not relax responsibility to perform Work in accordance with Contract Documents.
- .4 If defects are identified during testing and/or inspections, the designated agency will require further inspection and/or additional testing to define the precise nature and extent of these defects. The contractor shall correct the defects as directed by the Ministerial Representative, at no additional cost to the Ministerial Representative, and pay the cost of retesting after the corrections are made.

#### **1.4 CONTRACTOR RESPONSIBILITY**

- .1 Advise the Ministerial Representative well in advance so to schedule the laboratory for testing.
- .2 Assume the cost of exposing or re-doing work that has been covered before being inspected and approved by the Ministerial Representative.
- .3 Send all samples of materials to be tested to the designated testing laboratory.
- .4 Additional tests: When inspections or tests conducted by the testing laboratory revealed non-compliance with the requirements of the contract, the contractor must pay the cost of additional tests or inspections that Ministerial Representative requires to verify if the corrections are acceptable.

#### **1.5 ACCESS TO WORK**

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

#### **1.6 PROCEDURES**

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

#### **1.7 REJECTED WORK**

- .1 Remove defective Work, whether result of poor workmanship, use of defective products or damage and whether incorporated in work or not, which has been rejected by Ministerial Representative as failing to conform to contract documents. Replace or re-execute in accordance with contract documents.
- .2 If in opinion of Ministerial Representative it is not expedient to correct defective Work or Work not performed in accordance with contract documents, owner will deduct from contract price difference in value between work performed and that called for by contract documents, amount of which will be determined by Ministerial Representative.

## **1.8 REPORTS**

- .1 Submit 4 copies of inspection and test reports to Ministerial Representative.
- .2 Provide copies to subcontractor of work being inspected or tested and to manufacturer or fabricator of material being inspected or tested.

## **1.9 TESTS AND MIX DESIGNS**

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

## **1.10 MOCK-UPS**

- .1 Prepare mock-ups for work specifically requested in the specifications. The requirements of this section apply to all sections of the specifications in which we are asked to provide mock-ups.
- .2 Construct in locations acceptable to Ministerial Representative as specified in specific Section.
- .3 Prepare mock-ups for Ministerial Representative's review with reasonable promptness and in orderly sequence, to not cause delays in work.
- .4 Failure to prepare mock-ups 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.
- .5 Specification section identifies whether mock-up may remain as part of work or if it is to be removed and when.

## **1.11 MILL TESTS**

- .1 Submit mill test certificates as required of specification sections.

**END OF SECTION**



## **PARTIE 1 - GENERAL**

### **1.1 RELATED SECTIONS**

- .1 This section is general in nature and refers to information that can be connected to each section of the tender documents.

### **1.2 PRECEDENCE**

- .1 For Federal Government Projects, Division 1 Sections take precedence over technical specifications in other divisions of this Project Manual.

### **1.3 CONTENT OF SECTION**

- .1 This section includes specific environmental and sustainable development requirements for building materials, products and systems needed to ensure that this project complies with green design processes and clients' sustainable development plan.

### **1.4 SUBMITTALS**

- .1 Provide submittals for work in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submittals required:
  - .1 Name, skills and experience of the person responsible for the design and compliance with the environmental protection plan to be submitted to the Ministerial Representative for approval.
  - .2 Compliance Report indicating requirement to purchase energy efficient and environmentally benign products.
  - .3 Compliance report with requirements concerning the use of materials, equipment and construction methods that will reduce energy consumption, water consumption and the possibility of formation of potentially toxic derivatives, the use of materials and recycled materials and reuse / recycling of materials and equipment recovered.
  - .4 Energy Report: to indicate EnerGuide ratings of new equipment and appliances.

### **1.5 ENVIRONMENT PROTECTION**

- .1 Follow methods and procedures specified in section 01 35 43 – Environmental Procedures.

## **1.6 GENERAL CONSTRUCTION MATERIALS/PRACTICES**

- .1 Materials and Resources
  - .1 Use uncontaminated demolition materials for fill and hardcore and/or granular base.
  - .2 Incorporate reused building materials as indicated.
- .2 Storage and Collection of Recyclables
  - .1 Provide separate storage/handling facilities for consumer recyclables including used paper, newspaper, newsprint, cardboard, glass, metal and plastic.
- .3 Construction Waste Management
  - .1 Follow recommendations and requirements of this projects construction, renovation and demolition (CRD) waste management plan in accordance with Section 01 74 21 - Construction/Demolition Waste Management And Disposal.

**END OF SECTION**

## **PARTIE 1 - GENERAL**

### **1.1 RELATED SECTIONS**

- .1 This section is of a general nature and provides information that could relate to all other sections of the contract documents.

### **1.2 SUBMITTALS**

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

### **1.3 INSTALLATION AND REMOVAL**

- .1 The construction facility location will be provided at the first work meeting.
- .2 Prepare a plan showing the proposed construction facility location that will be fenced, including the number of trailers, access roads to the fenced area and details of installation of the fence.
- .3 Provide, establish or develop the site facilities necessary for carrying out the work as soon as possible.
- .4 Remove equipment from the site when no longer needed.
- .5 Rehabilitate the site used for construction facilities to its original or better condition.

### **1.4 HOISTING**

- .1 Provide and install winches and cranes needed to move workers, materials and equipment, as well as ensure maintenance and operation. Make financial arrangements with sub-contractors for the use of lifting equipment.
- .2 The winches and cranes must be operated by a skilled worker.

### **1.5 SITE STORAGE/LOADING**

- .1 Ensure that work is performed within the limits specified in the contract documents. Do not clutter the site unreasonably with material or equipment.
- .2 Do not overload or permit overloading any part of the work so as not to compromise its integrity.
- .3 Ensure that the equipment is locked at all times. CSC is not responsible in case of loss or theft.

## **1.6 CONSTRUCTION PARKING**

- .1 Parking will be allowed on site, in the space provided for construction facilities

## **1.7 EQUIPMENT, TOOLS AND MATERIALS STORAGE**

- .1 Provide lockable, weather resistant, storage for equipment and tools and keep it clean and in good order.
- .2 Locate materials not required to be stored in weatherproof sheds on site in manner to cause least interference with work activities.

## **1.8 SANITARY FACILITIES**

- .1 Provide sanitary facilities for workers in accordance the regulations.
- .2 Display required notices and take all precautions required by local health authorities. Maintain the premises clean.

## **1.9 CLEAN-UP**

- .1 Remove construction debris on a daily basis.
- .2 Keep hard surfaces free of dust.
- .3 Recuperate material during the demolition work.
- .4 Stack stored new or salvaged material not in construction facilities.

**END OF SECTION**



## **PARTIE 1 - GENERAL**

### **1.1 RELATED SECTIONS**

- .1 This section is of a general nature and provides information that could relate to all other sections of the contract documents.

### **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 secure, rigid guard rails and barricades around deep excavations.
- .2 Provide as required by governing authorities.

### **1.4 FIRE ROUTES**

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

### **1.5 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.

### **1.6 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 Ministerial Representative locations and installation schedule 3 days prior to installation.
- .4 Be responsible for damage incurred due to lack of or improper protection.

## **1.7 WASTE MANAGEMENT AND DISPOSAL**

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

**END OF SECTION**

## **PARTIE 1 - GENERAL**

### **1.1 RELATED SECTIONS**

- .1 This section is of a general nature and provides information that could relate to all other section of the contract documents.

### **1.2 REFERENCES**

- .1 Within text of each specifications section, reference may be made to reference standards.
- .2 If there is question as to whether products or systems are in conformance with applicable standards, Ministerial Representative reserves right to have such products or systems tested to prove or disprove conformance.

### **1.3 QUALITY**

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

### **1.4 AVAILABILITY**

- .1 In event of failure to notify Ministerial Representative at commencement of work and should it subsequently appear that work may be delayed for such reason, Ministerial Representative

reserves right to substitute more readily available products of similar character, at no increase in contract price or contract time.

## **1.5 STORAGE, HANDLING AND PROTECTION**

- .1 Handle and store products in a manner to prevent damage, adulteration, deterioration and soiling and in accordance with manufacturer's instructions when applicable.
- .2 Store packaged or bundled products in original and undamaged condition with manufacturer's seal and labels intact. Do not remove from packaging or bundling until required in work.
- .3 Store products subject to damage from weather in weatherproof enclosures.
- .4 Replace damaged products at no cost and to satisfaction of Ministerial Representative.

## **1.6 TRANSPORTATION**

- .1 Pay costs of transportation of products required in performance of work.

## **1.7 MANUFACTURER'S INSTRUCTIONS**

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

## **1.8 QUALITY OF WORK**

- .1 Ensure quality of work is of highest standard, executed by workers experienced and skilled in respective duties for which they are employed. Immediately notify Ministerial Representative if required work is such as to make it impractical to produce required results.
- .2 Do not employ anyone unskilled in their required duties. Ministerial Representative reserves right to require dismissal from site, workers deemed incompetent or careless.
- .3 Decisions as to standard or fitness of quality of work in cases of dispute rest solely with Ministerial Representative whose decision is final.

## **1.9 CO-ORDINATION**

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

## **1.10 REMEDIAL WORK**

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

## **1.11 EXISTING UTILITIES**

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

**END OF SECTION**



## **PARTIE 1 - GENERAL**

### **1.1 RELATED SECTIONS**

- .1 This section is of a general nature and provides information that could relate to all other section of the contract documents.

### **1.2 MEASUREMENT FOR PAYMENT**

- .1 The work related to cleaning is not measurable for payment and must be included in the cost of work for which it is required.

### **1.3 SITE CLEANLINESS**

- .1 Maintain the site in tidy condition, free from accumulation of waste and debris, including that caused by other entities.
- .2 Remove waste materials from site at daily regularly scheduled times or dispose of as directed by Ministerial 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 Provide and use marked separate bins for recycling. Refer to Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
- .6 Dispose of waste materials and debris off site at designated dumping areas.
- .7 Store hazardous waste in appropriate containers and remove from premises at end of each working day.

### **1.4 FINAL CLEANING**

- .1 At the point of substantial completion remove surplus products, tools and construction 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 including that caused by Owner or other Contractors when located in work area.
- .5 Remove waste materials from site at regularly scheduled times or dispose of as directed by Ministerial Representative. 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 Remove dirt and other disfiguration from exterior surfaces.

## **1.5 WASTE MANAGEMENT AND DISPOSAL**

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

## **PARTIE 2 - EXECUTION**

### **2.1 RESPONSABILITIES OF THE CONTRACTOR**

- .1 Ensure the cleanliness of the work site and do all that is necessary to guarantee the site is safe and clean.
- .2 In the case of non-compliance, the Ministerial Representative will request corrective measure to be completed immediately or risk a stop work order.
- .3 Claims for financial compensation will not be accepted for work related to non-compliance and for operations related to this section.

**END OF SECTION**



## **PARTIE 1 - GENERAL**

### **1.1 RELATED SECTIONS**

- .1 This section is general in nature and refers to information that can be connected to each section of the tender documents.

### **1.2 WASTE MANAGEMENT GOALS**

- .1 Prior to start of work conduct meeting with Ministerial Representative to review and discuss PWGSC's Waste Management Plan and Goals.
- .2 PWGSC's Waste Management Goal: minimize total Project Waste to be diverted from landfill sites. Provide Ministerial Representative documentation certifying that waste management, recycling, reuse of recyclable and reusable materials have been extensively practiced.
- .3 Accomplish maximum control of solid construction waste.
- .4 Preserve environment and prevent pollution and environment damage.

### **1.3 MEASUREMENT FOR PAYMENT**

- .1 Unless otherwise indicated, the work related to construction/demolition waste management and disposal is not measurable for payment and must be included in the cost of work for which it is required.

### **1.4 DEFINITIONS**

- .1 Class III: non-hazardous waste - construction renovation and demolition waste.
- .2 Cost/Revenue Analysis Workplan (CRAW): based on information from WRW, and intended as financial tracking tool for determining economic status of waste management practices.
- .3 Demolition Waste Audit (DWA): relates to actual waste generated from project.
- .4 Inert Fill: inert waste - exclusively asphalt and concrete.
- .5 Materials Source Separation Program (MSSP): consists of series of ongoing activities to separate reusable and recyclable waste material into material categories from other types of waste at point of generation.
- .6 Recyclable: ability of product or material to be recovered at end of its life cycle and re-manufactured into new product for reuse.

- .7 Recycle: process by which waste and recyclable materials are transformed or collected for purpose of being transferred into new products.
- .8 Recycling: process of sorting, cleansing, treating and reconstituting solid waste and other discarded materials for purpose of using in altered form. Recycling does not include burning, incinerating, or thermally destroying waste.
- .9 Reuse: repeated use of product in same form but not necessarily for same purpose. Reuse includes:
  - .1 Salvaging reusable materials from re-modelling projects, before demolition stage, for resale, reuse on current project or for storage for use on future projects.
  - .2 Returning reusable items including pallets or unused products to vendors.
- .10 Salvage: removal of structural and non-structural materials from deconstruction/disassembly projects for purpose of reuse or recycling.
- .11 Separate condition: refers to waste sorted into individual types.
- .12 Source separation: acts of keeping different types of waste materials separate beginning from first time they became waste.
- .13 Waste Management Co-ordinator (WMC): contractor representative responsible for supervising waste management activities as well as coordinating related, required submittal and reporting requirements.
- .14 Waste Reduction Workplan (WRW): written report which addresses opportunities for reduction, reuse, or recycling of materials.

## **1.5 DOCUMENTS**

- .1 Maintain at job site, one copy of following documents:
  - .1 Waste Reduction Workplan.
  - .2 Material Source Separation Plan.

## **1.6 SUBMITTALS**

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Prepare and submit following prior to project start-up:
  - .1 Submit 2 copies of completed Waste Reduction Workplan (WRW)
  - .2 Submit 2 copies of Materials Source Separation Program (MSSP) description.

- .3 Submit before final payment summary of waste materials salvaged for reuse, recycling or disposal by project using deconstruction/disassembly material audit form.
  - .1 Failure to submit could result in hold back of final payment.
  - .2 Provide receipts, scale tickets, waybills, and show quantities and types of materials reused, recycled, co-mingled and separated off-site or disposed of.
  - .3 For each material reused, sold or recycled from the project, include the quantity in tonnes identifying type, size and the destination.
  - .4 For each material landfilled or incinerated from the project, include the quantity in tonnes and identity of landfill, incinerator or transfer station.

## **1.7 WASTE REDUCTION WORKPLAN (WRW)**

- .1 Prepare WRW prior to project start-up.
- .2 WRW should include but not be limited to:
  - .1 Destination of materials listed.
  - .2 Deconstruction/disassembly techniques and sequencing.
  - .3 Schedule for deconstruction/disassembly.
  - .4 Location.
  - .5 Security.
  - .6 Protection.
  - .7 Clear labelling of storage areas.
  - .8 Details on materials handling and removal procedures.
  - .9 Quantities for materials to be salvaged for reuse or recycled and materials sent to landfill.
- .3 Structure WRW to prioritize actions and follow 3R's hierarchy, with Reduction as first priority, followed by Reuse, then Recycle.
- .4 Describe management of waste.
- .5 Post WRW or summary where workers at site are able to review content.

- .6 Set realistic goals for waste reduction, recognize existing barriers and develop strategies to overcome these barriers.
- .7 Monitor and report on waste reduction by documenting total volume and cost of actual waste removed from project.

## **1.8 MATERIALS SOURCE SEPARATION PROGRAM (MSSP)**

- .1 Prepare MSSP and have ready for use prior to project start-up.
- .2 Implement MSSP for waste generated on project in compliance with approved methods and as reviewed by Ministerial Representative.
- .3 Provide on-site facilities for collection, handling, and storage of anticipated quantities of reusable and recyclable materials.
- .4 Provide containers to deposit reusable and recyclable materials.
- .5 Locate containers in locations, to facilitate deposit of materials without hindering daily operations.
- .6 Locate separated materials in areas which minimize material damage.
- .7 Collect, handle, store on-site, and transport off-site, salvaged materials in separate condition.
  - .1 Transport to approved and authorized recycling facility to users of material for recycling.
- .8 Collect, handle, store on-site, and transport off-site, salvaged materials in combined condition.
  - .1 Ship materials to a site operating under Certificate of Approval.
  - .2 Materials must be immediately separated into required categories for reuse or recycling.

## **1.9 WASTE TREATMENT SITES**

- .1 Provide the Ministerial Representative, a list of treatment sites to which waste will be transported for recycling. The list must be given to the Ministerial Representative before starting work.

## **PARTIE 2 - PRODUCTS**

### **2.1 NOT USED**

- .1 NOT USED

## **PARTIE 3 - EXECUTION**

### **3.1 GENERAL**

- .1 Do work in compliance with WRW.
- .2 Handle waste materials not reused, salvaged, or recycled in accordance with appropriate regulations and codes.

### **3.2 CLEANING**

- .1 Remove tools and waste materials on completion of work, and leave work area in clean and orderly condition.
- .2 Clean-up work area as work progresses.
- .3 Source separate materials to be reused/recycled into specified sort areas.

### **3.3 WASTE REDUCTION WORKPLAN (WRW)**

- .1 Schedule B:

Material Category	Person(s) Responsible	Total Quantity of Waste (unit)	Reused Amount (units)		Recycled Amount (unit)		Material(s) Destination
			Projected	Actual	Projected	Actual	

### **3.4 CANADIAN GOVERNMENTAL DEPARTMENTS CHIEF RESPONSIBILITY FOR THE ENVIRONMENT**

.1 Government Chief Responsibility for the Environment:

Ministère du Développement durable, de l'Environnement, de la faune et des  
Parcs  
850, boulevard Vanier  
Laval (Québec)  
H7C 2M7  
450-661-2008

**END OF SECTION**

## **PARTIE 1 - GENERAL**

### **1.1 RELATED SECTIONS**

- .1 This section is general in nature and refers to information that can be connected to each section of the tender documents.

### **1.2 GENERAL REQUIREMENTS RELATED TO MATERIALS AND PRODUCTS**

- .1 Conform to the requirements of section 01 61 00 – Common Product Requirements.
- .2 The instructions must be prepared by competent persons with the knowledge required for the operation and maintenance of the products described.
- .3 Two (2) weeks prior to substantial completion, submit to the Ministerial Representative four (4) final copies of operating and maintenance manuals, in English and French, when required.
- .4 Provide spare parts, maintenance materials and special tools of same quality and manufacture as products provided in work.
- .5 Upon request, provide documents confirming the type, source and quality of products supplied.
- .6 Defective products will be rejected, even if they have previously been inspected and they must be replaced at no additional cost.
- .7 Assume the cost of transporting products.

### **1.3 FORMAT**

- .1 Organize data as an instructional manual.
- .2 Binders: vinyl, hard covered, 3 'D' ring, loose leaf 219 x 279 mm with spine and face pockets.
- .3 When multiple binders are used, correlate data into related consistent groupings.
  - .1 Identify contents of each binder on spine.
- .4 Cover: identify each binder with type or printed title 'Project Record Documents'; list title of project and identify subject matter of contents.
- .5 Arrange content by process flow, under Section numbers and sequence of table of contents.

- .6 Provide tabbed fly leaf for each separate product and system, with typed description of product and major component parts of equipment.
- .7 Text: manufacturer's printed data, or typewritten data.
- .8 Drawings: provide with reinforced punched binder tab.
- .9 Provide 1:1 scaled CAO files in dwg format on CD.

#### **1.4 CONTENTS - PROJECT RECORD DOCUMENTS**

- .1 Table of contents for each volume: provide title of project;
  - .1 Date of submission.
  - .2 Name, addresses, and telephone numbers of consultant and contractor with name of responsible parties.
  - .3 Schedule of products and systems, indexed to content of volume.
- .2 For each product or system:
  - .1 List names, addresses and telephone numbers of subcontractors and suppliers, including local source of supplies and replacement parts.
- .3 Product data: mark each sheet to identify specific products and component parts, and data applicable to installation; delete inapplicable information.
- .4 Drawings: supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams.
- .5 Typewritten text: as required to supplement product data.
- .6 Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions.

#### **1.5 AS -BUILT DOCUMENTS AND SAMPLES**

- .1 Maintain, in addition to requirements in section General Conditions, at site for Ministerial Representative, one record copy of:
  - .1 Contract drawings.
  - .2 Specifications.
  - .3 Addenda.



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

## **1.6 EQUIPMENT AND SYSTEMS**

- .1 For each item of equipment and each system, include description of unit or system, and component parts.
  - .1 Give function, normal operation characteristics and limiting conditions.
  - .2 Include performance curves with engineering data and tests, and complete nomenclature and commercial number of replaceable parts.
- .2 Panel board circuit directories: provide electrical service characteristics, controls, and communications.
- .3 Include installed colour coded wiring diagrams.
- .4 Operating procedures: include start-up, break-in, and routine normal operating instructions and sequences.
  - .1 Include regulation, control, stopping, shut-down, and emergency instructions.
  - .2 Include summer, winter, and any special operating instructions.

- .5 Maintenance requirements: include routine procedures and guide for trouble-shooting; disassembly, repair and reassembly instructions and alignment, adjusting, balancing, and checking instructions.
- .6 Provide servicing and lubrication schedule, and list of lubricants required.
- .7 Include manufacturer's printed operation and maintenance instructions.
- .8 Include sequence of operation by controls manufacturer.
- .9 Provide original manufacturer's parts list, illustrations, assembly drawings and diagrams required for maintenance.
- .10 Provide installed control diagrams by controls manufacturer.
- .11 Provide list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.
- .12 Additional requirements: as specified in individual specification sections.

## **1.7 MAINTENANCE MATERIALS**

- .1 Spare Parts:
  - .1 Provide spare parts in quantities specified in individual specification sections.
  - .2 Provide items of same manufacture and quality as items in work.
  - .3 Deliver to location as directed by Ministerial Representative; place and store.
  - .4 Receive and catalogue items.
    - .1 Submit inventory listing to Ministerial Representative.
    - .2 Include approved listings in maintenance manual.
  - .5 Obtain receipt for delivered products and submit prior to final payment.

## **1.8 DELIVERY, STORAGE AND HANDLING**

- .1 Store spare parts, maintenance materials and special tools in a manner to prevent damage or deterioration.
- .2 Store in original and undamaged condition with manufacturer's seal and labels intact.
- .3 Store components subject to damage from weather in weatherproof enclosures.

- .4 Store freezable materials in a heated and ventilated room.
- .5 Remove and replace damaged products at own expense and for review by Ministerial Representative.

### **1.9 WARRANTY TAGS**

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

### **1.10 LIST OF WORKS**

- .1 At each well and / or excavation trenches, make a precise statement of all accessories (elbow, tee, valve, service connection, plug, etc.), existing and abandoned pipes, all underground structures to allow the location of these elements after backfilling.
- .2 Give the Ministerial Representative three (3) hard copies and three (3) CDs of the statement.

**END OF SECTION**



## **PARTIE 1 - GENERAL**

### **1.1 SUMMARY**

- .1 Related requirements
  - .1 Section 01 91 31 - Commissioning (CX) Plan.
  - .2 Section 01 91 33 - Commissioning Forms.
  - .3 Section 01 91 41 - Commissioning Training.
- .2 Acronyms:
  - .1 AFD - Alternate Forms of Delivery, service provider.
  - .2 BMM - Building Management Manual.
  - .3 Cx - Commissioning.
  - .4 EMCS - Energy Monitoring and Control Systems.
  - .5 O M - Operation and Maintenance.
  - .6 PI - Product Information.
  - .7 PV - Performance Verification.
  - .8 TAB - Testing, Adjusting and Balancing.

### **1.2 GENERAL**

- .1 Cx is a planned program of tests, procedures and checks carried out systematically on systems and integrated systems of the finished Project. Cx is performed after systems and integrated systems are completely installed, functional and Contractor's Performance Verification responsibilities have been completed and approved. Objectives:
  - .1 Verify installed equipment, systems and integrated systems operate in accordance with contract documents and design criteria and intent.
  - .2 Ensure appropriate documentation is compiled into the BMM.
  - .3 Effectively train O M staff.

- .2 Contractor assists in Cx process, operating equipment and systems, troubleshooting and making adjustments as required.
  - .1 Systems to be operated at full capacity under various modes to determine if they function correctly and consistently at peak efficiency. Systems to be interactively with each other as intended in accordance with Contract Documents and design criteria.
  - .2 During these checks, adjustments to be made to enhance performance to meet environmental or user requirements.
- .3 Design Criteria: as per client's requirements or determined by designer. To meet Project functional and operational requirements.
- .4 AFD managed projects the term Departmental Representative in Cx specifications to be interpreted as AFD Service Provider.

### **1.3 COMMISSIONING OVERVIEW**

- .1 Section 01 91 31 - Commissioning (Cx) Plan.
- .2 For Cx responsibilities refer to Section 01 91 31 - Commissioning (Cx) Plan.
- .3 Cx to be a line item of Contractor's cost breakdown.
- .4 Cx activities supplement field quality and testing procedures described in relevant technical sections.
- .5 Cx is conducted in concert with activities performed during stage of project delivery. Cx identifies issues in Planning and Design stages which are addressed during Construction and Cx stages to ensure the built facility is constructed and proven to operate satisfactorily under weather, environmental and occupancy conditions to meet functional and operational requirements. Cx activities include transfer of critical knowledge to facility operational personnel.
- .6 Departmental Representative will issue Interim Acceptance Certificate when:
  - .1 Completed Cx documentation has been received, reviewed for suitability and approved by Departmental Representative.
  - .2 Equipment, components and systems have been commissioned.
  - .3 O M training has been completed.

#### **1.4 NON-CONFORMANCE TO PERFORMANCE VERIFICATION REQUIREMENTS**

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

#### **1.5 PRE-CX REVIEW**

- .1 Before Construction:
  - .1 Review contract documents, confirm by writing to Departmental Representative.
    - .1 Adequacy of provisions for Cx.
    - .2 Aspects of design and installation pertinent to success of Cx.
- .2 During Construction:
  - .1 Co-ordinate provision, location and installation of provisions for Cx.
- .3 Before start of Cx:
  - .1 Have completed Cx Plan up-to-date.
  - .2 Ensure installation of related components, equipment, sub-systems, systems is complete.
  - .3 Fully understand Cx requirements and procedures.
  - .4 Have Cx documentation shelf-ready.
  - .5 Understand completely design criteria and intent and special features.
  - .6 Submit complete start-up documentation to Departmental Representative.
  - .7 Have Cx schedules up-to-date.
  - .8 Ensure systems have been cleaned thoroughly.
  - .9 Complete TAB procedures on systems, submit TAB reports to Departmental Representative for review and approval.

- .10 Ensure "As-Built" system schematics are available.
- .4 Inform Departmental Representative in writing of discrepancies and deficiencies on finished works.

## **1.6 CONFLICTS**

- .1 Report conflicts between requirements of this section and other sections to Departmental Representative before start-up and obtain clarification.
- .2 Failure to report conflict and obtain clarification will result in application of most stringent requirement.

## **1.7 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submittals: in accordance with section 01 33 00 - Submittal Procedures.
  - .1 Submit no later than 4 weeks after award of Contract:
    - .1 Name of Contractor's Cx agent.
    - .2 Draft Cx documentation.
    - .3 Preliminary Cx schedule.
  - .2 Request in writing to Departmental Representative for changes to submittals and obtain written approval at least 8 weeks prior to start of Cx.
  - .3 Submit proposed Cx procedures to Departmental Representative where not specified and obtain written approval at least 4 weeks prior to start of Cx.
  - .4 Provide additional documentation relating to Cx process required by Departmental Representative.

## **1.8 COMMISSIONING DOCUMENTATION**

- .1 Refer to section 01 91 33 - Commissioning (Cx) Forms: Installation Check Lists and Product Information (PI) / Performance Verification (PV) Forms for requirements and instructions for use.
- .2 Departmental Representative to review and approve Cx documentation.
- .3 Provide completed and approved Cx documentation to Departmental Representative.



## **1.9 COMMISSIONING SCHEDULE**

- .1 Provide detailed Cx schedule as part of construction schedule in accordance with section 01 32 16.06 - Construction Progress Schedule - Critical Path Method (CPM).
- .2 Provide adequate time for Cx activities prescribed in technical sections and commissioning sections including:
  - .1 Approval of Cx reports.
  - .2 Verification of reported results.
  - .3 Repairs, retesting, re-commissioning, re-verification.
  - .4 Training.

## **1.10 COMMISSIONING MEETINGS**

- .1 Convene Cx meetings following project meetings: section 01 32 16.06 - Construction Progress Schedule - Critical Path Method (CPM) and as specified herein.
- .2 Purpose: to resolve issues, monitor progress, identify deficiencies, relating to Cx.
- .3 Continue Cx meetings on regular basis until commissioning deliverables have been addressed.
- .4 At 60% construction completion stage. section 01 32 16.06 - Construction Progress Schedule - Critical Path Method (CPM), Departmental Representative to call a separate Cx scope meeting to review progress, discuss schedule of equipment start-up activities and prepare for Cx. Issues at meeting to include:
  - .1 Review duties and responsibilities of Contractor and subcontractors, addressing delays and potential problems.
  - .2 Determine the degree of involvement of trades and manufacturer's representatives in the commissioning process.
- .5 Thereafter Cx meetings to be held until project completion and as required during equipment start-up and functional testing period.
- .6 Meeting will be chaired by Departmental Representative, who will record and distribute minutes.
- .7 Ensure subcontractors and relevant manufacturer representatives are present at 60% and subsequent Cx meetings and as required.

### **1.11 STARTING AND TESTING**

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

### **1.12 WITNESSING OF STARTING AND TESTING**

- .1 Provide 14 days notice prior to commencement.
- .2 Departmental Representative to witness of start-up and testing.
- .3 Contractor's Cx Agent to be present at tests performed and documented by sub-trades, suppliers and equipment manufacturers.

### **1.13 MANUFACTURER'S INVOLVEMENT**

- .1 Factory testing: manufacturer to:
  - .1 Coordinate time and location of testing.
  - .2 Provide testing documentation for approval by Departmental Representative.
  - .3 Arrange for Departmental Representative to witness tests.
  - .4 Obtain written approval of test results and documentation from Departmental Representative before delivery to site.
- .2 Obtain manufacturers installation, start-up and operations instructions prior to start-up of components, equipment and systems and review with Departmental Representative
  - .1 Compare completed installation with manufacturer's published data, record discrepancies, and review with manufacturer.
  - .2 Modify procedures detrimental to equipment performance and review same with manufacturer before start-up.
- .3 Integrity of warranties:
  - .1 Use manufacturer's trained start-up personnel where specified elsewhere in other divisions or required to maintain integrity of warranty.
  - .2 Verify with manufacturer that testing as specified will not void warranties.

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

#### **1.14 PROCEDURES**

- .1 Verify that equipment and systems are complete, clean, and operating in normal and safe manner prior to conducting start-up, testing and Cx.
- .2 Conduct start-up and testing in following distinct phases:
  - .1 Included in delivery and installation:
    - .1 Verification of conformity to specification, approved shop drawings and completion of PI report forms.
    - .2 Visual inspection of quality of installation.
  - .2 Start-up: follow accepted start-up procedures.
  - .3 Operational testing: document equipment performance.
  - .4 System PV: include repetition of tests after correcting deficiencies.
  - .5 Post-substantial performance verification: to include fine-tuning.
- .3 Correct deficiencies and obtain approval from Departmental Representative after distinct phases have been completed and before commencing next phase.
- .4 Document require tests on approved PV forms.
- .5 Failure to follow accepted start-up procedures will result in re-evaluation of equipment by an independent testing agency selected by Departmental Representative. If results reveal that equipment start-up was not in accordance with requirements, and resulted in damage to equipment, implement following:
  - .1 Minor equipment/systems: implement corrective measures approved by Departmental Representative.
  - .2 Major equipment/systems: if evaluation report concludes that damage is minor, implement corrective measures approved by Departmental Representative.

- .3 If evaluation report concludes that major damage has occurred, Departmental Representative shall reject equipment.
  - .1 Rejected equipment to be remove from site and replace with new.
  - .2 Subject new equipment/systems to specified start-up procedures.

### **1.15 START-UP DOCUMENTATION**

- .1 Assemble start-up documentation and submit to Departmental Representative for approval before commencement of commissioning.
- .2 Start-up documentation to include:
  - .1 Factory and on-site test certificates for specified equipment.
  - .2 Pre-start-up inspection reports.
  - .3 Signed installation/start-up check lists.
  - .4 Start-up reports,
  - .5 Step-by-step description of complete start-up procedures, to permit Departmental Representative to repeat start-up at any time.

### **1.16 OPERATION AND MAINTENANCE OF EQUIPMENT AND SYSTEMS**

- .1 After start-up, operate and maintain equipment and systems as directed by equipment/system manufacturer.
- .2 With assistance of manufacturer develop written maintenance program and submit Departmental Representative for approval before implementation.
- .3 Operate and maintain systems for length of time required for commissioning to be completed.
- .4 After completion of commissioning, operate and maintain systems until issuance of certificate of interim acceptance.

### **1.17 TEST RESULTS**

- .1 If start-up, testing and/or PV produce unacceptable results, repair, replace or repeat specified starting and/or PV procedures until acceptable results are achieved.
- .2 Provide manpower and materials, assume costs for re-commissioning.

## **1.18 START OF COMMISSIONING**

- .1 Notify Departmental Representative at least 21 days prior to start of Cx.
- .2 Start Cx after elements of building affecting start-up and performance verification of systems have been completed.

## **1.19 INSTRUMENTS / EQUIPMENT**

- .1 Submit to Departmental Representative for review and approval:
  - .1 Complete list of instruments proposed to be used.
  - .2 Listed data including, serial number, current calibration certificate, calibration date, calibration expiry date and calibration accuracy.
- .2 Provide the following equipment as required:
  - .1 2-way radios.
  - .2 Ladders.
  - .3 Equipment as required to complete work.

## **1.20 COMMISSIONING PERFORMANCE VERIFICATION**

- .1 Carry out Cx:
  - .1 Under actual operating conditions, over entire operating range, in all modes.
  - .2 On independent systems and interacting systems.
- .2 Cx procedures to be repeatable and reported results are to be verifiable.
- .3 Follow equipment manufacturer's operating instructions.
- .4 EMCS trending to be available as supporting documentation for performance verification.

## **1.21 WITNESSING COMMISSIONING**

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

## **1.22 AUTHORITIES HAVING JURISDICTION**

- .1 Where specified start-up, testing or commissioning procedures duplicate verification requirements of authority having jurisdiction, arrange for authority to witness procedures so as to avoid duplication of tests and to facilitate expedient acceptance of facility.
- .2 Obtain certificates of approval, acceptance and compliance with rules and regulation of authority having jurisdiction.
- .3 Provide copies to Departmental Representative within 5 days of test and with Cx report.

## **1.23 COMMISSIONING CONSTRAINTS**

- .1 Since access into secure or sensitive areas will be very difficult after occupancy it is necessary to complete Cx of occupancy, weather, and seasonal sensitive equipment and systems in these areas before issuance of the Interim Certificate, using, if necessary, simulated thermal loads.
- .2 The Contractor shall take all measures and precautions to finalize its patches, its trials, its settings and simulations at each stage of phasing required for this work. Floor areas of work completed by the phasing will then occupied and prohibits to the Contractor.

## **1.24 EXTRAPOLATION OF RESULTS**

- .1 Where Cx of weather, occupancy, or seasonal-sensitive equipment or systems cannot be conducted under near-rated or near-design conditions, extrapolate part-load results to design conditions when approved by Departmental Representative in accordance with equipment manufacturer's instructions, using manufacturer's data, with manufacturer's assistance and using approved formulae.

## **1.25 EXTENT OF VERIFICATION**

- .1 Elsewhere:
  - .1 Provide manpower and instrumentation to verify up to 30 % of reported results, unless specified otherwise in other sections.
- .2 Number and location to be at discretion of Departmental Representative.
- .3 Conduct tests repeated during verification under same conditions as original tests, using same test equipment, instrumentation.
- .4 Review and repeat commissioning of systems if inconsistencies found in more than 20 % of reported results.

- .5 Perform additional commissioning until results are acceptable to Departmental Representative.

### **1.26 REPEAT VERIFICATIONS**

- .1 Assume costs incurred by Departmental Representative for third and subsequent verifications where:
  - .1 Verification of reported results fail to receive Departmental Representative's approval.
  - .2 Repetition of second verification again fails to receive approval.
  - .3 Departmental Representative deems Contractor's request for second verification was premature.

### **1.27 SUNDRY CHECKS AND ADJUSTMENTS**

- .1 Make adjustments and changes which become apparent as Cx proceeds.
- .2 Perform static and operational checks as applicable and as required.

### **1.28 DEFICIENCIES, FAULTS, DEFECTS**

- .1 Correct deficiencies found during start-up and Cx to satisfaction of Departmental Representative.
- .2 Report problems, faults or defects affecting Cx to Departmental Representative in writing. Stop Cx until problems are rectified. Proceed with written approval from Departmental Representative.

### **1.29 COMPLETION OF COMMISSIONING**

- .1 Upon completion of Cx leave systems in normal operating mode.
- .2 Except for warranty and seasonal verification activities specified in Cx specifications, complete Cx prior to issuance of Interim Certificate of Completion.
- .3 Cx to be considered complete when contract Cx deliverables have been submitted and accepted by Departmental Representative.

### **1.30 ACTIVITIES UPON COMPLETION OF COMMISSIONING**

- .1 When changes are made to baseline components or system settings established during Cx process, provide updated Cx form for affected item.

### **1.31 TRAINING**

- .1 In accordance with section 01 91 41 - Commissioning (Cx) - Training.

### **1.32 MAINTENANCE MATERIALS, SPARE PARTS, SPECIAL TOOLS**

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

### **1.33 OCCUPANCY**

- .1 Cooperate fully with Departmental Representative during stages of acceptance and occupancy of facility.

### **1.34 INSTALLED INSTRUMENTATION**

- .1 Use instruments installed under Contract for TAB and PV if:
  - .1 Accuracy complies with these specifications.
  - .2 Calibration certificates have been deposited with Departmental Representative.
- .2 Calibrated EMCS sensors may be used to obtain performance data provided that sensor calibration has been completed and accepted.

### **1.35 PERFORMANCE VERIFICATION TOLERANCES**

- .1 Application tolerances:
  - .1 Specified range of acceptable deviations of measured values from specified values or specified design criteria. Except for special areas, to be within +/- 10% of specified values.
- .2 Instrument accuracy tolerances:
  - .1 To be of higher order of magnitude than equipment or system being tested.
- .3 Measurement tolerances during verification:
  - .1 Unless otherwise specified actual values to be within +/- 2 % of recorded values.

### **1.36 OWNER'S PERFORMANCE TESTING**

- .1 Performance testing of equipment or system by Departmental Representative will not relieve Contractor from compliance with specified start-up and testing procedures.



## **PARTIE 2 - PRODUCTS**

### **2.1 NOT USED**

.1 Not Used.

## **PARTIE 3 - EXECUTION**

### **3.1 NOT USED**

.1 Not Used.

**END OF SECTION**



## **PARTIE 1 - GENERAL**

### **1.1 RELATED REQUIREMENTS**

- .1 Section 01 91 13 - General commissioning (CX) Requirements.

### **1.2 REFERENCES**

- .1 American Water Works Association (AWWA)
- .2 National Fire Protection Association (NFPA)
  - .1 NFPA-13-02, Installation of Sprinkler Systems Handbook.
  - .2 NFPA-14-02, Automatic Sprinkler Systems Handbook.
  - .3 NFPA-20-03, Standard for the Installation of Stationary Fire Pumps for Fire Protection.
- .3 Public Works and Government Services Canada (PWGSC)
  - .1 PWGSC - Commissioning Guidelines CP.4 -3rd edition-03.
- .4 Underwriters' Laboratories of Canada (ULC)

### **1.3 GENERAL**

- .1 Provide a fully functional facility:
  - .1 Systems, equipment and components must be operational in relation to the terms of phasing of work.
  - .2 Systems, equipment and components meet user's functional requirements before date of acceptance, and operate consistently at peak efficiencies and within specified energy budgets under normal loads.
  - .3 Facility user and O M personnel have been fully trained in aspects of installed systems.
  - .4 Optimized life cycle costs.
  - .5 Complete documentation relating to installed equipment and systems.
- .2 Term "Cx" in this section means "Commissioning".

- .3 Use this Cx Plan as master planning document for Cx:
  - .1 Outlines organization, scheduling, allocation of resources, documentation, pertaining to implementation of Cx.
  - .2 Communicates responsibilities of team members involved in Cx Scheduling, documentation requirements, and verification procedures.
  - .3 Sets out deliverables relating to O M, process and administration of Cx.
  - .4 Describes process of verification of how built works meet design requirements.
  - .5 Produces a complete functional system prior to issuance of Certificate of Occupancy.
  - .6 Management tool that sets out scope, standards, roles and responsibilities, expectations, deliverables, and provides:
    - .1 Overview of Cx.
    - .2 General description of elements that make up Cx Plan.
    - .3 Process and methodology for successful Cx.
- .4 Acronyms:
  - .1 Cx - Commissioning.
  - .2 BMM - Building Management Manual.
  - .3 EMCS - Energy Monitoring and Control Systems.
  - .4 MSDS - Material Safety Data Sheets.
  - .5 PI - Product Information.
  - .6 PV - Performance Verification.
  - .7 TAB - Testing, Adjusting and Balancing.
  - .8 WHMIS - Workplace Hazardous Materials Information System.
- .5 Commissioning terms used in this Section:
  - .1 Bumping: short term start-up to prove ability to start and prove correct rotation.
  - .2 Deferred Cx - Cx activities delayed for reasons beyond Contractor's control due to lack of occupancy, weather conditions, need for heating/cooling loads.

#### **1.4 DEVELOPMENT OF 100% CX PLAN**

- .1 Cx Plan to be 95% completed before added into Project Specifications.
- .2 Cx Plan to be 100% completed within 8 weeks of award of contract to take into account:
  - .1 Approved shop drawings and product data.
  - .2 Approved changes to contract.
  - .3 Contractor's project schedule.
  - .4 Cx schedule.
  - .5 Contractor's, sub-contractor's, suppliers' requirements.
  - .6 Project construction team's and Cx team's requirements.
- .3 Submit completed Cx Plan to Departmental Representative and obtain written approval.

#### **1.5 REFINEMENT OF CX PLAN**

- .1 During construction phase, revise, refine and update Cx Plan to include:
  - .1 Changes resulting from Client program modifications.
  - .2 Approved design and construction changes.
- .2 Revise, refine and update every 6 weeks during construction phase. At each revision, indicate revision number and date.
- .3 Submit each revised Cx Plan to Departmental Representative for review and obtain written approval.
- .4 Include testing parameters at full range of operating conditions and check responses of equipment and systems.

#### **1.6 COMPOSITION, ROLES AND RESPONSIBILITIES OF CX TEAM**

- .1 Departmental Representative to maintain overall responsibility for project and is sole point of contact between members of commissioning team.
- .2 Project Manager will select Cx Team consisting of following members:
  - .1 Consultant Design Quality Review Team: during construction, will conduct periodic site reviews to observe general progress.

- .2 Quality Assurance Commissioning Manager: ensures Cx activities are carried out to ensure delivery of a fully operational project including:
  - .1 Review of Cx documentation from operational perspective.
  - .2 Review for performance, reliability, durability of operation, accessibility, maintainability, operational efficiency under conditions of operation.
  - .3 Protection of health, safety and comfort of occupants and O M personnel.
  - .4 Monitoring of Cx activities, training, development of Cx documentation will be updated when the contractor will have the contract .
  - .5 Work closely with members of Cx Team.
- .3 .Departmental Representative is responsible for:
  - .1 Organizing Cx.
  - .2 Monitoring operations Cx activities.
  - .3 Witnessing, certifying accuracy of reported results.
  - .4 Witnessing and certifying TAB and other tests.
  - .5 Developing BMM.
  - .6 Ensuring implementation of final Cx Plan.
  - .7 Performing verification of performance of installed systems and equipment.
  - .8 Implementation of Training Plan.
- .4 Construction Team: contractor, sub-contractors, suppliers and support disciplines, is responsible for construction/installation in accordance with contract documents, including:
  - .1 Testing.
  - .2 TAB.
  - .3 Performance of Cx activities.
  - .4 Delivery of training and Cx documentation.
  - .5 Assigning one person as point of contact with Consultant and PWGSC Cx Manager for administrative and coordination purposes.

- .5 Contractor's Cx agent implements specified Cx activities including:
  - .1 Demonstrations.
  - .2 Training.
  - .3 Testing.
  - .4 Preparation, submission of test reports.
- .6 Property Manager: represents lead role in Operation Phase and onwards and is responsible for:
  - .1 Receiving facility.
  - .2 Day-To-Day operation and maintenance of facility.

## **1.7 CX PARTICIPANTS**

- .1 Employ the following Cx participants to verify performance of equipment and systems:
  - .1 Installation contractor/subcontractor:
    - .1 Equipment and systems except as noted.
  - .2 Equipment manufacturer: equipment specified to be installed and started by manufacturer.
    - .1 To include performance verification.
  - .3 Specialist subcontractor: equipment and systems supplied and installed by specialist subcontractor.
  - .4 Specialist Cx agency:
    - .1 Possessing specialist qualifications and installations providing environments essential to client's program but are outside scope or expertise of Cx specialists on this project.
  - .5 Client: responsible for intrusion and access security systems.
  - .6 Ensure that Cx participant:
    - .1 Could complete work within scheduled time frame.
    - .2 Available for emergency and troubleshooting service during first year of occupancy by user for adjustments and modifications outside responsibility of O M personnel, including:

- .1 Modify ventilation rates to meet changes in off-gassing.
- .2 Changes to heating or cooling loads beyond scope of EMCS.
- .3 Changes to EMCS control strategies beyond level of training provided to O M personnel.
- .4 Redistribution of electrical services.
- .5 Modifications of fire alarm systems.
- .6 Modifications to voice communications systems.
- .7 Provide names of participants to Departmental Representative and details of instruments and procedures to be followed for Cx 3 months prior to starting date of Cx for review and approval.

## **1.8 EXTENT OF CX**

- .1 Commission mechanical systems and associated equipment:
  - .1 Plumbing systems:
    - .1 Domestic cold water system.
    - .2 Regular sanitary waste systems.
  - .2 HVAC systems:
    - .1 Existing system 10S/ 10E (10E existing).
    - .2 System VA-2.
    - .3 System VA-1 (existing system)
    - .4 System VA-2.
    - .5 Compressor/condenser CP-CD-1.
    - .6 Compressor/condenser CP-CD-2.
    - .7 Fresh air , air supply and exhaust systems.
  - .3 Noise and vibration control systems for mechanical systems.
  - .4 Seismic restraint and control measures.
  - .5 IAQ environmental control systems:



- .1 Indoor conditions in areas listed herein:
- .2 Indoor air quality (IAQ) in areas listed herein:
- .3 Environmental control systems in areas listed herein:
- .6 EMCS:
  - .1 Building automation system
  - .2 Local network.
  - .3 Building controller.
- .2 Commission electrical systems and equipment:
  - .1 Low voltage below 750 V:
    - .1 Low voltage equipment.
    - .2 Low voltage distribution systems.
  - .2 Lighting systems:
    - .1 Lighting equipment.
    - .2 Distribution systems.
    - .3 Emergency lighting systems, including battery packs.
    - .4 Fire exit emergency signage.

## **1.9 DELIVERABLES RELATING TO O M PERSPECTIVES**

- .1 General requirements:
  - .1 Compile French documentation.
  - .2 Documentation to be computer-compatible format ready for inputting for data management.
- .2 Provide deliverables:
  - .1 Warranties.
  - .2 Project record documentation.
  - .3 Inventory of spare parts, special tools and maintenance materials.

- .4 Maintenance Management System (MMS) identification system used.
- .5 WHMIS information.
- .6 MSDS data sheets.
- .7 Electrical Panel inventory containing detailed inventory of electrical circuitry for each panel board. Duplicate of inventory inside each panel.

### **1.10 DELIVERABLES RELATING TO THE CX PROCESS**

- .1 General:
  - .1 Start-up, testing and Cx requirements, conditions for acceptance and specifications form part of relevant technical sections of these specifications.
- .2 Definitions:
  - .1 Cx as used in this section includes:
    - .1 Cx of components, equipment, systems, subsystems, and integrated systems.
    - .2 Factory inspections and performance verification tests.
- .3 Deliverables: provide:
  - .1 Cx Specifications.
  - .2 Startup, pre-Cx activities and documentation for systems, and equipment.
  - .3 Completed installation checklists (ICL).
  - .4 Completed product information (PI) report forms.
  - .5 Completed performance verification (PV) report forms.
  - .6 Results of Performance Verification Tests and Inspections.
  - .7 Description of Cx activities and documentation.
  - .8 Description of Cx of integrated systems and documentation.
  - .9 Tests of following witnessed by PWGSC Design Quality Review Team:
  - .10 Tests performed by Owner/User.
  - .11 Training Plans.
  - .12 Cx Reports.

- .13 Prescribed activities during warranty period.
- .4 Departmental Representative to witness and certify tests and reports of results provided to Departmental Representative.
- .5 Departmental Representative to participate.

### **1.11 PRE-CX ACTIVITIES AND RELATED DOCUMENTATION**

- .1 Items listed in this Cx Plan include the following:
  - .1 Pre-Start-Up inspections: by Departmental Representative prior to permission to start up and rectification of deficiencies to Departmental Representative's satisfaction.
  - .2 Departmental Representative to use approved check lists.
  - .3 Departmental Representative will monitor some of these pre-start-up inspections.
  - .4 Include completed documentation with Cx report.
  - .5 Conduct pre-start-up tests: conduct pressure, static, flushing, cleaning, and "bumping" during construction as specified in technical sections. To be witnessed and certified by Departmental Representative and does not form part of Cx specifications.
  - .6 Departmental Representative will monitor some of these inspections and tests.
  - .7 Include completed documentation in Cx report.
- .2 Pre-Cx activities - MECHANICAL:
  - .1 Plumbing systems:
    - .1 "Bump" each item of equipment in its "stand-alone" mode.
    - .2 Complete pre-start-up checks and complete relevant documentation.
  - .2 HVAC equipment and systems:
    - .1 "Bump" each item of equipment in its "stand-alone" mode.
    - .2 At this time, complete pre-start-up checks and complete relevant documentation.
    - .3 After equipment has been started, test related systems in conjunction with control systems on a system-by-system basis.

- .4 Perform TAB on systems. TAB reports to be approved by Departmental Representative.
- .3 EMCS:
  - .1 EMCS trending to be available as supporting documentation for performance verification.
  - .2 Perform point-by-point testing in parallel with start-up.
  - .3 Carry out point-by-point verification.
  - .4 Demonstrate performance of systems, to be witnessed by Departmental Representative prior to start of 30 day Final Acceptance Test period.
  - .5 Perform final Cx and operational tests during demonstration period and 30 day test period.
  - .6 Only additional testing after foregoing have been successfully completed to be "Off-Season Tests".
- .3 Pre-Cx activities - ELECTRICAL:
  - .1 Low voltage distribution systems under 750 V:
    - .1 Requires independent testing agency to perform pre- energization and post-energization tests.
  - .2 Lighting systems:
    - .1 Emergency lighting systems:
      - .1 Tests to include verification of lighting levels and coverage, initially by disrupting normal power.

## **1.12 START-UP**

- .1 Start up components, equipment and systems.
- .2 Equipment manufacturer, supplier, installing specialist sub-contractor, as appropriate, to start-up, under Contractor's direction, following equipment, systems:
- .3 Departmental Representative to monitor some of these start-up activities.
  - .1 Rectify start-up deficiencies to satisfaction of Departmental Representative.
- .4 Performance Verification (PV):

- .1 Approved Cx Agent to perform.
  - .1 Repeat when necessary until results are acceptable to Departmental Representative.
- .2 Use procedures modified generic procedures to suit project requirements.
- .3 Departmental Representative to witness and certify reported results using approved PI and PV forms.
- .4 Departmental Representative to approve completed PV reports and provide to Departmental Representative.
- .5 Departmental Representative reserves right to verify up to 30% of reported results at random.
- .6 Departmental Representative reserves the right to verify redundant systems to complete the results presented.
- .7 Failure of randomly selected item shall result in rejection of PV report or report of system start-up and testing.

### **1.13 CX ACTIVITIES AND RELATED DOCUMENTATION**

- .1 Perform Cx by specified Cx agency using procedures developed by Departmental Representative and approved by Departmental Representative.
- .2 Departmental Representative to monitor Cx activities.
- .3 Upon satisfactory completion, Cx agency performing tests to prepare Cx Report using approved PV forms.
- .4 Departmental Representative to witness, certify reported results of, Cx activities and forward to Departmental Representative.
- .5 Departmental Representative reserves right to verify a percentage of reported results at no cost to contract.

### **1.14 CX OF INTEGRATED SYSTEMS AND RELATED DOCUMENTATION**

- .1 Cx to be performed by specified Cx specialist, using procedures developed by Departmental Representative and approved by Departmental Representative.
- .2 Tests to be witnessed by Departmental Representative and documented on approved report forms.
- .3 Upon satisfactory completion, Cx specialist to prepare Cx Report, to be certified by Departmental Representative and submitted to Departmental Representative for review.

- .4 Departmental Representative reserves right to verify percentage of reported results.
- .5 Integrated systems to include:
  - .1 HVAC and associated systems forming part of integrated HVAC systems.
  - .2 Indoor air quality.
  - .3 Environmental space conditions.
  - .4 Emergency lighting systems.
- .6 Identification:
  - .1 In later stages of Cx, before hand-over and acceptance Departmental Representative, Contractor, and Cx Manager to co-operate to complete inventory data sheets and provide assistance to PWGSC in full implementation of MMS identification system of components, equipment, sub-systems, systems.

#### **1.15 INSTALLATION CHECK LISTS (ICL)**

- .1 Refer to section 01 91 33 - Commissioning (Cx) Forms: Installation Check Lists and Product Information (PI) / Performance Verification (PV) Forms.

#### **1.16 PRODUCT INFORMATION (PI) REPORT FORMS**

- .1 Refer to section 01 91 33 - Commissioning (Cx) Forms: Installation Check Lists and Product Information (PI) / Performance Verification (PV) Forms.

#### **1.17 PERFORMANCE VERIFICATION (PV) REPORT**

- .1 Refer to section 01 91 33 - Commissioning (Cx) Forms: Installation Check Lists and Product Information (PI) / Performance Verification (PV) Forms.

#### **1.18 DELIVERABLES RELATING TO ADMINISTRATION OF CX**

- .1 General:
  - .1 Because of risk assessment, complete Cx of occupancy, weather and seasonal-sensitive equipment and systems in these areas before building is occupied.
  - .2 The proper functioning of redundant for safe functional operation equipment.

#### **1.19 CX SCHEDULES**

- .1 Prepare detailed critical path Cx Schedule and submit to Departmental Representative for review and approval same time as project Construction Schedule.

- .2 Cx schedule must take in account the phasing of work as presented in architecture documents. The following steps must be repeated for each phase. Training must be provided in the final phase.
- .3 Include:
  - .1 Milestones, testing, documentation, training and Cx activities of components, equipment, subsystems, systems and integrated systems, including:
    - .1 Design criteria, design intents.
    - .2 Pre-TAB review: 28 days after contract award, and before construction starts.
    - .3 Cx agents' credentials: 30 days before start of Cx.
    - .4 Cx procedures: 1 month after award of contract.
    - .5 Cx Report format: 1 month after contract award.
    - .6 Discussion of heating/cooling loads for Cx: 1 month before start-up.
    - .7 Submission of list of instrumentation with relevant certificates: 14 days before start of Cx.
    - .8 Notification of intention to start TAB: 14 days before start of TAB.
    - .9 TAB: after successful start-up, correction of deficiencies and verification of normal and safe operation.
    - .10 Notification of intention to start Cx: 14 days before start of Cx.
    - .11 Notification of intention to start Cx of integrated systems: after Cx of related systems is completed 7 days before start of integrated system Cx.
    - .12 Identification of deferred Cx.
    - .13 Implementation of training plans.
    - .14 Cx reports: immediately upon successful completion of Cx.
    - .15 Emergency evacuation exercises: after 80% occupancy.
  - .2 Detailed training schedule to demonstrate no conflicts with testing, completion of project and hand-over to Property Manager.
  - .3 6 months in Cx schedule for verification of performance in all seasons and wear conditions.

- .4 After approval, incorporate Cx Schedule into Construction Schedule.
- .5 Consultant, Contractor, Contractor's Cx agent, and Departmental Representative will monitor progress of Cx against this schedule.

### **1.20 CX REPORTS**

- .1 Submit reports of tests, witnessed and certified by Departmental Representative to Departmental Representative who will verify reported results.
- .2 Include completed and certified PV reports in properly formatted Cx Reports.
- .3 Before reports are accepted, reported results to be subject to verification by Departmental Representative.

### **1.21 ACTIVITIES DURING WARRANTY PERIOD**

- .1 Cx activities must be completed before issuance of Interim Certificate, it is anticipated that certain Cx activities may be necessary during Warranty Period, including:
  - .1 Fine tuning of HVAC systems.
  - .2 Adjustment of ventilation rates to promote good indoor air quality and reduce deleterious effects of VOCs generated by off-gassing from construction materials and furnishings.
  - .3 Full-scale emergency evacuation exercises.

### **1.22 TESTS TO BE PERFORMED BY OWNER/USER**

- .1 None is anticipated on this project.

### **1.23 TRAINING PLANS**

- .1 Refer to section 01 91 41 - Commissioning (Cx) - Training.

### **1.24 FINAL SETTINGS**

- .1 Upon completion of Cx to satisfaction of Departmental Representative lock control devices in their final positions, indelibly mark settings marked and include in Cx Reports.

## **PARTIE 2 - PRODUCTS**

### **2.1 NOT USED**

- .1 Not Used.



### **PARTIE 3 - EXECUTION**

#### **3.1 NOT USED**

.1 Not Used.

**END OF SECTION**



## **PARTIE 1 - GENERAL**

### **1.1 RELATED REQUIREMENTS**

- .1 Section 01 91 13 - General commissioning (CX) Requirements.

### **1.2 INSTALLATION/START-UP CHECK LISTS**

- .1 Include the following data:
  - .1 Product manufacturer's installation instructions and recommended checks.
  - .2 Special procedures as specified in relevant technical sections.
  - .3 Items considered good installation and engineering industry practices deemed appropriate for proper and efficient operation.
- .2 Equipment manufacturer's installation/start-up check lists are acceptable for use. As deemed necessary by Departmental Representative supplemental additional data lists will be required for specific project conditions.
- .3 Use check lists for equipment installation. Document check list verifying checks have been made, indicate deficiencies and corrective action taken.
- .4 Installer to sign check lists upon completion, certifying stated checks and inspections have been performed. Return completed check lists to Departmental Representative. Check lists will be required during Commissioning and will be included in Building Maintenance Manual (BMM) at completion of project.
- .5 Use of check lists will not be considered part of commissioning process but will be stringently used for equipment pre-start and start-up procedures.

### **1.3 PRODUCT INFORMATION (PI) REPORT FORMS**

- .1 Product Information (PI) forms compiles gathered data on items of equipment produced by equipment manufacturer, includes nameplate information, parts list, operating instructions, maintenance guidelines and pertinent technical data and recommended checks that is necessary to prepare for start-up and functional testing and used during operation and maintenance of equipment. This documentation is included in the BMM at completion of work.
- .2 Prior to Performance Verification (PV) of systems complete items on PI forms related to systems and obtain Departmental Representative's approval.

#### **1.4 PERFORMANCE VERIFICATION (PV) FORMS**

- .1 PV forms to be used for checks, running dynamic tests and adjustments carried out on equipment and systems to ensure correct operation, efficiently and function independently and interactively with other systems as intended with project requirements.
- .2 PV report forms include those developed by Contractor records measured data and readings taken during functional testing and Performance Verification procedures.
- .3 Prior to PV of integrated system, complete PV forms of related systems and obtain Departmental Representative's approval.

#### **1.5 SAMPLES OF COMMISSIONING FORMS**

- .1 Revise items on Commissioning forms to suit project requirements.
- .2 Samples of Commissioning forms and a complete index of produced to date will be attached to this section.

#### **1.6 CHANGES AND DEVELOPMENT OF NEW REPORT FORMS**

- .1 When additional forms are required, but are not available from Departmental Representative develop appropriate verification forms and submit to Departmental Representative for approval prior to use.
  - .1 Additional commissioning forms to be in same format as provided by Departmental Representative

#### **1.7 COMMISSIONING FORMS**

- .1 Use Commissioning forms to verify installation and record performance when starting equipment and systems.
- .2 Strategy for Use:
  - .1 Departmental Representative provides Contractor project-specific Commissioning forms with Specification data included.
  - .2 Contractor will provide required shop drawings information and verify correct installation and operation of items indicated on these forms.
  - .3 Confirm operation as per design criteria and intent.
  - .4 Identify variances between design and operation and reasons for variances.

- .5 Verify operation in specified normal and emergency modes and under specified load conditions.
- .6 Record analytical and substantiating data.
- .7 Verify reported results.
- .8 Form to bear signatures of recording technician and reviewed and signed off by Departmental Representative.
- .9 Submit immediately after tests are performed.
- .10 Reported results in true measured SI unit values.
- .11 Provide Departmental Representative with originals of completed forms.
- .12 Maintain copy on site during start-up, testing and commissioning period.
- .13 Forms to be both hard copy and electronic format with typed written results in Building Management Manual in accordance with Section 01 91 51 - Building Management Manual (BMM).

## **1.8 LANGUAGE**

- .1 To suit the language profile of the awarded contract.

## **PARTIE 2 - PRODUCTS**

### **2.1 NOT USED**

- .1 Not Used.

## **PARTIE 3 - EXECUTION**

### **3.1 NOT USED**

- .1 Not Used.

## **END OF SECTION**



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## **Appendix - Forms**

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PROJECT: R.066564.001/342-4203	<b>PWGSC</b>	Form: 22 11 16
	<b>Ste-Anne-Des-Plaines Establishment Pumping Station Modifications - Ventilation</b>	1 of 2
<b>APPENDIX 1 - COMMISSIONING FORM</b>		

<b>HYDRAULIC SYSTEM (DOMESTIC WATER)</b>
--

<b>IDENTIFICATION</b>	Identification:	Drawing Number:
	Location:	
	Service area:	

REPORT	INCLUDED	N/A	COMMENTS
Cleaning	<input type="checkbox"/>	<input type="checkbox"/>	
Balancing	<input type="checkbox"/>	<input type="checkbox"/>	
Commissioning and Control	<input type="checkbox"/>	<input type="checkbox"/>	
Pressure Test	<input type="checkbox"/>	<input type="checkbox"/>	
Concentration of Glycol/Ethanol	<input type="checkbox"/>	<input type="checkbox"/>	
Sound Level	<input type="checkbox"/>	<input type="checkbox"/>	
Earthquake-Resistant Report	<input type="checkbox"/>	<input type="checkbox"/>	

<b>MAINTENANCE REQUIREMENTS</b>

MEMORANDUM (Deficiencies, repair work, sound, maintenance)	STATUS
	<input type="checkbox"/> Compliance
	<input type="checkbox"/> Requires Additional Checking
	<input type="checkbox"/> To be Completed
	<input type="checkbox"/> Out of Service
	<input type="checkbox"/> Non Compliance

Name of Technician:	Date:
Approved by: (Commissioning Authority)	Date:



PROJECT: R.066564.001/342-4203	<b>PWGSC</b>	Form: 22 13 17
	<b>Ste-Anne-Des-Plaines Establishment Pumping Station Modifications - Ventilation</b>	1 of 2
<b>APPENDIX 1 - COMMISSIONING FORM</b>		

**HYDRAULIC SYSTEM (DRAINAGE)**

<b>IDENTIFICATION</b>	Identification:	Drawing Number:
	Location:	
	Service area:	

REPORT	INCLUDED	N/A	COMMENTS
Cleaning	<input type="checkbox"/>	<input type="checkbox"/>	
Balancing	<input type="checkbox"/>	<input type="checkbox"/>	
Commissioning and Control	<input type="checkbox"/>	<input type="checkbox"/>	
Pressure Test	<input type="checkbox"/>	<input type="checkbox"/>	
Concentration of Glycol/Ethanol	<input type="checkbox"/>	<input type="checkbox"/>	
Sound Level	<input type="checkbox"/>	<input type="checkbox"/>	
Earthquake-Resistant Report	<input type="checkbox"/>	<input type="checkbox"/>	

**MAINTENANCE REQUIREMENTS**

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MEMORANDUM (Deficiencies, repair work, sound, maintenance)	STATUS
	<input type="checkbox"/> Compliance
	<input type="checkbox"/> Requires Additional Checking
	<input type="checkbox"/> To be Completed
	<input type="checkbox"/> Out of Service
	<input type="checkbox"/> Non Compliance

Name of Technician:	Date:
Approved by: (Commissioning Authority)	Date:



PROJECT : R.066564.001/342-4203	<b>PWGSC</b>	Fiche : 23 05 49.01	No :
	<b>Ste-Anne-Des-Plaines Establishment Pumping Station Modifications - Ventilation</b>	1 de 1	
<b>APPENDIX 1 - COMMISSIONING FORM</b>			

<b>GÉNÉRAL – SISMIC PROTECTION</b>
------------------------------------

INCLUDED REPORTS :	INITIAL REPORT	DATE	CONFORMITY LETTER	DATE
Plumbing	<input type="checkbox"/>		<input type="checkbox"/>	
Heating	<input type="checkbox"/>		<input type="checkbox"/>	
Ventilation	<input type="checkbox"/>		<input type="checkbox"/>	
Électricité	<input type="checkbox"/>		<input type="checkbox"/>	

MEMORANDUM (Deficiencies, repair work, sound, maintenance)	STATUT
	<input type="checkbox"/> Compliance
	<input type="checkbox"/> Requires Additional Checking
	<input type="checkbox"/> To be Completed
	<input type="checkbox"/> Out of Service
	<input type="checkbox"/> Non Compliance

Name of Technician:	Date :
Approved by: (Commissioning Authority)	Date :



<b>PROJECT:</b> R.066564.001/342-4203	<b>PWGSC</b> <b>Ste-Anne-Des-Plaines Establishment</b> <b>Pumping Station</b> <b>Modifications - Ventilation</b>	Form: 23 33 15 <hr/> 1 of 2
<b>APPENDIX 1 - COMMISSIONING FORM</b>		

<b>DUCTS AND DAMPERS</b>
--------------------------

<b>IDENTIFICATION</b>	Identification:	Drawing Number:
	Location:	
	Description of System:	

<b>Installation Checks</b>			
<b>ITEM</b>	<b>YES</b>	<b>NO</b>	<b>COMMENTS</b>
Duct joint sealant properly installed			
Balancing dampers installed as per drawings and TAB's site visit			
All dampers close tightly			
Casing condition good: no dents, leaks, door gaskets installed			

<b>MEMORANDUM</b> (Deficiencies, repair work, sound, maintenance)	<b>STATUS</b>
	<input type="checkbox"/> Compliance
	<input type="checkbox"/> Requires Additional Checking
	<input type="checkbox"/> To be Completed
	<input type="checkbox"/> Out of Service
	<input type="checkbox"/> Non Compliance

Name of Technician:	Date:
Approved by: (Commissioning Authority)	Date:





PROJECT: R.066564.001/342.4203	<b>PWGSC</b> <b>Ste-Anne-Des-Plaines Establishment</b> <b>Pumping Station</b> <b>Modifications - Ventilation</b>	Form: 23 34 00	No.:
		1 of 2	
<b>ANNEXE 1 - COMMISSIONING FORM</b>			

<b>FANS</b>
-------------

<b>IDENTIFICATION</b>	Equipment Tag:	Serial Number:
	Type :	Location:
	Brand:	Contractor:
	Model Number:	Manufacturer:
	Description of System (SUPPLY / RETURN / EXHAUST):	
	Variable speed drive:	
Controls: <input type="checkbox"/> N/A <input type="checkbox"/> Internal <input type="checkbox"/> External <input type="checkbox"/> Pneumatic <input type="checkbox"/> Electric <input type="checkbox"/> Digital		Communication/Integration: <input type="checkbox"/> Coordination with BAS <input type="checkbox"/> N/A

<input type="checkbox"/> Manufacturer Check List	<input type="checkbox"/> Performance Sheets Included	<input type="checkbox"/> Operation and Maintenance Manuals
--	--	--

<b>Installation Check List</b>			
Item	Yes	No	Comments
Cabinet and general installation			
Permanent labels affixed/Filters installed and replacement type and efficiency permanently affixed to housing/construction filters removed			
Exhaust fan and motor aligned/ Exhaust fan belt tension & condition good/ Exhaust fan protective shrouds for belts in place and secure			
Exhaust fan and motor lube lines installed and lubed			
Fan rotation correct (If VFD, check rotation in bypass and VFD Inverter mode)			
Fan has no unusual noise or vibration			

Name of Technician:	Date:
Approved by: (Commissioning Authority)	Date:

PROJECT: R.066564.001/342.4203	<b>PWGSC</b> <b>Ste-Anne-Des-Plaines Establishment</b> <b>Pumping Station</b> <b>Modifications - Ventilation</b>	Form: 23 34 00	No.:
		2 of 2	
<b>ANNEXE 1 - COMMISSIONING FORM</b>			

<b>FANS</b>
-------------

MEMORANDUM (Deficiencies, repair work, sound, maintenance)	STATUS
	<input type="checkbox"/> Compliance
	<input type="checkbox"/> Requires Additional Checking
	<input type="checkbox"/> To Complete
	<input type="checkbox"/> Out of Service
	<input type="checkbox"/> Non Compliance

PERFORMANCE	Operating conditions	Design	Measure
	Air flow:		
	Static pressure:		
	Drive type:		
	RPM:		
	Amperage:		
	Voltage:		

Name of Technician:	Date:
Approved by: (Commissioning Authority)	Date:

PROJECT: R.066564.001/342-4203	<b>PWGC</b>	Form : 23 36 00	No :
	<b>Ste-Anne-Des-Plaines Establishment Pumping Station Modifications - Ventilation</b>	1 de 1	
<b>APPENDIX 1 - COMMISSIONING FORM</b>			

<b>ELECTRICAL COIL</b>
------------------------

<b>IDENTIFICATION</b>	Equipment Tag:	Serial number :
	Type :	Location :
	Brand :	Contractor :
	Model:	Provider :
	Size :	
	Area served:	
	accessories : <input type="checkbox"/> Detector high humidity limit <input type="checkbox"/> Pneumatic <input type="checkbox"/> Flow switch <input type="checkbox"/> Electric <input type="checkbox"/> Internal control <input type="checkbox"/> External control <input type="checkbox"/> Digital	Communication/Integration: <input type="checkbox"/> Coordination with BAS

<input type="checkbox"/> Manufacturer Check List	<input type="checkbox"/> Performance Sheets Included	<input type="checkbox"/> Operation and Maintenance Manuals
--	--	--

<b>PERFORMANCE</b>	<b>Operating Conditions</b>	<b>Design</b>	<b>Reading</b>
	Air Flow		
	Operation of the high temperature protection		
	Operation of the flow switch		

**\*attach the contractor installation check list.**

MEMORANDUM (Deficiencies, repair work, sound, maintenance)	STATUS
	<input type="checkbox"/> Compliance
	<input type="checkbox"/> Requires Additional Checking
	<input type="checkbox"/> To be Completed
	<input type="checkbox"/> Out of Service
	<input type="checkbox"/> Non Compliance

Name of Technician:	Date:
Approved by: (Commissioning Authority)	Date:



PROJECT: R.066564.001/342-4203	<b>PWGSC</b>	Fiche : <b>23 73 10</b>	No :
	<b>Ste-Anne-Des-Plaines Establishment Pumping Station Modifications - Ventilation</b>		1 de 2
<b>FICHE DE MISE EN SERVICE</b>			

**COOLING/HEATING COIL**

<b>IDENTIFICATION</b>	Equipment Tag:	Serial Number:
	Location:	
	Model Number:	Contractor:
	Type:	Manufacturer:
	Description of System:	
Controls: <input type="checkbox"/> N/A <input type="checkbox"/> Pneumatic <input type="checkbox"/> Internal <input type="checkbox"/> Electric <input type="checkbox"/> External <input type="checkbox"/> Digital		Communication/Integration: <input type="checkbox"/> Coordination with BAS <input type="checkbox"/> N/A

<input type="checkbox"/> Manufacturer Check List	<input type="checkbox"/> Performance Sheets Included	<input type="checkbox"/> Operation and Maintenance Manuals
--	--	--

<b>INSTALLATION CHECK LIST</b>			
Item	Yes	No	Comments
Carrier system / Proper instillation			
Coil accessible for disassembly			
Coil equipped with thermometers and pressure gauges required			
Cleanliness of the coils and ducts			
Inlet filter found and clean			
Draining board and drain functional			

<b>MEMORANDUM</b> (Deficiencies, repair work, sound, maintenance)	<b>STATUS</b>
	<input type="checkbox"/> Compliance
	<input type="checkbox"/> Requires Additional Checking
	<input type="checkbox"/> To be Completed
	<input type="checkbox"/> Out of Service
	<input type="checkbox"/> Non Compliance

Name of Technician:	Date:
Approved by: (Commissioning Authority)	Date:

PROJECT: R.066564.001/342-4203	<b>PWGSC</b>	Fiche : <b>23 73 10</b>	No :
	<b>Ste-Anne-Des-Plaines Establishment Pumping Station Modifications - Ventilation</b>		2 de 2
<b>FICHE DE MISE EN SERVICE</b>			

<b>COOLING/HEATING COIL</b>
-----------------------------

<b>PERFORMANCE</b>	<b>Operating conditions</b>	<b>Design</b>	<b>Reading</b>	
	sensible capacity			
	Total capacity			
	Fluid flow	R-410A		
	Air flow			
	Air pressure loss			
	Fluid pressure loss		IN :	OUT :

<b>FLUID</b>	<b>Operating conditions</b>	<b>Heating Mode</b>	
		<b>Design</b>	<b>Reading</b>
	Temperature in:		
	Temperature out:		
	Differential		
Capacity			
<b>AIR</b>	<b>Operating conditions</b>	<b>Cooling Mode</b>	
		<b>Design</b>	<b>Reading</b>
	Temperature in:		
	Temperature out:		
	Differential		
Capacity			

Name of Technician:	Date:
Approved by: (Commissioning Authority)	Date:

PROJECT: R.066564.001/342-4203	<b>PWGSC</b> <b>Ste-Anne-Des-Plaines Establishment</b> <b>Pumping Station</b> <b>Modifications - Ventilation</b>	Section: 23 73 10	No.:
		1 of 2	
<b>ANNEX 1 - COMMISSIONING FORM</b>			

<b>VENTILATION SYSTEM</b>
---------------------------

<b>IDENTIFICATION</b>	Identification:	Plan Number:
	Location:	
	Description of system:	

REPORT	INCLUDED	N/A	COMMENTS
Cleaning	<input type="checkbox"/>	<input type="checkbox"/>	
Balancing	<input type="checkbox"/>	<input type="checkbox"/>	
Commissioning and Control	<input type="checkbox"/>	<input type="checkbox"/>	
Earthquake-Resistant Report	<input type="checkbox"/>	<input type="checkbox"/>	
Pressure Test	<input type="checkbox"/>	<input type="checkbox"/>	

<b>MAINTENANCE REQUIREMENTS</b>

MEMORANDUM (Deficiencies, repair work, sound, maintenance)	STATUS
	<input type="checkbox"/> Compliance <input type="checkbox"/> Requires Additional Checking <input type="checkbox"/> To complete <input type="checkbox"/> Out of service <input type="checkbox"/> Non Compliance

Name of Technician:	Date:
Approved by: (Commissioning Authority)	Date:





PROJECT: R.066564.001/342-4203	<b>PWGSC</b>	Fiche : 237400	No :
	Ste-Anne-Des-Plaines Establishment Pumping Station Modifications - Ventilation	1 de 2	
<b>APPENDIX 1 – Construction Check-list Form</b>			

<b>Packaged Outdoor HVAC Equipment</b>
--

<b>IDENTIFICATION</b>	Equipment Tag:	Serial Number:
	Type :	Location :
	Brand :	Contractor :
	Model :	Manufacturer :
	size:	
	Connected to the system :	
	Area of service :	
	Controls:	<input type="checkbox"/> Pneumatic
<input type="checkbox"/> N/A		<input type="checkbox"/> Coordination with BAS
<input type="checkbox"/> Internal	<input type="checkbox"/> Electric	<input type="checkbox"/> N/A

<input type="checkbox"/> Manufacturer report	<input type="checkbox"/> Performance included
--	---

<b>INSTALLATION CHECK LIST</b>			
Item	Item	Item	Item
Mounting system / proper installation of evaporator			
Mounting system / proper installation of condenser			
Components are accessible for maintenance			
No condenser vibration			
Coil and ducts clean			
Filtre available and clean			
All condensate drain pans clean and slope to drain			

<b>MEMORANDUM</b> (Deficiencies, repair work, sound, maintenance)	<b>STATUS</b>
	<input type="checkbox"/> Compliance
	<input type="checkbox"/> Requires Additional Checking
	<input type="checkbox"/> To be Completed
	<input type="checkbox"/> Out of Service
	<input type="checkbox"/> Non Compliance

Name of Technician:	
Approved by: (Commissioning Authority)	

PROJECT: R.066564.001/342-4203	<b>PWGSC</b>	Fiche : 237400	No :
	Ste-Anne-Des-Plaines Establishment Pumping Station Modifications - Ventilation	2 de 2	
<b>APPENDIX 1 – Construction Check-list Form</b>			

<b>Packaged Outdoor HVAC Equipment</b>
--

## Fan

PERFORMANCE	Operation Data	Design	Reading
	Flow :		
	Pressure :		
	rpm :		
MOTOR	Operation Data	Design	Reading
	Amp:		
	V:		

## Compresseur

COMPRESSOR	Operation Data	Design	Reading
	Refrigerant		
	Compressor ( V / A)	/	/
	Succion pressure		
	Discharge pressure		

## Performance : Air Condition

AIR (Cooling mode)	Operation Data	Design	Reading
	In let Temperature :		
	Out let Temperature :		
	Differential :		

Name of Technician:	
Approved by: (Commissioning Authority)	

PROJET : R.066564.001/342-4203	<b>PWGSC</b>	Form : 250111	No :
	<b>Ste-Anne-Des-Plaines Establishment Pumping Station Modifications - Ventilation</b>	1 de 2	
<b>APPENDIX 1 - COMMISSIONING FORM</b>			

<b>POINTS DE CONTRÔLE NUMÉRIQUES</b>
--------------------------------------

<b>IDENTIFICATION</b>	Contrôleur :	No of drawing :
	Brand :	Localisation :
	Model :	Entrepreneur :
		Fournisseur :
	Système contrôlé :	

<b>MEMORANDUM (Deficiencies, repair work, sound, maintenance)</b>	<b>STATUT</b>
	<input type="checkbox"/> Compliance
	<input type="checkbox"/> Requires Additional Checking
	<input type="checkbox"/> To be Completed
	<input type="checkbox"/> Out of Service
	<input type="checkbox"/> Non Compliance

Name of Technician:	Date:
Approved by: (Commissioning Authority)	Date:



PROJECT : R.066564.001/342-4203	<b>PWGSC</b>	Fiche : 25 30 02	No :
	<b>Ste-Anne-Des-Plaines Establishment Pumping Station Modifications - Ventilation</b>	1 de 1	
<b>APPENDIX 1 - COMMISSIONING FORM</b>			

**ROOM CONTROL**

<b>IDENTIFICATION</b>	Type :	No de drawing :
	Brand :	Localisation :
	Model :	Entrepreneur :
	Deserve area :	Fournisseur :
	Controls : <input type="checkbox"/> s/o <input type="checkbox"/> Pneumatic                      Communication / Intégration <input type="checkbox"/> Internal <input type="checkbox"/> Électric <input type="checkbox"/> Coordination with BAS <input type="checkbox"/> External <input type="checkbox"/> Digital <input type="checkbox"/> N/A	

NO	ROOM	SÉQUENCE	SENSOR	COMMUNICATION	BAL.	GRAPHIC	TECHNICIAN	NOTE

<b>MEMORANDUM</b> (Deficiencies, repair work, sound, maintenance)	<b>STATUT</b>
	<input type="checkbox"/> Compliance
	<input type="checkbox"/> Requires Additional Checking
	<input type="checkbox"/> To Complete
	<input type="checkbox"/> Out of Service
	<input type="checkbox"/> Non Compliance

Name of Technician:	Date :
Approved by: (Commissioning Authority)	Date :



PROJECT : R.066564.001/342-4203	<b>PWGSC</b> <b>Ste-Anne-Des-Plaines Establishment</b> <b>Pumping Station</b> <b>Modifications - Ventilation</b>	Form : 25 90 01	No :
		1 of 1	
<b>APPENDIX 1 - COMMISSIONING FORM</b>			

<b>SEQUENCE OF OPERATIONS</b>
-------------------------------

<b>IDENTIFICATION</b>	Name of System:		
	Description of System:		
	<b>Controls:</b> <input type="checkbox"/> N/A <input type="checkbox"/> Internal <input type="checkbox"/> External	<input type="checkbox"/> Pneumatic <input type="checkbox"/> Electric <input type="checkbox"/> Digital	<b>Communication/Integration:</b> <input type="checkbox"/> Coordination with BAS <input type="checkbox"/> N/A

SEQUENCE OF OPERATION	VERIFIED	COMMENTS
All sensors and actuators are calibrated, correctly positioned and working properly.		
Configuration of occupation schedule and pre-startup mode or night set back temperature.		
Modulation of valves and dampers		
Temperature control loop		
Humidity control loop		
Supply air control loop		
Hardware protections (freeze, high pressure, proof of flow, high temperature, high humidity)		
Positioning of systems when stopped		

Name of Technician:	Date:
Approved by: (Commissioning Authority)	Date:





## **PARTIE 1 - GENERAL**

### **1.1 RELATED REQUIREMENTS**

- .1 Section 01 91 13 - General commissioning (CX) Requirements.

### **1.2 TRAINEES**

- .1 Trainees: personnel selected for operating and maintaining this facility. Includes Property Manager, building operators, maintenance staff, security staff, and technical specialists as required.
- .2 Trainees will be available for training during later stages of construction for purposes of familiarization with systems.

### **1.3 INSTRUCTORS**

- .1 Departmental Representative will provide:
  - .1 Descriptions of systems.
  - .2 Instruction on design philosophy, design criteria, and design intent.
- .2 Contractor and certified factory-trained manufacturers' personnel: to provide instruction on the following:
  - .1 Start-Up, operation, shut-down of equipment, components and systems.
  - .2 Control features, reasons for, results of, implications on associated systems of, adjustment of set points of control and safety devices.
  - .3 Instructions on servicing, maintenance and adjustment of systems, equipment and components.
- .3 Contractor and equipment manufacturer to provide instruction on:
  - .1 Start-up, operation, maintenance and shut-down of equipment they have certified installation, started up and carried out PV tests.

### **1.4 TRAINING OBJECTIVES**

- .1 Training to be detailed and duration to ensure:
  - .1 Safe, reliable, cost-effective, energy-efficient operation of systems in normal and emergency modes under all conditions.

- .2 Effective on-going inspection, measurements of system performance.
- .3 Proper preventive maintenance, diagnosis and trouble-shooting.
- .4 Ability to update documentation.
- .5 Ability to operate equipment and systems under emergency conditions until appropriate qualified assistance arrives.

## **1.5 TRAINING MATERIALS**

- .1 Instructors to be responsible for content and quality.
- .2 Training materials to include:
  - .1 "As-Built" Contract Documents.
  - .2 Operating Manual.
  - .3 Maintenance Manual.
  - .4 Management Manual.
  - .5 TAB and PV Reports.
- .3 Project Manager, Commissioning Manager and Property Manager will review training manuals.
- .4 Training materials to be in a format that permits future training procedures to same degree of detail.
- .5 Supplement training materials:
  - .1 Transparencies for overhead projectors.
  - .2 Multimedia presentations.
  - .3 Manufacturer's training videos.
  - .4 Equipment models.

## **1.6 SCHEDULING**

- .1 Include in Commissioning Schedule time for training.
- .2 Deliver training during regular working hours, training sessions to be three (3) hours in length.
- .3 Training to be completed prior to acceptance of facility.

## **1.7 RESPONSIBILITIES**

- .1 Be responsible for:
  - .1 Implementation of training activities,
  - .2 Coordination among instructors,
  - .3 Quality of training, training materials,
- .2 Departmental Representative will evaluate training and materials.
- .3 Upon completion of training, provide written report, signed by Instructors, witnessed by Departmental Representative.

## **1.8 TRAINING CONTENT**

- .1 Training to include demonstrations by Instructors using the installed equipment and systems.
- .2 Content includes:
  - .1 Review of facility and occupancy profile.
  - .2 Functional requirements.
  - .3 System philosophy, limitations of systems and emergency procedures.
  - .4 Review of system layout, equipment, components and controls.
  - .5 Equipment and system start-up, operation, monitoring, servicing, maintenance and shut-down procedures.
  - .6 System operating sequences, including step-by-step directions for starting up, shut-down, operation of valves, dampers, switches, adjustment of control settings and emergency procedures.
  - .7 Maintenance and servicing.
  - .8 Trouble-shooting diagnosis.
  - .9 Inter-Action among systems during integrated operation.
  - .10 Review of O M documentation.

- .3 Provide specialized training as specified in relevant Technical Sections of the construction specifications.

## **1.9 VIDEO-BASED TRAINING**

- .1 Manufacturer's videotapes to be used as training tool with Departmental Representative's review and written approval 1 month prior to commencement of scheduled training.
- .2 On-Site training videos:
  - .1 Videotape training sessions for use during future training.
  - .2 To be performed after systems are fully commissioned.
  - .3 Organize into several short modules to permit incorporation of changes.
- .3 Production methods to be high quality.

## **PARTIE 2 - PRODUCTS**

### **2.1 NOT USED**

- .1 Not Used.

## **PARTIE 3 - EXECUTION**

### **3.1 NOT USED**

- .1 Not Used.

**END OF SECTION**

## **PARTIE 1 - GENERAL**

### **1.1 RELATED REQUIREMENTS**

- .1 Section 01 91 13 - General commissioning (CX) Requirements.

### **1.2 ACRONYMS**

- .1 BMM - Building Management Manual.
- .2 Cx - Commissioning.
- .3 HVAC - Heating, Ventilation and Air Conditioning.
- .4 PI - Product Information.
- .5 PV - Performance Verification.
- .6 TAB - Testing, Adjusting and Balancing.
- .7 WHMIS - Workplace Hazardous Materials Information System.

### **1.3 GENERAL REQUIREMENTS**

- .1 Standard letter size paper 216 mm x 279 mm.
- .2 Methodology used to facilitate updating.
- .3 Drawings, diagrams and schematics to be professionally developed.
- .4 Electronic copy of data to be in a format accepted and approved by Departmental Representative.

### **1.4 APPROVALS**

- .1 Prior to commencement, co-ordinate requirements for preparation, submission and approval with Departmental Representative.

### **1.5 GENERAL INFORMATION**

- .1 Provide Departmental Representative the following for insertion into appropriate Part and Section of BMM:
  - .1 Complete list of names, addresses, telephone and fax numbers of contractor, sub-contractors that participated in delivery of project - as indicated in Section 1.2 of BMM.

- .2 Summary of fire protection, mechanical and electrical systems installed and commissioned - as indicated in Section 1.4 of BMM.
  - .1 Including sequence of operation as finalized after commissioning is complete as indicated in Section 2.0 of BMM.
- .3 Description of building operation under conditions of heightened security and emergencies as indicated in Section 2.0 of BMM.
- .4 System, equipment and components Maintenance Management System (MMS) identification - Section 2.1 of BMM.
- .5 Information on operation and maintenance of fire protection and life safety systems and equipment installed and commissioned - Section 2.0 of BMM.
- .6 Information on operation and maintenance of mechanical systems and equipment installed and commissioned - Section 2.0 of BMM.
- .7 Operating and maintenance manual - Section 3.2 of BMM.
- .8 Final commissioning plan as actually implemented.
- .9 Completed commissioning checklists.
- .10 Commissioning test procedures employed.
- .11 Completed Product Information (PI) and Performance Verification (PV) report forms, approved and accepted by Departmental Representative.
- .12 Commissioning reports.

## **1.6 CONTENTS OF OPERATING AND MAINTENANCE MANUAL**

- .1 For detailed requirements refer to section 01 78 00 - Closeout Submittals.
- .2 Departmental Representative to review and approve format and organization within 12 weeks of award of contract.
- .3 Include original manufactures brochures and written information on products and equipment installed on this project.
- .4 Record and organize for easy access and retrieval of information contained in BMM.
- .5 Include completed PI report forms, data and information from other sources as required.
- .6 Inventory directory relating to information on installed systems, equipment and components.

- .7 Approved project shop-drawings, product and maintenance data.
- .8 Manufacturer's data and recommendations relating: manufacturing process, installation, commissioning, start-up, O M, shutdown and training materials.
- .9 Inventory and location of spare parts, special tools and maintenance materials.
- .10 Warranty information.
- .11 Inspection certificates with expiration dates, which require on-going re-certification inspections.
- .12 Maintenance program supporting information including:
  - .1 Recommended maintenance procedures and schedule.
  - .2 Information to removal and replacement of equipment including, required equipment, points of lift and means of entry and egress.

## **1.7 LIFE SAFETY COMPLIANCE (LSC) MANUAL**

- .1 Samples of LSC Manual will be available from Departmental Representative..
- .1 Content of Manual:
  - .1 All possible Emergency situations modes including: presence of fire and smoke, power failure, lose of water or pressure, chemical spills and refrigerant release.
  - .2 Failure of elevators and escalators.
  - .3 HVAC emergencies and fuel supply failures.
  - .4 Intrusion and security breach.
  - .5 Emergency provisions for natural disasters, bomb threats and other disruptive situations.
  - .6 Dedicated emergency generators for high security projects, medical facilities and computer systems.
  - .7 Emergency control procedures for fire, power and major equipment failure.
  - .8 Emergency contacts and numbers.
  - .9 Manual to be readily available and comprehensible to non- technical readers.

## **1.8 SUPPORTING DOCUMENTATION FOR INSERTION INTO SUPPORTING APPENDICES**

- .1 Provide Departmental Representative supporting documentation relating to installed equipment and system, including:
  - .1 General:
    - .1 Finalized commissioning plan.
    - .2 WHMIS information manual.
    - .3 Approved "as-built" drawings and specifications.
    - .4 Procedures used during commissioning.
    - .5 Cross-Reference to specification sections.
  - .2 Architectural and structural:
    - .1 Inspection certificates, construction permits.
    - .2 PV reports.
  - .3 Fire prevention, suppression and protection:
    - .1 Test reports.
    - .2 Smoke test reports.
    - .3 PV reports.
  - .4 Mechanical:
    - .1 Installation permits, inspection certificates.
    - .2 Piping pressure test certificates.
    - .3 Ducting leakage test reports.
    - .4 TAB and PV reports.
    - .5 Charts of valves and steam traps.
    - .6 Copies of posted instructions.
  - .5 Electrical:
    - .1 Installation permits, inspection certificates.



- .2 TAB and PV reports.
  - .3 Electrical work log book.
  - .4 Charts and schedules.
  - .5 Locations of cables and components.
  - .6 Copies of posted instructions.
- .2 Assist Departmental Representative with preparation of BMM.

## **1.9 LANGUAGE**

- .1 English and French Language to be in separate binders.

## **1.10 USE OF CURRENT TECHNOLOGY**

- .1 Use current technology for production of documentation. Emphasis on ease of accessibility at all times, maintain in up-to-date state, compatibility with user's requirements.
- .2 Obtain Departmental Representative's approval before starting Work.

## **PARTIE 2 - PRODUCTS**

### **2.1 NOT USED**

- .1 Not used.

## **PARTIE 3 - EXECUTION**

### **3.1 NOT USED**

- .1 Not used.

**END OF SECTION**



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**Division 07 / Thermal / Humidity**

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## **PART 1 - GENERAL**

### **1.1 RELATED REQUIREMENTS**

- .1 Divisions 21, 22, 23, 25 and 26.

### **1.2 REFERENCES**

- .1 American National Standards Institute/National Fire Protection Association (ANSI/NFPA).
  - .1 NFPA 101, Life Safety Code.
- .2 American Society for Testing and Materials International (ASTM).
  - .1 ASTM E 2174, Standard Practice for On-site Inspection of Installed Fire Stops.
- .3 Underwriter's Laboratories of Canada (ULC)
  - .1 CAN/ULC-S101, Standard Methods of Fire Endurance Tests of Building Construction and Materials.
  - .2 CAN/ULC-S102, Standard Test Method for Surface Burning Characteristics of Building Materials.
  - .3 CAN/ULC-S115, Fire Tests of Firestop Systems.
- .4 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  - .1 Material Safety Data Sheets (MSDS).

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

- .1 Provide submittals in accordance with section 01 33 00 - Submittal Procedures.
- .2 Shop Drawings:
  - .1 Shop drawings shall include:
    - .1 Submit shop drawings to show location, proposed material, reinforcement, anchorage, fastenings and method of installation.
    - .2 Construction details should accurately reflect actual job conditions.

- .3 Data sheets:
  - .1 Submit product data and specifications and the manufacturer's documentation. Specify product characteristics, performance criteria, dimensions, constraints and finishing.
- .4 Samples:
  - .1 Submit a sample of each firestop, smoke control system and any other accessories must be submitted for approval.
- .5 Test reports:
  - .1 According to CAN/ULC-S101 on the fire resistance of building elements and to CAN/ULC-S102 on the surface Burning Characteristics.
  - .2 Submit test reports issued by independent testing laboratories, certifying that the products, materials and fire equipment meet the requirements specified in physical characteristics and performance criteria.
- .6 Certificates:
  - .1 Submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .7 Manufacturer's Instructions:
  - .1 Submit manufacturer's installation instructions and special handling criteria, installation sequence and cleaning procedures.
- .8 Manufacturer's Field Reports:
  - .1 Submit to manufacturer's written reports within 3 days of review, verifying compliance of Work, as described in PART 3 - FIELD QUALITY CONTROL.

#### **1.4 CLOSEOUT SUBMITTALS**

- .1 Required maintenance sheets must be supplied for inclusion in the operations and maintenance manual, in compliance with section 01 78 00 - Closeout submittals.
- .2 Maintenance sheets:
  - .1 Maintenance sheets must include or specify the following information:
    - .1 A description of equipment including the manufacturer's name, type, model number, year of fabrication as well as power, output or capacity;

- .2 Details pertaining to the operation, maintenance and upkeep of equipment;
- .3 A list of recommended spare parts.

## **1.5 WORK REQUIRED**

- .1 The contractor must supply the necessary personnel, equipment and services for the installation of firestops and smoke control systems pertaining to piping and ducts required for the mechanical system which penetrate walls and floors requiring a fire resistance rating.

## **1.6 QUALITY ASSURANCE**

- .1 Work pertaining to this section must be performed by a specialized business enterprise, approved by the firestop manufacturer and which employs qualified, certified and experienced personnel in the application of firestops and installation of smoke control systems.
- .2 The work performed must be top quality work according to the best engineering practices and in strict compliance with written manufacturer's specifications.
- .3 In such cases where the manufacturer does not supply ULC- or UL-approved assemblies of firestop elements or a derivative of similar elements, or one subject to other tests, drawings of these elements will be presented to local authorities having jurisdiction in these matters for approval before installation.
- .4 Site Meetings: as part of Manufacturer's Services described in PART 3 - FIELD QUALITY CONTROL, schedule site visits, to review Work, at stages listed.
  - .1 After delivery and storage of products, and when preparatory Work is complete, but before installation begins;
  - .2 Twice during progress of Work at 25% and 60% complete;
  - .3 Upon completion of Work, after cleaning is carried out.

## **1.7 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 the site in undamaged condition and in original unopened containers, marked to indicate brand name, manufacturer and ULC markings.
- .2 Storage and Protection:
  - .1 Store materials in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Replace defective or damaged materials with new.

## **1.8 WASTE MANAGEMENT AND DISPOSAL**

- .1 Waste must be sorted and recycled in compliance with section 01 74 21 - Construction/demolition waste management and disposal.

## **PART 2 - PRODUCTS**

### **2.1 GENERAL**

- .1 All products used in facilities measure against firestop must be officially approved "cUL", "ULC" and "FM" and must be labeled as such.

### **2.2 MATERIAL**

- .1 Firestop systems and smoke control systems:
  - .1 Must be asbestos free and capable of maintaining an efficient barrier and conform to the relevant flame, smoke and gas ratings in compliance with standard CAN-S115, and not exceed the opening dimensions for which they are designed.
  - .2 Firestop and smoke control assemblies: ULC certified, in compliance with standard CAN-S115.
  - .3 The fire rating of firestops must not be inferior to the fire ratings of adjoining floors and walls in compliance with architectural plans.
- .2 Service penetration assemblies: systems tested to CAN-ULC-S115.
- .3 Service penetration fire stop components: certified by test laboratory to CAN-ULC-S115
- .4 Fire-resistance rating of installed fire stopping assembly in accordance with NBC.



- .5 Fire stopping and smoke seals at openings intended for ease of re-entry such as cables: elastomeric seal.
- .6 Fire stopping and smoke seals at openings around penetrations for pipes, ductwork and other mechanical items requiring sound and vibration control: elastomeric seal.
- .7 Firestop devices:
  - .1 Highly sensitive devices for plastic pipes, made of an expanding intumescent material when exposed to temperatures of 149 °C or more. The material must expand up to 25 times its original volume in order to seal the opening created by the plastic pipe
  - .2 Devices must be certified in compliance with standard CAN4-S115-M, and in compliance with a differential pressure test performed in 50 Pa and offering one to two hours fire resistance.
- .8 Coating: the most stringent manufacturer's recommendations must be followed for specific material used for base coats and top coats.
- .9 Water (if applicable): must be potable, clean and free of dangerous quantities of harmful substances
- .10 Mineral wool: rockfibre and clinker glued with a heat resistant binder. Maximum operating temperature of 1,035 °C. Material must have a near neutral pH content.
- .11 Compacting and reinforcing material and anchoring and support devices: in compliance with the manufacturer's recommendations and systems installed and approved by authorities having jurisdiction.
- .12 Sealers and vertical joints: free of deflections, in compliance with ULC assembly tests.

## **PART 3 - EXECUTION**

### **3.1 MANUFACTURER'S INSTRUCTIONS**

- .1 Comply with requirements, recommendations and manufacturer's written data, including product technical bulletins, instructions for handling, storage and implementation of products and indications data sheets.

### **3.2 PREPARATORY WORK**

- .1 Dimensions and conditions of spaces to be filled must be inspected in order to establish the exact thickness of required insulations and materials to be installed. Base coats and surfaces must be dry and free of rime.
  - .1 Ensure surfaces are clean, dry and frost.
- .2 Prepare surfaces that are placed in contact with the fire and smoke materials, according to the manufacturer's instructions.
- .3 Ensure the integrity of the insulation around pipes and duct penetrations through fire walls, including the vapor barrier.
- .4 Overflows and over-coatings must be cleaned appropriately and stains must be cleaned from adjoining surfaces.

### **3.3 INSTALLATION**

- .1 Firestop and smoke control material and components must be installed in compliance with the manufacturer's specifications to ensure a fire rating no less than the fire rating of the adjoining walls and floors.
- .2 Sleeves must be installed in openings for mechanical services penetrating through walls and floors.
- .3 Joints and openings must be sealed to ensure an integral and continuous firestop separation.
- .4 Temporary forms must be supplied and removed only after materials have sufficiently matured and are strong enough.
- .5 Visible surfaces must be smoothed with a trowel to obtain a smooth finish.

### **3.4 SCHEDULING OF WORK**

- .1 Proceed with the implementation only when documents/samples submitted have been reviewed by the Departmental Representative.
- .2 Achieve fire protection floor before putting in place interior walls.
- .3 Bonding to a metal support: the fire protection must be done before the implementation of any projection retardant coating, for the purpose of insurance bond required
- .4 Insulation of piping mechanical systems consisting of a certified fire protection set.
  - .1 Make sure the insulation of piping is installed before the fire stopping.

### **3.5 QUALITY CONTROL ON SITE**

- .1 Inspections: Before conceal or cover materials or firestop inform the Departmental Representative that the works are ready for inspection.
- .2 Inspections made by the manufacturer:
  - .1 Obtain written report from manufacturer verifying compliance of Work specified criteria in regard to the handling, implementation, application products and the protection and cleaning of the work, then report submit this report in accordance with Article DOCUMENTS / ITEMS TO SUBMIT, PART 1.
  - .2 The manufacturer shall make recommendations regarding the use of the product, and make periodic visits to check if the implementation was carried out according to its recommendations.
  - .3 Provide site visits in accordance with article QUALITY ASSURANCE, PART 1

### **3.6 SITE CONDITIONS**

- .1 Temperatures, relative humidity and humidity content of base coats must be in compliance with the manufacturer's specifications for the application and drying procedures of firestop material and smoke control systems.
- .2 Ongoing work must be protected against any possible damages, defacement or dirt stemming from other building trades work.
- .3 All defects must be corrected upon work completion and site conditions must be returned in perfect condition.

### **3.7 VERIFICATION**

- .1 All firestop surfaces to be sealed must be checked. A written report must be issued to the contractor, for any non-conforming or unsatisfactory condition, before the work begins.
- .2 Acceptable surface conditions must be achieved before the work begins.

### **3.8 MIXING**

- .1 Materials must be mixed in strict compliance with the manufacturer's specifications.
- .2 All components have to be mixed and prepared by qualified personnel.

### **3.9 MATURING OF COATINGS**

- .1 Coatings must be left to mature in compliance with the manufacturer's specifications.
- .2 Materials should not be covered until the maturing process is complete.

### **3.10 INSPECTION OF THE WORK**

- .1 The departmental representative must be advised when the work is ready for inspection before the work is covered by a fire protection enclosure or control material or any other services penetrating the firestop partitions.
- .2 Inspection of firestop penetrations must be performed in compliance with standard ASTM E 2174.

### **3.11 CLEANING**

- .1 All excess material or waste must be removed. Adjoining surfaces must be immediately cleaned after installation.
- .2 Temporary barriers must be removed after completion of the work.

### **3.12 TESTS**

- .1 Simulation tests pertaining to smoke penetration must be performed.
- .2 Any defects must be corrected upon detection of any smoke penetration through joints or openings such as specified in the present section and tests must be performed again at no additional costs to the owner.
- .3 The simulating product must not be toxic or staining and must supply a smoke screen 80 mg/m<sup>3</sup> in thickness with an acceptable level of air concentration of 50 ppm.
- .4 Smoke must be generated at a rate of 4 seconds/2.8 m<sup>3</sup> while maintaining the smoke screen until the inspection is finished.

### **3.13 LOCATION OF FIRESTOP SETS**

- .1 Provide protection firestop and smoke barrier to building components having a fire resistance including the places listed below:
  - .1 Crossings walls and masonry walls, concrete and gypsum with a degree of fire resistance.

- .2 Crossings floor slabs, ceilings and roofs with a degree of fire resistance.
- .3 Access openings and crossing walls firestop formed in for later use.
- .4 Around pipes and other mechanical and electrical equipment through walls firestop.
- .5 Rigid ducts with section greater than 129 cm<sup>2</sup>: Fire protection performed by means of a line of material provided between the light cutting angle of the retaining and the firestop wall, and between the retaining bracket and the conduit, on both of side of the partition firestop.

**END OF SECTION**



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**Division 21 / Generalities and Fire Protection**

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## **PART 1 - GENERAL**

### **1.1 GENERAL**

- .1 These specifications are based on the National Master Specifications (NMS). However, it has been adapted to take project features into consideration.
- .2 In these sections, drawings and specifications refer to construction drawings and specifications issued with Contract documents.
- .3 This section includes common requirements for all sections of Divisions 21, 22, 23 and 25 and is a complement to all Contract clauses, to all general clauses, and to all other applicable clauses of architectural, electrical and structural specifications.
- .4 These specifications do not contain necessarily detailed specifications for the design, for construction, or for all equipment parts and components, and installations. If not available, the Contractor shall observe generally accepted techniques and manufacturer's recommendations.
- .5 All discrepancies between drawings and general specs or other trades with electrical drawings and specs shall be brought to the attention of the Departmental Representative before submission close date. The later shall provide supplementary information as necessary by addendum.
- .6 These mechanical specifications apply to the general contractor as well as other contractors. Construction manager shall assume general responsibility and good coordination of his works and coordination with other contractors.
- .7 All systems shall be complete, fully operational and containing all equipment and accessories required delivering at completion of work fully functional places in conformity to applicable codes and standards.

### **1.2 SCOPE OF WORK**

- .1 More precisely, the work of the Mechanical Contractor consists of, but not limited to, provision, installation, and connection of following equipment:
  - .1 Plumbing and heating systems including:
    - .1 Domestic CWS,
    - .2 Sanitary waste systems;
    - .3 Insulation.
  - .2 Networks and ventilation equipment including:

- .1 Modification to VA-1 air system, including:
  - .1 The new air intake of the total flow by keeping the minimum air intake;
  - .2 The motorized fresh air damper;
  - .3 The moving of the motorized mixing damper;
  - .4 The new DX cooling coil and his pipe with basin stainless steel drain;
  - .5 The bi-bloc air conditioning and refrigeration piping;
  - .6 The air distribution including accessories and grilles;
  - .7 The thermal insulation of ductwork air and refrigeration and domestic cold water system piping;
  - .8 Testing and commissioning.
- .2 VA-2 new air system, including
  - .1 The fresh air intake;
  - .2 The motorized fresh air damper;
  - .3 The mixing damper;
  - .4 The filter box including his filter;
  - .5 The new DX cooling coil and his pipe with basin stainless steel drain;
  - .6 The supply fan;
  - .7 The bi-bloc air conditioning and refrigeration piping;
  - .8 The electrical heating coil;
  - .9 The air distribution including accessories and grilles;
  - .10 The exhaust air intake including the motorized damper;
  - .11 The thermal insulation of ductwork air and refrigeration piping;
  - .12 Testing and commissioning.

- .3 Modification to 10S/10E air system, including
  - .1 The filter box including his filter;
  - .2 The supply fan;
  - .3 The electrical heating coil;
  - .4 The air distribution including accessories and grilles;
  - .5 Insulation network fresh air pipe until the air heater;
  - .6 Testing and commissioning.
  
- .3 Automatic regulation, including:
  - .1 Modification to VA-1 existing air system, including the control of new motorized dampers, the control of temperature and humidity, the adjustment of setpoint temperature and humidity;
  - .2 VA-2 new air system, including the control of motorized dampers, the control of temperature and humidity, the adjustment of setpoint temperature and humidity;
  - .3 Modification to 10S/10E air system, including the control, the adjustment of setpoint temperature;
  - .4 Compressor/condensing unit system, local temperature and humidity control;
  - .5 Modification to existing Panels and news panels and their electrical connections to a source of emergency;
  - .6 Connections to a central PC (Communication);
  - .7 Graphics and programming;
  - .8 Testing and commissioning;

### **1.3 RELATED REQUIREMENTS**

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 35 29.06 - Health and Safety Requirements.
- .3 Section 01 61 00 - Common Product Requirements.
- .4 Section 01 73 00 - Execution Requirements.

- .5 Section 01 74 11 - Cleaning.
- .6 Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
- .7 Section 01 78 00 - Closeout Submittals.
- .8 Section 09 91 23 - Interior Painting.
- .9 Section 22 05 00 - Common Work Results - Plumbing.
- .10 Section 23 05 00 - Common Work Results - HVAC.
- .11 Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.

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

- .1 Submit documents and samples in accordance with section 01 33 00 - Submittal Procedures.
- .2 Shop drawings to show:
  - .1 Mounting arrangements;
  - .2 Operating and maintenance clearances.
- .3 Shop drawings and product data accompanied by:
  - .1 Detailed drawings of bases, supports, and anchor bolts;
  - .2 Acoustical sound power data, where applicable;
  - .3 Points of operation on performance curves;
  - .4 Manufacturer to certify current model production;
  - .5 Certification of compliance to applicable codes.
- .4 In addition to transmittal letter referred to in section 01 33 00 - Submittal Procedures: use MCAC "Shop Drawing Submittal Title Sheet". Identify section and paragraph number.

#### **1.5 CLOSEOUT SUBMITTALS**

- .1 Provide operation and maintenance data for incorporation into manual specified in section 01 78 00 - Closeout Submittals.
- .2 Operation and maintenance manual approved by, and final copies deposited with, Departmental Representative before final inspection.

- .3 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.
- .4 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.
- .5 Performance data to include:
  - .1 Equipment manufacturer's performance datasheets with point of operation as left after commissioning is complete.
  - .2 Equipment performance verification test results.
  - .3 Special performance data as specified.
  - .4 Testing, adjusting and balancing reports as specified in section 23 05 93 - Testing, Adjusting and Balancing for HVAC.
- .6 Approvals:
  - .1 Submit three (3) 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.

- .7 Additional data:
  - .1 Prepare and insert into Operation and Maintenance Manual additional data when need for it becomes apparent during specified demonstrations and instructions.
- .8 Site records:
  - .1 Provide sets of white prints as required for each phase of work. Mark changes as work progresses and as changes occur. Include changes to existing mechanical systems, control systems and low voltage control wiring.
  - .2 Transfer information weekly to reproducible, revising reproducible to show work as actually installed.
  - .3 Use different colour waterproof ink for each service.
  - .4 Make available for reference purposes and inspection.
- .9 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.
- .10 Submit copies of as-built drawings for inclusion in final TAB report.

## **1.6 QUALITY ASSURANCE**

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

## **1.7 MAINTENANCE**

- .1 Furnish spare parts in accordance with section 01 78 00 - Closeout Submittals 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.
- .2 Provide one set of special tools required to service equipment as recommended by manufacturers and in accordance with section 01 78 00 - Closeout Submittals.
- .3 Furnish one (1) commercial quality grease gun, grease and adapters to suit different types of grease and grease fittings.

### **1.8 WASTE MANAGEMENT AND DISPOSAL**

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

## **PART 2 - PRODUCTS**

### **2.1 NOT USED**

- .1 Not Used.

## **PART 3 - EXECUTION**

### **3.1 PAINTING REPAIRS AND RESTORATION**

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

### **3.2 CLEANING**

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

### **3.3 FIELD QUALITY CONTROL**

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

.2 Manufacturer's Field Services:

- .1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - SUBMITTALS.
- .2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
- .3 Schedule site visits, to review Work, as directed in PART 1 - QUALITY ASSURANCE.

**3.4 DEMONSTRATION**

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

**3.5 PROTECTION**

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

**END OF SECTION**



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**Division 22 / Plumbing**

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## **PART 1 - GENERAL**

### **1.1 RELATED REQUIREMENTS**

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

### **1.2 SUBMITTALS**

- .1 Submit documents and samples in accordance with section 01 33 00 - Submittal Procedures.
- .2 Shop drawings shall include:
  - .1 Mounting arrangements.
  - .2 Operating and maintenance clearances.
- .3 Shop drawings and product data accompanied by:
  - .1 Detailed drawings of bases, supports, and anchor bolts.
  - .2 Acoustical sound power data, where applicable.
  - .3 Points of operation on performance curves.
  - .4 Manufacturer to certify current model production.
  - .5 Certification of compliance to applicable codes.
- .4 In addition to transmittal letter referred to in section 01 33 00 - Submittal Procedures: use MCAC "Shop Drawing Submittal Title Sheet". Identify section and paragraph number.
- .5 Erection drawings:
  - .1 General:
    - .1 Erection drawings consist of plans drawn to scale, showing the position of equipment, conduits, piping, faucets and others, with sections and details required, including dimensions of equipment, conduits and pipes, locations of ducts, openings, anchorages and supports, relative positions with structural, architectural, and other mechanical and electrical works, position of access doors, and clearances required for operation and maintenance.

- .2 Prepare and submit erection drawings in order to coordinate the work of the various trades of construction. Erection drawings are required for at least the following works:
  - .1 Plumbing work located in mechanical and electrical rooms, tunnels, wells, parking lots, etc;
  - .2 Plumbing work located in places where space is congested with equipment such as corridors false ceilings and in raised floors;
  - .3 Expected ducts, openings drillings in walls, floors, roofs, beams and columns;
  - .4 Anchors;
  - .5 All supports located in technical shafts;
  - .6 In places as described in plumbing specification sections;
  - .7 This clause is not restrictive. Erection drawings may be required in areas deemed necessary by the Departmental Representative.
- .3 Erection drawings must show clearly and precisely all the work involved, those of the discipline and those made by others.
- .2 Preparation:
  - .1 Prepare drawings at an appropriate scale but not smaller than 1:50.
  - .2 Prepare erection drawings and coordinate with other mechanical and electrical trades.
  - .3 All erection drawings shall be prepared with the latest AutoCAD version in the form of file .DWG files, sepia, and paper, in the quantity required. AutoCAD layers of each trade shall meet PWGSC CADD standards.
  - .4 Provide AutoCAD erection drawings to Division 23 for incorporation into the global erection drawings. If necessary, revise the drawings and resubmit them to ensure full coordination and avoid incompatibilities.

### **1.3 CLOSEOUT SUBMITTALS**

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

- .1 Operation and maintenance manual approved by, and final copies deposited with, Departmental Representative before final inspection.
- .2 Operation data to include:
  - .1 Operation instruction for systems and component.
  - .2 Description of actions to be taken in event of equipment failure.
  - .3 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 as specified in section 23 05 93 - Testing, Adjusting and Balancing for HVAC.
- .5 Approvals:
  - .1 Submit three (3) copies of draft Operation and Maintenance Manual to Departmental Representative for approval. Submission of individual data will not be accepted unless directed by Departmental Representative.
  - .2 Make changes as required and re-submit as directed by Departmental Representative.
- .6 Additional data:
  - .1 Prepare and insert into operation and maintenance manual additional data when need for it becomes apparent during specified demonstrations and instructions.

- .7 Site records:
  - .1 Departmental Representative will provide one (1) set of reproducible mechanical drawings. Provide sets of white prints as required for each phase of work. Mark changes as work progresses and as changes occur. Include changes to existing mechanical systems.
  - .2 Transfer information weekly to reproducibles, revising reproducibles to show work as actually installed.
  - .3 Use different colour waterproof ink for each service.
  - .4 Make available for reference purposes and inspection.
- .8 As-built drawings:
  - .1 Prior to start of Testing, Adjusting and Balancing for HVAC, finalize production of as-built drawings.
  - .2 Identify each drawing in lower right hand corner in letters at least 12 mm high as follows: - "AS BUILT DRAWINGS: THIS DRAWING HAS BEEN REVISED TO SHOW MECHANICAL SYSTEMS AS INSTALLED". (Signature of Contractor) (Date).
  - .3 As-built drawings, annotations, changes and signatures must be written with a red ink pencil.
  - .4 Submit to Departmental Representative for approval and make corrections as directed.
  - .5 Perform testing, adjusting and balancing for HVAC using as-built drawings.
  - .6 Submit completed reproducible as-built drawings with Operating and Maintenance Manuals.
- .9 Submit copies of as-built drawings for inclusion in final TAB report.

#### **1.4 MAINTENANCE MATERIAL SUBMITTALS**

- .1 Provide one set of special tools required to service equipment as recommended by manufacturers, and in accordance with section 01 78 00 - Closeout Submittals.

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

- .1 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
  - .1 Store materials off ground, indoors and in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect materials from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.
- .4 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, packaging materials as specified in Construction Waste Management Plan in accordance with section 01 74 21 - Construction/Demolition Waste Management and Disposal.

## **PART 2 - PRODUCTS**

### **2.1 NOT USED**

- .1 Not Used.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

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

### **3.2 PAINTING REPAIRS AND RESTORATION**

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

### **3.3 SYSTEM CLEANING**

- .1 Clean interior and exterior of all systems.

### **3.4 FIELD QUALITY CONTROL**

- .1 Site Tests: conduct following tests in accordance with section 01 45 00 - Quality Control and submit report as described in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS.
- .2 Manufacturer's Field Services:
  - .1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS.
  - .2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
  - .3 Provide site visits in accordance with Article PART 1 - QUALITY ASSURANCE.

### **3.5 DEMONSTRATION**

- .1 Departmental Representative will use equipment and systems for test purposes prior to acceptance. Supply labour, material, and instruments required for testing.
- .2 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.
- .3 Use operation and maintenance manual, as-built drawings, and audio visual aids as part of instruction materials.
- .4 Instruction duration time requirements as specified in appropriate sections.
- .5 Departmental Representative will record these demonstrations on video tape for future reference.



### **3.6 CLEANING**

- .1 Progress Cleaning: clean in accordance with section 01 74 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 Waste Management: separate waste materials for reuse recycling in accordance with section 01 74 21 - Construction/Demolition Waste Management and Disposal.

### **3.7 PROTECTION**

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

**END OF SECTION**



## **PART 1 - GENERAL**

### **1.1 REFERENCES**

- .1 ASTM International Inc.
  - .1 ASTM B32-08, Standard Specification for Solder Metal.
  - .2 ASTM B306-02, Standard Specification for Copper Drainage Tube (DWV).
  - .3 ASTM C564-03a, Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings.
- .2 Canadian Standards Association (CSA International).
  - .1 CSA B67-1972(R1996), Lead Service Pipe, Waste Pipe, Traps, Bends and Accessories.
  - .2 CAN/CSA-B70-06, Cast Iron Soil Pipe, Fittings and Means of Joining.
  - .3 CAN/CSA-B125.3-05, Plumbing Fittings.
- .3 Green Seal Environmental Standards (GSES)
  - .1 Standard GS-36-00, Commercial Adhesives.
- .4 South Coast Air Quality Management District (SCAQMD), California State
  - .1 SCAQMD Rule 1168-A2005, Adhesive and Sealant Applications.

### **1.2 ACTION AND INFORMATIONAL SUBMITTALS**

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

### **1.3 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle in accordance with section 01 61 00 - Common Product Requirements.

- .2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
- .3 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding and packaging materials in accordance with section 01 74 21 - Construction/Demolition Waste Management and Disposal.

## **PART 2 - PRODUCTS**

### **2.1 COPPER TUBE AND FITTINGS**

- .1 Above ground sanitary, storm and vent piping and fittings, less than NPS 3: type DWV, to ASTM B306.
  - .1 Fittings:
    - .1 Cast brass: to CAN/CSA B125.3.
    - .2 Wrought copper: to CAN/CSA B125.3.
  - .2 Solder: lead free, tin-antimony 95:5, to ASTM B32.

### **2.2 CAST IRON PIPING AND FITTINGS**

- .1 Buried sanitary, storm and vent piping and fittings: gray iron, Class 4000, hub and spigot, to CAN/CSA-B70, with one layer of protective bituminous coating.
- .2 Above ground sanitary, storm and vent piping and fittings, NPS 3 and above : gray iron, Class 4000, to CAN/CSA-B70, with one layer of protective bituminous coating.
- .3 Joints:
  - .1 Standard joints for spigot cast iron piping and fittings, buried and above ground, NPS 4 and less.
    - .1 Mechanical joints with neoprene gasket, reinforced with a stainless steel sheath of 0.2 mm thick and equipped with a T-304 stainless steel hose clamp. Joints: to CAN/CSA B70-M, CSA B602 and CAN/ULC S102 or CAN/ULC S102.2.
  - .2 Standard joints between spigot cast iron piping and DWV copper piping, above ground.
    - .1 Mechanical joints with neoprene gasket, reinforced with stainless steel sheath of 0.2 mm thick and equipped with a T-304 stainless steel hose

- clamp. Joints: to CAN/CSA B70-M, CSA B602 and CAN/ULC S102 or CAN/ULC S102.2.
- .2 Cast iron threaded fittings: to receive the brass male adapter. Use a piping joint compound approved or a 100% Teflon tape.
  - .3 Standard joints for spigot cast iron piping and fittings, buried and above ground, NPS 10 and less.
    - .1 Mechanical joints with neoprene gasket, reinforced with a stainless steel sheath of 0.4 mm thick and equipped with a T-304 stainless steel hose clamp and hexagonal bolt of 9,5 mm, at 550 kPa. Joints : to CAN/CSA B70-M, CSA B602, ASTM C1277, UPC-IAPMO, FM and CAN/ULC S102 or CAN/ULC S102.2.
    - .4 Standard joints for hub cast iron piping and fittings, buried and above ground, NPS 15 and less.
      - .1 Neoprene compression seals, to CAN/CSA B70-M et CSA B602.
      - .2 Lead for joint and oakum, to CSA B67.
      - .3 Cold caulking compound, such as PC4 or approved equivalent.
  - .4 Clamps :
    - .1 Carbon steel clamps.

## **PART 3 - EXECUTION**

### **3.1 APPLICATION**

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

### **3.2 INSTALLATION**

- .1 In accordance with section 23 05 05 - Installation of Pipework.
- .2 Unless otherwise specified, install in accordance with National Plumbing Code of Canada, provincial codes, and local authority having jurisdiction.
- .3 Install piping close to walls and ceilings. Group exposed piping and install them parallel to the walls.

- .4 Copper drain piping NPS 1 ¼ to connect to the nearest floor drain all drainage fittings (seal trap) of coil drip pans, air intake, humidifier and air duct drip pans.

### **3.3 TESTING**

- .1 Piping must be tested up to the roof.
- .2 Testing to National Plumbing Code of Canada, provincial codes, and local authority having jurisdiction. Testing must be realised with the presence of plumbing inspectors or Departmental Representative.

### **3.4 PERFORMANCE VERIFICATION**

- .1 Cleanouts:
  - .1 Ensure accessible and that access doors are correctly located.
  - .2 Open, cover with linseed oil and re-seal.
  - .3 Verify that cleanout rods can probe as far as the next cleanout, at least.
- .2 Test to ensure traps are fully and permanently primed.
- .3 Ensure that fixtures are properly anchored, connected to system and effectively vented.
- .4 Affix applicable label (storm, sanitary, vent, pump discharge etc.) c/w directional arrows every floor or 4.5 m (whichever is less)

### **3.5 CLEANING**

- .1 Clean in accordance with section 01 74 11 - Cleaning.
- .2 Waste Management: separate waste materials for reuse and recycling in accordance with section 01 74 21 - Construction/Demolition Waste Management and Disposal.

**END OF SECTION**

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**Division 23 / HVAC**

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## **PART 1 - GENERAL**

### **1.1 RELATED REQUIREMENTS**

- .1 Section 21 05 01 - Common Work Results - Mechanical.
- .2 Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.

### **1.2 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submittals: in accordance with section 01 33 00 - Submittal Procedures.
- .2 Shop drawings:
  - .1 Submit product data and instructions and manufacturer documentation. Data sheets should indicate product characteristics, performance criteria, dimensions, finish and limitations.
- .3 Shop drawings:
  - .1 Indicate the following on the drawings:
    - .1 Mounting arrangements.
    - .2 Operating and maintenance clearances.
  - .2 Submit the following documents with the shop drawings and specifications:
    - .1 Detailed drawings of bases, supports, and anchor bolts.
    - .2 Acoustical sound power data, where applicable.
    - .3 Points of operation on performance curves.
    - .4 Manufacturer to certify current model production.
    - .5 Certification of compliance to applicable codes.
  - .3 In addition to transmittal letter referred to in section 01 33 00 - Submittal Procedures: use MCAC "Shop Drawing Submittal Title Sheet". Identify section and paragraph number.

- .4 Erection drawings:
  - .1 General:
    - .1 Erection drawings consist of plans drawn to scale, showing the position of equipment, conduits, piping, faucets and others, with sections and details required, including dimensions of equipment, conduits and pipes, locations of ducts, openings, anchorages and supports, relative positions with structural, architectural, and other mechanical and electrical works, position of access doors, and clearances required for operation and maintenance.
    - .2 Prepare and submit erection drawings in order to coordinate the work of the various trades of construction. Erection drawings are required for at least the following works:
      - .1 HVAC work located in places where space is congested with equipment such as corridors false ceilings and in raised floors;
      - .2 Expected ducts, openings drillings in walls, floors, roofs, beams and columns;
      - .3 Anchors;
      - .4 All supports located in technical shafts;
      - .5 In places as described in HVAC specification sections;
      - .6 This clause is not restrictive. Erection drawings may be required in areas deemed necessary by the Departmental Representative.
    - .3 Erection drawings must show clearly and precisely all the work involved, those of the discipline and those made by others.
  - .2 Preparation:
    - .1 Prepare drawings at an appropriate scale but not smaller than 1:50.
    - .2 Prepare erection drawings and coordinate with other mechanical and electrical trades.
    - .3 All erection drawings shall be prepared with the latest AutoCAD version in the form of file .DWG files, sepia, and paper, in the quantity required. AutoCAD layers of each trade shall meet PWGSC CADD standards.
    - .4 Receive erection drawings from other mechanical and electrical divisions and incorporate them with the HVAC erection drawings to form the global erection drawings. Ensure full coordination of global erection drawings and submit to the Departmental Representative for verification. If necessary,

review the drawings and resubmit to ensure proper coordination and avoid incompatibilities.

- .1 At the request of the Departmental Representative, submit the overall erection drawings printed with different colors to distinguish the work of different trades.
- .2 Verification of erection drawings by Departmental Representative is limited to ensure that the technical requirements are met (VCF, grills, insulation, etc.). Departmental Representative does not check the quality of the coordination prepared by the Contractor.
- .3 The Contractor shall allocate in his work plan a minimum of ten working days for verification of erection drawings by Departmental Representative

### **1.3 CLOSEOUT SUBMITTALS**

- .1 Provide operation and maintenance data for incorporation into manual specified in section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Sheets: provide instructions on the operation and maintenance, which will be incorporated into the Operation and Maintenance Manual.
- .3 Operation and maintenance manual approved by and final copies deposited with, the Departmental Representative before final inspection.
  - .1 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 instructions for systems and components.
    - .5 Description of actions to be taken in event of equipment failure.
    - .6 Colour coding chart.
  - .2 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.
- .3 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 (TAB) reports as specified in section 23 05 93 - Testing, Adjusting and Balancing for HVAC.
- .4 Approvals:
  - .1 Submit three (3) copies of draft Operation and Maintenance Manual to the Departmental Representative for approval. Submission of individual data will not be accepted unless directed by the Departmental Representative.
  - .2 Make changes as required and re-submit as directed by the Departmental Representative.
- .5 Additional data:
  - .1 Prepare and insert into Operation and Maintenance Manual additional data when need for it becomes apparent during specified demonstrations and instructions.
- .6 Site records:
  - .1 Departmental Representative will provide one (1) set of reproducible mechanical drawings. Provide sets of white prints as required for each phase of work. Mark changes as work progresses and as changes occur. Include changes to existing mechanical systems, control systems and low voltage control wiring.
  - .2 Transfer information weekly to reproducible, revising reproducible to show work as actually installed.
  - .3 Use different colour waterproof ink for each service.
  - .4 Make available for reference purposes and inspection.
- .7 As-built drawings:
  - .1 Prior to start of Testing, Adjusting and Balancing for HVAC, finalize production of as-built drawings.

- .2 Identify each drawing in lower right hand corner in letters at least 12 mm high as follows: - "AS BUILT DRAWINGS: THIS DRAWING HAS BEEN REVISED TO SHOW MECHANICAL SYSTEMS AS INSTALLED" (Signature of Contractor) (Date).
- .3 As-built drawings, annotations, changes and signatures must be written with a red ink pencil.
- .4 Submit to Departmental Representative for approval and make corrections as directed.
- .5 Perform testing, adjusting and balancing for HVAC using as-built drawings.
- .6 Submit completed reproducible as-built drawings with Operating and Maintenance Manuals.
- .8 Submit copies of as-built drawings for inclusion in final TAB report.

#### **1.4 QUALITY ASSURANCE**

- .1 Quality assurance: in accordance with section 01 45 00 - Quality Control.
- .2 Health and Safety: Do construction occupational health and Safety in accordance with section 01 35 29.06 - Health and Safety.

#### **1.5 MAINTENANCE SUBMITTALS**

- .1 Furnish as follow maintenance submittals in accordance with section 01 78 00 - Closeout Submittals.
  - .1 One (1) filter cartridge or one (1) set of filter media for each filter or filter bank in addition to final operating set.
- .2 Provide one set of special tools required to service equipment as recommended by manufacturers and in accordance with section 01 78 00 - Closeout Submittals.
- .3 Furnish one (1) commercial quality grease gun, grease and adapters to suit different types of grease and grease fittings.

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

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

## **PART 2 - PRODUCTS**

### **2.1 ACCESS DOORS**

- .1 All HVAC equipment and boxes installed in false ceiling to be accessible and to have the required clearance.
- .2 In the case of fixed false ceilings, ensure to have access doors to access equipment and boxes.
  - .1 In case it is not possible to use existing access doors because of congestion or lack of doors where required, provide access doors in sufficient quantity to ensure the required access.
    - .1 Access doors in accordance with section 31 08 00.01 - Access Doors - Mechanical, with the required type according to the type of ceiling.
    - .2 Access doors will be installed by architectural division.

## **PART 3 - EXECUTION**

### **3.1 INSPECTION**

- .1 Verification of Conditions: Before installing, make sure that the state of the surfaces / supports previously implemented under other sections or contracts is acceptable and can perform the work in accordance with manufacturer's written instructions
  - .1 Make a visual inspection of surfaces/substrates in the presence of the Departmental Representative.
  - .2 Immediately notify the Departmental Representative of unacceptable conditions detected.
  - .3 Start the installation work only after correcting unacceptable conditions and received the written approval of the Departmental Representative.

### **3.2 PAINTING REPAIRS AND RESTORATION**

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

### **3.3 CLEANING SYSTEMS**

- .1 Clean the inside and outside of all the elements, devices and systems, including filters, and vacuum inside the ducts and the air handling units air.

### **3.4 FIELD QUALITY CONTROL**

- .1 Site Tests: conduct following tests in accordance with section 01 45 00 - Quality Control and submit report as described in PART 1 - SUBMITTALS.
- .2 Manufacturer's Field Services:
  - .1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - SUBMITTALS.
  - .2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
  - .3 Schedule site visits, to review Work, as directed in PART 1 - QUALITY ASSURANCE.

### **3.5 DEMONSTRATION**

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

### **3.6 PROTECTION**

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

**END OF SECTION**





## **PART 1 - GENERAL**

### **1.1 RELATED REQUIREMENTS**

- .1 Section 21 05 01 - Common Work Results - Mechanical.
- .2 Section 23 05 00 - Common Work Results for HVAC.
- .3 Section 23 08 02 - Cleaning and Start-up of Mechanical Piping Systems.

### **1.2 REFERENCES**

- .1 Canadian General Standards Board (CGSB)
  - .1 CAN/CGSB-1.181-99, Ready-Mixed Organic Zinc-Rich Coating.
- .2 Canadian Standards Association (CSA International)
  - .1 CSA B139-04, Installation Code for Oil Burning Equipment.
- .3 Green Seal Environmental Standards (GSES)
  - .1 Standard GS-11-2008, 2nd Edition, Environmental Standard for Paints and Coatings.
- .4 National Fire Code of Canada (NFCC 2010)
- .5 South Coast Air Quality Management District (SCAQMD), California State, Regulation XI. Source Specific Standards
  - .1 SCAQMD Rule 1113-A2007, Architectural Coatings.
  - .2 SCAQMD Rule 1168-A2005, Adhesive and Sealant Applications.

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

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

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

- .1 Deliver, store and handle materials in accordance with section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements
  - .1 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
- .3 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, packaging materials in accordance with section 01 74 21 - Construction/Demolition Waste Management and Disposal.

## **PART 2 - PRODUCTS**

### **2.1 NOT USED**

- .1 Not Used.

## **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 CONNECTIONS TO EQUIPMENT**

- .1 In accordance with manufacturer's instructions unless otherwise indicated.
- .2 Use valves and either unions or flanges for isolation and ease of maintenance and assembly.
- .3 Use double swing joints when equipment mounted on vibration isolation and when piping subject to movement.

### **3.3 CLEARANCES**

- .1 Provide clearance around systems, equipment and components for observation of operation, inspection, servicing, maintenance and as recommended by manufacturer.
- .2 Provide space for disassembly, removal of equipment and components as recommended by manufacturer as indicated without interrupting operation of other system, equipment, and components.

### **3.4 DRAINS**

- .1 Install piping with grade in direction of flow except as indicated.
- .2 Install drain valve at low points in piping systems, at equipment and at section isolating valves.
- .3 Pipe each drain valve discharge separately to above floor drain.
  - .1 Discharge to be visible.
- .4 Drain valves: NPS 3/4 gate or globe valves unless indicated otherwise, with hose end male thread, cap and chain.

### **3.5 AIR VENTS**

- .1 Install manual air vents at high points in piping systems.
- .2 Install isolating valve at each automatic air valve.
- .3 Install drain piping to approved location and terminate where discharge is visible.

### **3.6 DIELECTRIC COUPLINGS**

- .1 General: compatible with system, to suit pressure rating of system.
- .2 Locations: where dissimilar metals are joined.
- .3 NPS 2 and under: isolating unions or bronze valves.
- .4 Over NPS 2: isolating flanges.

### **3.7 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 Saddle type branch fittings may be used on mains if branch line is no larger than half size of main.
  - .1 Hole saw (or drill) and ream main to maintain full inside diameter of branch line prior to welding saddle.

- .6 Install exposed piping, equipment, rectangular cleanouts and similar items parallel or perpendicular to building lines.
- .7 Install concealed pipework to minimize furring space, maximize headroom, conserve space.
- .8 Slope piping, except where indicated, in direction of flow for positive drainage and venting.
- .9 Install, except where indicated, to permit separate thermal insulation of each pipe.
- .10 Group piping wherever possible [and as indicated].
- .11 Ream pipes; remove scale and other foreign material before assembly.
- .12 Use eccentric reducers at pipe size changes to ensure positive drainage and venting.
- .13 Provide for thermal expansion as indicated.
- .14 Valves:
  - .1 Install in accessible locations.
  - .2 Remove interior parts before soldering.
  - .3 Install with stems above horizontal position unless indicated.
  - .4 Valves accessible for maintenance without removing adjacent piping.
  - .5 Install globe valves in bypass around control valves.
  - .6 Use gate, ball and butterfly valves at branch take-offs for isolating purposes except where specified.
  - .7 Install butterfly valves between weld neck flanges to ensure full compression of liner.
  - .8 Use chain operators on valves NPS 2 1/2 and larger where installed more than 2400 mm above floor in Mechanical Rooms.
- .15 Check valves:
  - .1 Install silent check valves on discharge of pumps and in vertical pipes with downward flow and as indicated.
  - .2 Install swing check valves in horizontal lines on discharge of pumps and as indicated.

### **3.8 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, provide space for firestopping. 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.

### **3.9 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.
- .4 Inside diameter to fit around pipe or outside of insulation if so provided.

### **3.10 PREPARATION FOR FIRE STOPPING**

- .1 Install firestopping within annular space between pipes, ducts, insulation and adjacent fire separation in accordance with section 07 84 00 - Fire Stopping.
- .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.
- .4 Insulated pipes and ducts: ensure integrity of insulation and vapour barriers.

### **3.11 FLUSHING OUT OF PIPING SYSTEMS**

- .1 Before start-up, clean interior of piping systems in accordance with requirements of section 01 74 11 - Cleaning supplemented as specified in relevant mechanical sections.
- .2 Preparatory to acceptance, clean and refurbish equipment and leave in operating condition, including replacement of filters in piping systems.

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

- .1 Advise Departmental Representative 48 hours minimum prior to performance of pressure tests.
- .2 Pipework: test as specified in relevant sections of heating, ventilating and air conditioning work.
- .3 Maintain specified test pressure without loss for four (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.

### **3.13 CLEANING**

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

- .2 Waste Management: separate waste materials for reuse and recycling in accordance with section 01 74 21 - Construction/Demolition Waste Management and Disposal.

**END OF SECTION**





## **PART 1 - GENERAL**

### **1.1 RELATED REQUIREMENTS**

- .1 Section 21 05 01 - Common Work Results - Mechanical.
- .2 Section 23 05 00 - Common Work Results for HVAC.
- .3 Section 23 34 00 - HVAC Fans.
- .4 Section 23 81 40 - Air and Water Source Unitary Heat Pumps

### **1.2 REFERENCES**

- .1 American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE).
  - .1 ASHRAE 90.1-01, Energy Standard for Buildings Except Low-Rise Residential Buildings (IESNA cosponsored; ANSI approved; Continuous Maintenance Standard).
- .2 Electrical Equipment Manufacturers' Association Council (EEMAC).
- .3 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  - .1 Material Safety Data Sheets (MSDS).

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

- .1 Submittals: in accordance with section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .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.
    - .1 Submit three copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with section 01 33 00 - Submittal Procedures.
- .3 Quality Control: in accordance with section 01 45 00 - Quality Control.
  - .1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

- .2 Instructions: submit manufacturer's installation instructions.
  - .1 Departmental Representative will make available 1 copy of systems supplier's installation instructions.
- .4 Closeout Submittals
  - .1 Provide maintenance data for motors, drives and guards for incorporation into manual specified in section 01 78 00 - Closeout Submittals.

#### **1.4 QUALITY ASSURANCE**

- .1 Regulatory Requirements: work to be performed in compliance with applicable Provincial regulations.
- .2 Health and Safety Requirements: do construction occupational health and safety in accordance with section 01 35 29.06 - Health and Safety Requirements.

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

- .1 Packing, shipping, handling and unloading:
  - .1 Deliver, store and handle in accordance with section 01 61 00 - Common Product Requirements.
  - .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Waste Management and Disposal:
  - .1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with section 01 74 21 - Construction/Demolition Waste Management and Disposal.

### **PART 2 - PRODUCTS**

#### **2.1 GENERAL**

- .1 Motors: high efficiency, in accordance with local Hydro company standards and to ASHRAE 90.1.

#### **2.2 MOTORS**

- .1 Provide motors for mechanical equipment as specified.

- .2 Motors under 373 W (½ HP): speed as indicated, continuous duty, built-in overload protection, resilient mount, single phase, 120 V, unless otherwise specified or indicated.
- .3 Motors 373 W (½ HP) and larger: EEMAC Class B, squirrel cage induction, speed as indicated, continuous duty, drip proof, ball bearing, maximum temperature rise 40 degrees C, 3 phase, 600 V, unless otherwise indicated.
- .4 When frequency inverters are used, the engines must be "Inverter Duty" or "Inverter Ready" and conform to NEMA MG-1, Part 31.
- .5 Engines 2 HP or more shall be fitted with thermistors.

### **2.3 TEMPORARY MOTORS**

- .1 If delivery of specified motor will delay completion or commissioning work, install motor approved by Departmental Representative for temporary use. Work will only be accepted when specified motor is installed.

## **PART 3 - EXECUTION**

### **3.1 MANUFACTURER'S INSTRUCTIONS**

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

### **3.2 INSTALLATION**

- .1 Fasten securely in place.
- .2 Make removable for servicing, easily returned into, and positively in position.

### **3.3 FIELD QUALITY CONTROL**

- .1 Site Tests: conduct following tests [in accordance with section 01 45 00 and submit report as described in PART 1 - SUBMITTALS.
- .2 Manufacturer's Field Services
  - .1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - SUBMITTALS.

- .2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

### **3.4 CLEANING**

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

**END OF SECTION**

## **PART 1 - GENERAL**

### **1.1 REFERENCES**

- .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-M1987(R2008), Certification of Companies for Fusion Welding of Aluminum.
  - .2 CSA W48-06, Filler Metals and Allied Materials for Metal Arc Welding.
  - .3 CSA B51-03(R2007), Boiler, Pressure Vessel and Pressure Piping Code.
  - .4 CSA-W117.2-2006, Safety in Welding, Cutting and Allied Processes.
  - .5 CSA W178.1-2008, Certification of Welding Inspection Organizations.
  - .6 CSA W178.2-2008, 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.

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

- .1 Deliver, store and handle in accordance with section 01 61 00 - Common Product Requirements.
- .2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
- .3 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, packaging materials in accordance with section 01 74 21 - Construction/Demolition Waste Management and Disposal.

## **PART 2 - PRODUCTS**

### **2.1 ELECTRODES**

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

## **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 QUALITY OF WORK**

- .1 Welding: in accordance with ANSI/ASME B31.1, B31.3, ANSI/ASME Boiler and Pressure Vessel Code, Sections I and IX and ANSI/AWWA C206, using procedures conforming to AWS B3.0, AWS C1.1, and special procedures specified elsewhere in others sections and applicable requirements of provincial authority having jurisdiction.

### **3.3 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 under: install welding type sockets.
  - .2 Branch connections: install welding tees or forged branch outlet fittings.

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

- .1 Review weld quality requirements and defect limits of applicable codes and standards with Departmental Representative before work is started.
- .2 Formulate "Inspection and Test Plan" in co-operation with Departmental Representative.

- .3 Do not conceal welds until they have been inspected, tested and approved by inspector.
- .4 Provide for 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 Perform examinations and tests by specialist qualified to CSA W178.1 and CSA W178.2 and approved by Departmental Representative.
  - .2 To ANSI/ASME Boiler and Pressure Vessels Code, Section V, CSA B51 and requirements of authority having jurisdiction.
  - .3 Inspect and test 5 % of welds in accordance with "Inspection and Test Plan" by non-destructive visual examination and magnetic particle (hereinafter referred to as "particle") tests and spot full gamma ray radiographic (hereinafter referred to as "radiography") tests.
- .2 Hydrostatically test welds to ANSI/ASME B31.1.
- .3 Visual examinations: include entire circumference of weld externally and wherever possible internally.
- .4 Failure of visual examinations
  - .1 Upon failure of welds by visual examination, perform additional testing as directed by Departmental Representative of total of up to 10 % of welds, selected at random by Departmental Representative by radiographic particle tests.
- .5 Full radiographic tests for piping systems
  - .1 Spot radiography
    - .1 Conduct spot radiographic tests of up to 10 % of welds, selected at random by Departmental Representative from welds which would be most difficult to repair in event of failure after system is operational.
  - .2 Radiographic film
    - .1 Identify each radiographic film with date, location, name of welder, and submit to Departmental Representative. Replace film if rejected because of poor quality.
  - .3 Interpretation of radiographic films
    - .1 By qualified radiographer.



- .4 Failure of radiographic tests
  - .1 Extend tests to welds by welder responsible when those welds fail tests.

### **3.6 DEFECTS CAUSING REJECTION**

- .1 As described in ANSI/ASME B31.1 and ANSI/ASME Boiler and Pressure Vessels Code.
- .2 In addition, piping for systems below 1 000 kPa:
  - .1 Undercutting greater than 0.8 mm adjacent to cover bead on outside of pipe.
  - .2 Undercutting greater than 0.8 mm adjacent to root bead on inside of pipe.
  - .3 Undercutting greater than 0.8 mm at combination of internal surface and external surface.
  - .4 Incomplete penetration and incomplete fusion greater than total length of 38 mm in 1500 mm length of weld depth of such defects being greater than 0.8 mm.
  - .5 Repair cracks and defects in excess of 0.8 mm in depth.
  - .6 Repair defects whose depth cannot be determined accurately on basis of visual examination.

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

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

### **3.8 CLEANING**

- .1 Clean in accordance with section 01 74 11 - Cleaning.
- .2 Waste Management: separate waste materials for reuse and recycling in accordance with section 01 74 21 - Construction/Demolition Waste Management and Disposal.

**END OF SECTION**



## **PART 1 - GENERAL**

### **1.1 RELATED REQUIREMENTS**

- .1 Section 21 05 01 - Common Work Results - Mechanical.
- .2 Section 23 05 00 - Common Work Results for HVAC.
- .3 Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment.
- .4 Section 23 05 49 - Seismic Restraint Systems (SRS) Type P2 Buildings.

### **1.2 REFERENCES**

- .1 American Society of Mechanical Engineers (ASME)
  - .1 ASME B31.1-07, Power Piping.
- .2 ASTM International
  - .1 ASTM A125-1996(2007), Standard Specification for Steel Springs, Helical, Heat-Treated.
  - .2 ASTM A307-07b, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
  - .3 ASTM A563-07a, 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 SP58-2002, Pipe Hangers and Supports - Materials, Design and Manufacture.
  - .2 MSS SP69-2003, Pipe Hangers and Supports - Selection and Application.
  - .3 MSS SP89-2003, Pipe Hangers and Supports - Fabrication and Installation Practices.
- .5 Underwriters Laboratories of Canada (ULC).

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

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

- .2 Product Data:
  - .1 Provide manufacturer's printed product literature and data sheets for hangers and supports and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
  - .1 Submit shop drawings for:
    - .1 Bases, hangers and supports.
    - .2 Connections to equipment and structure.
    - .3 Structural assemblies.
- .4 Certificates:
  - .1 Submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .5 Manufacturers' Instructions:
  - .1 Provide manufacturer's installation instructions.

#### **1.4 CLOSEOUT SUBMITTALS**

- .1 Provide maintenance data for incorporation into manual specified in section 01 78 00 - Closeout Submittals.

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

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

#### **1.6 PACKAGING WASTE MANAGEMENT**

- .1 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, packaging materials in accordance with section 01 74 21 - Construction/Demolition Waste Management and Disposal.

## **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 Performance Requirements:

- .1 Design supports, platforms, catwalks, hangers to withstand seismic events.

### **2.2 GENERAL**

- .1 Fabricate hangers, supports and sway braces in accordance with ANSI B31.1 and MSS SP58.
- .2 Use components for intended design purpose only. Do not use for rigging or erection purposes.
- .3 Perforated metal bands are not accepted.
- .4 Hammer anchors such as « Ramset » are not permitted. Use fastener pliers to avoid drilling steel beams.

### **2.3 PIPE HANGERS**

.1 Finishes:

- .1 Pipe hangers and supports: galvanized after manufacture.

- .2 Use electro-plating galvanizing process.
- .3 Ensure steel hangers in contact with copper piping are copper plated or epoxy coated.
- .2 Upper attachment structural: suspension from lower flange of I-Beam:
  - .1 Piping NPS 2 maximum: malleable iron C-clamp with hardened steel cup point setscrew, locknut and carbon steel retaining clip, UL and ULC listed, FM approved, to MSS-SP69.
  - .2 Piping NPS 2 1/2 or greater: malleable iron beam clamp, eye rod, jaws and extension with carbon steel retaining clip, tie rod, nuts and washers, UL and ULC listed, FM approved, to MSS-SP69.
- .3 Upper attachment structural: suspension from upper flange of I-Beam:
  - .1 Ductile iron top-of-beam C-clamp with hardened steel cup point setscrew, locknut and carbon steel retaining clip, UL and ULC listed, FM approved, to MSS SP69.
  - .2 Malleable iron top-of-beam jaw-clamp with hooked rod, spring washer, plain washer and nut, UL listed, FM approved, to MSS SP69.
- .4 Steel truss:
  - .1 Piping NPS 2 1/2 maximum: supporting steel plates with two locknuts.
  - .2 Piping NPS 2 1/2 or greater supporting steel plates with two locknuts, carbon steel weldable bracket and malleable iron eye nut.
  - .3 Carbon steel weldable bracket with two locknuts, to MSS-SP-69, type 22.
- .5 Steel section or angle beam (lower flange):
  - .1 Ductile iron top-of-beam C-clamp with hardened steel cup point setscrew, locknut and carbon steel retaining clip, UL and ULC listed, FM approved, to MSS SP69.
- .6 Steel section or angle beam (upper flange):
  - .1 Malleable iron top-of-beam jaw-clamp with hooked rod, spring washer, plain washer and nut, UL listed, FM approved, to MSS SP69.
- .7 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 Expanding anchors.
- .3 Concrete recessed brackets, corner, protection plate with breakable insert, UL and ULC listed, FM approved and to MSS-SP-69.
- .8 Shop and field-fabricated assemblies:
  - .1 Trapeze hanger assemblies.
  - .2 Steel brackets.
  - .3 Sway braces for seismic restraint systems: to section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment.
- .9 Hanger rods: threaded rod material to MSS SP58:
  - .1 Ensure that hanger rods are subject to tensile loading only.
  - .2 Provide linkages where lateral or axial movement of pipework is anticipated.
- .10 Pipe attachments installed directly on the pipe (All diameter):
  - .1 Steel or plastic piping, longitudinal movement less than 25 mm: adjustable clevis, to MSS-SP-69, type 10, UL listed and FM approved.
  - .2 Copper piping, longitudinal movement less than 25 mm: copper adjustable clevis, to MSS-SP-69, type 10.
  - .3 Steel and plastic piping, longitudinal movement of more than 25 mm : yoke style pipe roll to MSS-SP-69, type 43.
  - .4 Steel and plastic piping supported below: pipe roller to MSS-SP-69, type 44.
  - .5 Ductile iron vent and drainage piping, steel mechanical joints, adjustable double hook-type on both sides of the joint, (for NPS 2 to NPS 6) and ductile iron shield (for NPS 8 and NPS 10).
- .11 Fire protection pipe attachments:
  - .1 Steel or plastic fire protection piping: adjustable clevis, to MSS-SP-69, type 10, UL listed and FM approved.
  - .2 Copper fire protection piping: copper adjustable clevis, to MSS-SP-69, type 10.

- .12 Supporting elements for refrigeration piping:
  - .1 Copper refrigeration piping, not insulated: steel fasteners, a finished electro plated with a plastic insert mounted on a profile in "U" 41 mm x 41 mm and 2.6 mm thick, plated steel finished with a electro, according to ASTM B633, Type III SC1.
  - .2 Copper refrigeration piping, insulated: fastening steel, plated with an electro-mounted on a section "U" of 41 mm x 41 mm and 2.6 mm thick steel finish of a finished plated electro, according to ASTM B633, Type III SC1.
- .13 Yoke style pipe roll: carbon steel yoke, rod and nuts with cast iron roll, to MSS SP69
- .14 U-bolts: carbon steel to MSS SP69 with 2 nuts at each end to ASTM A563.
  - .1 Finishes for steel pipework galvanized.
  - .2 Finishes for copper, glass, brass or aluminum pipework: black with formed portion plastic coated.
- .15 Pipe rollers: cast iron roll and roll stand with carbon steel rod to MSS SP69.

## **2.4 RISER CLAMPS**

- .1 Steel or cast iron pipe: carbon steel, UL and ULC listed, to MSS SP69, type 8.
- .2 Copper pipe: carbon steel copper plated to MSS SP69, type 8
- .3 Bolts: to ASTM A307.
- .4 Nuts: to ASTM A563.

## **2.5 INSULATION PROTECTION SHIELDS**

- .1 Insulated cold piping:
  - .1 64 kg/m<sup>3</sup> density insulation plus insulation protection shield to: MSS SP69, galvanized sheet carbon steel. Length designed for maximum 3 m span.
- .2 Insulated hot piping:
  - .1 Curved plate 300 mm long, with edges turned up, welded-in centre plate for pipe sizes NPS 12 and over, carbon steel to comply with MSS SP69.



## **2.6 CONSTANT SUPPORT SPRING HANGERS**

- .1 Springs: alloy steel to ASTM A125, shot peened, magnetic particle inspected, with +/-5% spring rate tolerance, tested for free height, spring rate, loaded height and provided with Certified Mill Test Report (CMTR)
- .2 Load adjustability: 10% minimum adjustability each side of calibrated load. Adjustment without special tools. Adjustments not to affect travel capabilities.
- .3 Provide upper and lower factory set travel stops.
- .4 Provide load adjustment scale for field adjustments.
- .5 Total travel to be actual travel + 20%. Difference between total travel and actual travel 25 mm minimum.
- .6 Individually calibrated scales on each side of support calibrated prior to shipment, complete with calibration record.
- .7 Acceptable products: Vibro-Acoustics; Vibra-Sil; Kinetics Noise Control. Replacement materials or products: approved by addendum according to Instructions to bidders.

## **2.7 VARIABLE SUPPORT SPRING HANGERS**

- .1 Vertical movement: 13mm minimum, 50mm maximum, use single spring pre-compressed variable spring hangers.
- .2 Vertical movement greater than 50mm: use double spring pre-compressed variable spring hanger with 2 springs in series in single casing.
- .3 Variable spring hanger completes with factory calibrated travel stops. Provide certificate of calibration for each hanger.
- .4 Steel alloy springs: to ASTM A125, shot peened, magnetic particle inspected, with +/-5% spring rate tolerance, tested for free height, spring rate, loaded height and provided with CMTR.

## **2.8 EQUIPMENT SUPPORTS**

- .1 Fabricate equipment supports not provided by equipment manufacturer from structural grade steel. Submit calculations with shop drawings.

## **2.9 EQUIPMENT ANCHOR BOLTS AND TEMPLATES**

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

## **PART 3 - EXECUTION**

### **3.1 MANUFACTURER'S INSTRUCTIONS**

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

### **3.2 INSTALLATION**

- .1 Provide antivibration devices for piping at pumps, boilers and as specified.
- .2 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.
- .3 Clevis plates:
  - .1 Attach to concrete with 4 minimum concrete inserts, one at each corner.
- .4 Use approved constant support type hangers where:
  - .1 Vertical movement of pipework is 13 mm or more,
  - .2 Transfer of load to adjacent hangers or connected equipment is not permitted.
- .5 Use variable support spring hangers where:
  - .1 Transfer of load to adjacent piping or to connected equipment is not critical.
  - .2 Variation in supporting effect does not exceed 25 % of total load.

### **3.3 HANGER SPACING**

- .1 Plumbing piping: to National Plumbing Code of Canada, Provincial Code and authority having jurisdiction.
- .2 Fire protection: to NFPA 13 and NFPA 14.

- .3 Copper piping: up to NPS 1/2: every 1.5 m.
- .4 Within 300 mm of each elbow.
- .5 Plastic piping, other than polypropylene, polymer and pyrex: to manufacturer recommendations.
- .6 Ductile iron pipe: hanger at each joint. Distance between two hangers shall not be more than 3 m. This distance must be reduced to 1 m when adjacent fittings spaced of 300 mm or less are installed on piping with mechanical joints.
- .7 Vertical piping: supported at the bas, highest point and at each floor.
- .8 In addition to the media requested above, install brackets and suspensions on straight lengths of pipe as shown in the table below:

<b>PLUMBING, COOLING AND HEATING PIPING</b>						
<b>MAXIMUM SPACING- HORIZONTAL PIPING - MÈTERS</b>						
<b>Ø PIPING (NPS)</b>	<b>Ø ROD mm</b>	<b>STEEL</b>	<b>COPPER</b>	<b>ASBESTOS CEMENT</b>	<b>ABS PVC</b>	<b>CPVC</b>
Up to 1/2	10	2,1	1,5	---	0,9	0,8
3/4	10	2,1	1,5	---	1,0	0,9
1	10	2,1	1,8	---	1,1	1,0
1 1/4	10	2,1	2,1	2,0	1,2	1,2
1 1/2	10	2,7	2,4	2,0	1,3	1,3
2	10	3,0	2,4	2,0	1,5	1,4
2 1/2	13	3,4	2,7	2,0	---	1,7
3	13	3,6	3,0	2,0	1,9	1,8
3 1/2	13	3,9	3,4	2,0	---	---
4	16	4,2	3,7	2,0	2,2	2,1
5	16	4,8	---	2,0	---	---
6	19	5,1	---	2,0	2,6	2,6
8	19	5,7	---	2,0	3,0	3,0
10	22	6,6	---	2,0	3,5	3,3

### 3.4 HANGER INSTALLATION

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

- .3 Support from structural members. Where structural bearing does not exist or inserts are not in suitable locations, provide supplementary structural steel members.

### **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.

### **3.7 FIELD QUALITY CONTROL**

- .1 Site Tests: conduct following tests in accordance with section 01 45 00 - Quality Control and submit report as described in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS.
- .2 Manufacturer's Field Services:
  - .1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS.

- .2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
- .3 Schedule site visits, to review Work, as directed in PART 1 - QUALITY ASSURANCE.
- .3 Verification requirements in accordance with section 01 47 17 - Sustainable Requirements: Contractor's Verification, include:
  - .1 Materials and resources.
  - .2 Storage and collection of recyclables.
  - .3 Construction waste management.
  - .4 Resource reuse.
  - .5 Recycled content.
  - .6 Local/regional materials.
  - .7 Certified wood.
  - .8 Low-emitting materials.

### **3.8 CLEANING**

- .1 Clean in accordance with section 01 74 11 - Cleaning.
  - .1 Remove surplus materials, excess materials, rubbish, tools and equipment.
- .2 Waste Management: separate waste materials for reuse in accordance with section 01 74 21 - Construction/Demolition Waste Management and Disposal.

**END OF SECTION**



## **PART 1 - GENERAL**

### **1.1 RELATED REQUIREMENTS**

- .1 Section 21 05 01 - Common Work Results - Mechanical.
- .2 Section 23 05 00 - Common Work Results for HVAC.
- .3 Section 23 05 49 01 - Seismic Restraint Systems (SRS) - Type P2 Buildings.
- .4 Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.

### **1.2 REFERENCES**

- .1 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  - .1 Material Safety Data Sheets (MSDS).
- .2 National Fire Protection Association (NFPA).
  - .1 NFPA 13-2002, Standard for the Installation of Sprinkler Systems.
- .3 National Building Code of Canada (NBC) - 1995

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

- .1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
  - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.
    - .1 Submit three copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with section 01 33 00 - Submittal Procedures.
  - .2 Submit shop drawings in accordance with section 01 33 00 - Submittal Procedures.
    - .1 Provide separate shop drawings for each isolated system complete with performance and product data.
    - .2 Provide detailed drawings of seismic control measures for equipment and piping.
- .3 Quality assurance submittals: submit following in accordance with section 01 33 00 - Submittal Procedures.
  - .1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

- .2 Instructions: submit manufacturer's installation instructions.
- .1 Departmental Representative will make available 1 copy of systems supplier's installation instructions.
- .3 Manufacturer's Field Reports: manufacturer's field reports specified.

#### **1.4 QUALITY ASSURANCE**

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

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

- .1 Packing, shipping, handling and unloading:
  - .1 Deliver, store and handle in accordance with section 01 61 00 - Common Product Requirements.
  - .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Waste Management and Disposal:
  - .1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with section 01 74 21 - Construction/Demolition Waste Management and Disposal.

#### **1.6 VIBRATION AND SEISMIC CONTROLS UTILISATION**

- .1 Provide seismic controls for mechanical equipments as required in the table below:



Equipment	Power (HP) and other	RPM	Equipment location											
			Slab on ground			Slab - Span								
						Up to 6 m			From 6 to 9 m			From 9 to 12 m		
			Base	Isolator	Min. deflection (mm)	Base	Isolator	Min. deflection (mm)	Base	Isolator	Min. deflection (mm)	Base	Isolator	Min. deflection (mm)
<b>Axial fans</b>														
Diameter : Up to 560 mm	All	All	A	2	5	A	3	20	A	3	20	C	3	20
Diameter : 600 mm and over	S.P. ≤ 500 Pa	Up to 300	B	3	65	C	3	90	C	3	90	C	3	90
		301 to 500	B	3	20	B	3	40	C	3	65	C	3	65
		501 and greater	B	3	20	B	3	40	B	3	40	B	3	40
	S.P. ≥ 501 Pa	Up to 300	C	3	65	C	3	90	C	3	90	C	3	90
		301 to 500	C	3	40	C	3	40	C	3	65	C	3	65
		501 and greater	C	3	20	C	3	40	C	3	40	C	3	65
<b>Centrifugal fans</b>														
Diameter : Up to 560 mm	All	All	B	2	5	B	3	20	B	3	20	C	3	40
Diameter : 600 mm and over	≤ 40	Up to 300	B	3	65	B	3	90	B	3	90	B	3	90
		301 to 500	B	3	40	B	3	40	B	3	65	B	3	65
		501 and greater	B	3	20	B	3	20	B	3	20	B	3	40
	≥ 50	Up to 300	C	3	65	C	3	90	C	3	90	C	3	90
		301 to 500	C	3	40	C	3	40	C	3	65	C	3	65
		501 and greater	C	3	25	C	3	40	C	3	40	C	3	65
<b>Helical fans</b>														
Wall	All	All	A	1	5	A	1	5	A	1	5	A	1	5
Roof	All	All	A	1	5	A	1	5	B	4	40	D	4	40
<b>Small fans and air terminal units</b>														
	≤ 285 L/s	All	A	3	15	A	3	15	A	3	15	A	3	15
	> 285 L/s	All	A	3	20	A	3	20	A	3	20	A	3	20

.2 Bases types:

- .1 A. No base, isolators are attached directly to equipment.
- .2 B. Steel base or structural rail (2.9).

- .3 C Concrete inertia base (2.10).
- .4 D. Base mounted on curb (2.11).
  
- .3 Isolator types:
  - 1. Elastomeric pads (2.2).
    - 1.1 Rubber / Steel / Rubber plates (2.2, EP4).
  - 2. Floor or suspended elastomeric mounts (2.3, 2.6).
  - 3. Floor or suspended springs (2.6).
  - 4. Spring mounts (2.5).
  - 5. Thrust restraints (2.8).

## **PART 2 - PRODUCTS**

### **2.1 GENERAL**

- .1 Size and shape of bases type and performance of vibration isolation as indicated.
- .2 All products: to seismic norms.

### **2.2 ELASTOMERIC PAD**

- .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 Cadmium plate for all installations.
- .4 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.
- .6 Performance: as indicated.

## **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.
  - .1 Type H1: neoprene - in-shear, moulded with rod isolation bushing which passes through hanger box.

- .1 Acceptable products: Vibro-Acoustics, type HD; Vibra-Sil; Ingenia “Amber/Booth”. Replacement materials or products: approved by addendum according to Instructions to bidders.
- .2 Type H2: stable spring, elastomeric washer, cup with moulded isolation bushing which passes through hanger box.
  - .1 Acceptable products: Vibro-Acoustics, type SH; Vibra-Sil; Ingenia “Amber/Booth”. Replacement materials or products: approved by addendum according to Instructions to bidders.
- .3 Type H3: stable spring, elastomeric element, cup with moulded isolation bushing which passes through hanger box.
  - .1 Acceptable products: Vibro-Acoustics, type SHR; Vibra-Sil; Ingenia “Amber/Booth”. Replacement materials or products: approved by addendum according to Instructions to bidders.
- .4 Type H4: stable spring, elastomeric element with precompression washer and nut with deflection indicator.
  - .1 Acceptable products: Vibro-Acoustics; Vibra-Sil; Ingenia “Amber/ Booth”. Replacement materials or products: approved by addendum according to Instructions to bidders.
- .2 Performance: damping rate with minimal efficiency of 95 %.

## **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.
  - .1 Acceptable products: Vibro-Acoustics; Vibra-Sil; Ingenia “Amber/Booth”. Replacement materials or products: approved by addendum according to Instructions to bidders.

## **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.
  - .1 Acceptable products: Vibro-Acoustics, type HCS; Vibra-Sil; Ingenia “Amber/Booth”. Replacement materials or products: approved by addendum according to Instructions to bidders.

## **2.9 SEISMIC CONTROL MEASURES**

- .1 General:
  - .1 Seismic control systems to work in every direction.
  - .2 Fasteners and attachment points to resist same maximum load as seismic restraint.
  - .3 Drilled or power driven anchors and fasteners not permitted.
  - .4 No equipment, equipment supports or mounts to fail before failure of structure.
  - .5 Supports of cast iron or threaded pipe not permitted.
  - .6 Seismic control measures not to interfere with integrity of fire stopping.
- .2 Static equipment:
  - .1 Anchor equipment to equipment supports. Anchor equipment supports to structure.
  - .2 Suspended equipment:
    - .3 Use one or more of following methods depending upon site conditions and as indicated:
      - .1 Install tight to structure.
      - .2 Cross brace in every direction.
      - .3 Brace back to structure.
      - .4 Cable restraint system.
    - .4 Seismic restraints:
      - .5 Cushioning action gentle and steady.
      - .6 Never reach metal-like stiffness.
- .3 Vibration isolated equipment:
  - .1 Seismic control measures not to jeopardize noise and vibration isolation systems. Provide 6 to 9 mm clearance during normal operation of equipment and systems between seismic restraint and equipment.

- .2 Incorporate seismic restraints into vibration isolation system to resist complete isolator unloading.
- .3 As indicated.
- .4 Piping systems:
  - .1 Fire alarm system: according to NFPA 13.
  - .2 Piping systems: hangers longer than 300 mm; brace at each hanger.
  - .3 Compatible with requirements for anchoring and guiding of piping systems.
- .5 Bracing methods:
  - .1 Structural angles or channels.
  - .2 Cable restraint system incorporating grommets, shackles and other hardware to ensure alignment of restraints and to avoid bending of cables at connection points. Incorporate neoprene into cable connections to reduce shock loads.

## **PART 3 - EXECUTION**

### **3.1 MANUFACTURER'S INSTRUCTIONS**

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

### **3.2 INSTALLATION**

- .1 Seismic control measures to meet requirements of NBC.
- .2 Install vibration isolation equipment in accordance with manufacturer's instructions and adjust mountings to level equipment.
- .3 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.
- .4 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 NPS 4: first 3 points of support. NPS5 to NPS 8: first 4 points of support. NPS 10 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.
- .5 Where isolation is bolted to floor use vibration isolation rubber washers.
- .6 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.
- .7 Air handling units: elastomeric pads with static deflexion of 4 mm and maximum spacing of 2 400 mm on center.

### **3.3 FIELD QUALITY CONTROL**

- .1 Manufacturer's Field Services
  - .1 Arrange with manufacturer's representative to review work of this Section and submit written reports to verify compliance with Contract Documents.
  - .2 Manufacturer's Field Services: consisting of product use recommendations and periodic site visits to review installation, scheduled as follows:
    - .1 After delivery and storage of Products.
    - .2 After preparatory work is complete but before installation commences.
    - .3 Upon completion of installation.
  - .3 Submit manufacturer's reports to Departmental Representative within three (3) days of manufacturer representative's review.
  - .4 Make adjustments and corrections in accordance with written report.
- .2 Inspection and Certification
  - .1 Experienced and competent sound and vibration testing professional engineer to take vibration measurement for HVAC systems after start up and TAB of systems to section 23 05 93 - Testing, Adjusting and Balancing for HVAC.
  - .2 Take vibration measurements for equipments.
  - .3 Provide Departmental Representative with notice 24h in advance of commencement of tests.
  - .4 Establish adequacy of equipment isolation and acceptability of noise levels in occupied areas and where appropriate, remedial recommendations (including sound curves).
  - .5 Submit complete report of test results including sound curves.

### **3.4 CLEANING**

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

**END OF SECTION**



## **PART 1 - GENERAL**

### **1.1 RELATED REQUIREMENTS**

- .1 Section 21 05 01 - Common Work Results - Mechanical.
- .2 Section 23 05 00 - Common Work Results for HVAC.
- .3 Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment.
- .4 Section 26 05 00 - Common work results for electrical.
- .5 Section 26 05 29 - Hangers and supports for electrical systems.
- .6 Section 26 50 00 - Lighting.

### **1.2 REFERENCES**

- .1 Canadian Standards Association(CSA)/CSA International.
  - .1 CSA G40.20/G40.21, General Requirements for Rolled or Welded Structural Quality Steel.
- .2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  - .1 Material Safety Data Sheets (MSDS).
- .3 National Building Code of Canada (NBC) - 2005.

### **1.3 DEFINITIONS**

- .1 Priority Two (P2) Buildings: buildings in which life safety is of paramount concern. It is not necessary that P2 buildings remain operative during or after earthquake activity.
- .2 SRS: acronym for Seismic Restraint System.

### **1.4 DESCRIPTION**

- .1 SRS fully integrated into, and compatible with:
  - .1 Noise and vibration controls specified elsewhere.
  - .2 Structural, mechanical, electrical design of project.
- .2 Each Contractor is responsible of seismic restraint systems for their discipline.

- .3 During seismic event, SRS to prevent systems and equipment from causing personal injury and from moving from normal position.
- .4 Designed by Professional Engineer specializing in design of SRS and registered in Province of Quebec.

## **1.5 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submittals: in accordance with section 01 33 00 - Submittal Procedures.
- .2 Submit design data and details of seismic protection systems with a certificate with seal of recognition headings engineer for following:
  - .1 Full details of design criteria.
  - .2 Working drawings (prepared to same standard of quality and size as documents forming these tender documents), materials lists, schematics, full specifications for components of each SRS to be provided.
  - .3 Design calculations (including restraint loads resulting from seismic forces in accordance with National Building Code, detailed work sheets, tables).
  - .4 Separate shop drawings for each SRS and devices for each system, equipment.
  - .5 Identification of location of devices.
  - .6 Schedules of types of SRS equipment and devices.
  - .7 Details of fasteners and attachments to structure, anchorage loadings, attachment methods.
  - .8 Installation procedures and instructions.
  - .9 Design calculations including restraint loads to NBC and Supplement.
  - .10 Detailed design of SRS including complete working drawings prepared to same standard of quality and size as Contract Documents, materials lists, design calculations, schematics, specifications.
- .3 Submit additional copy of shop drawings and product data of seismic protection systems to Structural Engineer for review of connection points to building structure.
- .4 Quality assurance submittals: submit following in accordance with section 01 33 00 - Submittal Procedures.
  - .1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

- .2 Instructions: submit manufacturer's installation instructions.
  - .1 Departmental Representative will make available 1 copy of systems supplier's installation instructions.
- .5 Closeout Submittals:
  - .1 Provide maintenance data including monitoring requirements for incorporation into manuals specified in section 01 78 00 - Closeout Submittals.

## **1.6 QUALITY ASSURANCE**

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

## **1.7 DELIVERY, STORAGE, AND HANDLING**

- .1 Packing, shipping, handling and unloading:
  - .1 Deliver, store and handle in accordance with section 01 61 00 - Common Product Requirements.
  - .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Waste Management and Disposal:
  - .1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with section 01 74 21 - Construction/Demolition Waste Management and Disposal.

## **1.8 PROTECTION LEVEL**

- .1 Install anchorage and seismic stabilization devices for ventilation duct, equipment, reservoirs and piping (other than fire protection piping), as to « ASHRAE, A Practical Guide to Seismic Restraint » and norm ANSI/SMACNA 001.
  - .1 Protection level for the building:
    - .1 SHL-« C » for ducts and pipes.
    - .2 SHL-« B » for equipments.
    - .3 SHL-« D » for reservoir with flat bottom.

- .4 SHL-« B » for reservoir.
- .2 Install anchorage and seismic stabilization devices for fire protection piping as to NFPA 13. Protection level is  $V_p = 0.5 W_p$ .

## **PART 2 - PRODUCTS**

### **2.1 SRS MANUFACTURER**

- .1 Seismic protection devices and systems must be provided by a single manufacturer with experience in the field.

### **2.2 GENERAL**

- .1 SRS to provide gentle and steady cushioning action and avoid high impact loads.
- .2 SRS to provide gentle and steady cushioning action and avoid high impact loads. SRS to restrain seismic forces in every direction
- .3 Fasteners and attachment points to resist same load as seismic restraints.
- .4 SRS of Piping systems compatible with:
  - .1 Expansion, anchoring and guiding requirements.
  - .2 Equipment vibration isolation and equipment SRS.
- .5 SRS utilizing cast iron, threaded pipe, other brittle materials not permitted.
- .6 Attachments to RC structure:
  - .1 Use high strength mechanical expansion anchors.
  - .2 Drilled or power driven anchors not permitted.
- .7 Wet pipe sprinkler systems: refer to section 21 13 13 - Wet Pipe Sprinkler Systems.
- .8 Seismic control measures not to interfere with integrity of fire stopping.
- .9 Stabilize all accessories installed in suspended ceilings: diffusers and light fixtures.

## **2.3 STEEL ANGLE**

- .1 To AISI.
  - .1 Minimum tensile strength:  $F_u = 410$  MPa.
  - .2 Yield stress  $F_y = 300$  MPa.

## **2.4 C-CHANNEL**

- .1 To ASTM A1011/A1011M GR 33 and CSA G40.20/G40.21.

## **2.5 STRUCTURAL PIPING**

- .1 To ASTM A53/A53M, type E or S, grade B.

## **2.6 CABLE**

- .1 To ASTM A603 or ASTM A475 with at least seven strands and cover with a class A layer.
- .2 Connecting parts: To ASCE 96 and able to support 110 % of cable maximum stress.

## **2.7 BOLTS**

- .1 To ASTM A307, grade A, hexagon head.

## **2.8 SRS FOR STATIC EQUIPMENT, SYSTEMS**

- .1 Floor-mounted equipment, systems:
  - .1 Anchor equipment to equipment supports.
  - .2 Anchor equipment supports to structure.
  - .3 Use size of bolts scheduled in approved shop drawings.
- .2 Suspended equipment, systems:
  - .1 Use one or combination of following methods:
    - .1 Install tight to structure.
    - .2 Cross-brace in every direction.

- .3 Brace back to structure.
- .4 Slack cable restraint system.
- .2 SCS to prevent sway in horizontal plane, "rocking" in vertical plane, sliding and buckling in axial direction.
- .3 Hanger rods to withstand compressive loading and buckling.

## **2.9 SRS FOR VIBRATION ISOLATED EQUIPMENT**

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

## **2.10 SLACK CABLE RESTRAINT SYSTEM (SCS)**

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

## **2.11 SERVICE UTILITIES ENTRANCE INTO BUILDING**

- .1 Provide flexibility to prevent breakage in the event of earthquake activity.

## **PART 3 - EXECUTION**

### **3.1 MANUFACTURER'S INSTRUCTIONS**

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

### **3.2 INSTALLATION**

- .1 Attachment points and fasteners:
  - .1 To withstand same maximum load that seismic restraint is to resist and in every direction.
- .2 Attachment points and fasteners:
  - .1 Check that the anchor bolts, pin diameter, recess depth in the concrete and seld length, are conform to the drawings submitted for approval.
  - .2 Bolt to the frame or structure all the material that is not insulated against the transmission of vibrations.
  - .3 The oblong openings for adjusting bolts are prohibited.
  - .4 Small pipes may be rigidly secured to larger pipes for restraint purposes, but not reverse.
  - .5 Anchorage points in concrete slabs: to ASTM-E488 and manufacturer's recommendations.
- .3 Slack Cable Systems (SCS):
  - .1 Connect to suspended equipment so that axial projection of wire passes through centre of gravity of equipment.
  - .2 Tighten attachment point to manufacturer's recommendation.
  - .3 Use appropriate grommets, shackles, others hardware to ensure alignment of restraints and to avoid bending of cables at connection points.

- .4 Orient restraint wires on ceiling hung equipment at approximately 90 degrees to each other (in plan), tie back to structure at maximum of 45 degrees to structure.
- .5 Adjust restraint cables so that they are not visibly slack but permit vibration isolation system to function normally.
- .6 Tighten cable to reduce slack to 40 mm under thumb pressure. Cable not to support weight during normal operation.
- .4 Install SRS at least 25 mm from equipment, systems, services.
- .5 Miscellaneous equipment not vibration-isolated:
  - .1 Bolt through house-keeping pad to structure.
- .6 Co-ordinate connections with other disciplines.
- .7 Brace equipments regardless of ducts and pipes.
- .8 Never install two types of bracing in the same direction.
- .9 Suspension rod less than 300 mm: no stabilisation required for equipments.
- .10 Installation: minimum of 45o to horizontal and maximum 60o to horizontal.
- .11 Transverse seismic restraint system installation: perpendicular to piping or duct direction with a maximum angle variation of 2.5°.
- .12 Longitudinal seismic restraint system installation: parallel to piping or duct direction with a maximum angle variation of 2.5°.
- .13 For each duct or pipe straight section: install at least two transverse seismic restraint devices and systems and at least one longitudinal seismic restraint device and system.
- .14 Install transverse and longitudinal seismic restraint devices and systems at a maximum distance of 100 mm of a vertical support, which must be reinforced if required.

### **3.3 FIELD QUALITY CONTROL**

- .1 Manufacturer's Field Services:
  - .1 Arrange with manufacturer's representative to review work of this Section and submit written reports to verify compliance with Contract Documents.
  - .2 Manufacturer's Field Services: consisting of product use recommendations and periodic site visits to review installation, scheduled as follows:



- .1 After delivery and storage of Products.
  - .2 After preparatory work is complete but before installation commences.
  - .3 Twice during the installation, at 25% and 60% completion stages.
  - .4 Upon completion of installation.
- .3 Submit manufacturer's reports to Departmental Representative within 3 days of manufacturer representative's review.
- .2 Inspection and Certification:
    - .1 SRS: inspected and certified by Seismic Engineer upon completion of installation. Provide a certificate with seal of recognized engineer in the field.
    - .2 Provide written report to Departmental Representative with certificate of compliance.
  - .3 Commissioning Documentation:
    - .1 Upon completion and acceptance of certification, hand over to Departmental Representative complete set of construction documents, revised to show "as-built" conditions.

### **3.4 DOCUMENTS REQUIRED FOR COMMISSIONING**

- .1 Once certification is complete and the report is accepted, submit to the Departmental Representative a complete copy of the project file revised and annotated to show the conditions after execution.

### **3.5 PIPING INSTALLATION (OTHER THAN FIRE PROTECTION)**

- .1 Seismic restraint systems installation and design: to « ASHRAE, A Practical Guide to Seismic Restraint » and ANSI/SMACNA 001.
- .2 Stabilize piping of NPS 3 and more.
- .3 Install mechanical restraints to the following:
  - .1 Transverse stabilization:
    - .1 NPS 8 and less: 12.2 m.
    - .2 NPS 10 and greater: 6.1 m.
    - .3 Gas piping, not ductile or screwed: half of these distances.

- .2 Longitudinal stabilization:
  - .1 NPS 5 and less: 24.4 m.
  - .2 NPS 6 and NPS 8: 12.2 m.
  - .3 NPS 10 and greater: 6.1 m.
  - .4 Gas piping, not ductile or screwed: half of these distances.
- .4 Install seismic separation assemblies in areas where piping crosses building seismic separation. Stabilize transversely, vertically and longitudinally the assembly, at less than 1.83 m on each side of the separation.
- .5 Stabilize on each side of a 90 degrees direction change of ductile iron piping.

### **3.6 DUCT INSTALLATION**

- .1 Seismic restraint systems installation and design: to « ASHRAE, A Practical Guide to Seismic Restraint » and ANSI/SMACNA 001.
- .2 Stabilize rectangular ventilation ducts with a surface of 0.55 m<sup>2</sup> and greater and round ventilation ducts with a diameter of 700 mm and greater.
- .3 A wall can serve as a transverse seismic restraint device or system if the duct is firmly attached at its perimeter.
- .4 Install mechanical restraints to the following:
  - .1 Vertical stabilization:
    - .1 Regular supports.
  - .2 Transverse stabilization: 9.1 m.
  - .3 Longitudinal stabilization: 18.3 m.

### **3.7 ELECTRICAL INSTALLATION**

- .1 Do the installation and design of the earthquake-resistant systems as per the “ASHRAE, A Practical Guide to Seismic Restraint” manual.
- .2 Provide supports with longitudinal and transversal bracing, rigid type or cables.
- .3 Do not stabilize material with hanging supports of 305 mm in length or less.
- .4 Stabilize electric conduits of 35 mm nominal diameter and above, indoor.
- .5 Stabilize electric conduits of 63 mm nominal diameter and above, outdoor.

- .6 Install the mechanical restraint devices at the follow frequency:
  - .1 For the transversal stabilization: 9.1 m;
  - .2 For the longitudinal stabilization: 18.3 m.

### **3.8 RIGID RODS ANDTIE POINTS**

- .1 Use rods of appropriate diameter and which complies with requirements of seismic support manufacturer.
- .2 Vertical, lateral and longitudinal rods must be installed according to support manufacturer's recommendations.

### **3.9 CLEANING**

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

**END OF SECTION**



## **PART 1 - GENERAL**

### **1.1 REFERENCES**

- .1 Canadian Gas Association (CGA)
  - .1 CSA/CGA B149.1-05, Natural gas and propane installation code.
- .2 Canadian General Standards Board (CGSB)
  - .1 CAN/CGSB-1.60-97, Interior Alkyd Gloss Enamel.
  - .2 CAN/CGSB-24.3-92, Identification of Piping Systems.
- .3 National Fire Protection Association (NFPA)
  - .1 NFPA 13-2013, Standard for the Installation of Sprinkler Systems.
  - .2 NFPA 14-2003, Standard for the Installation of Standpipe and Hose Systems.

### **1.2 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Product Data:
- .2 Submittals: in accordance with section 01 33 00 - Submittal Procedures.
- .3 Product data to include paint colour chips, other products specified in this section.
- .4 Samples:
  - .1 Submit samples in accordance with section 01 33 00 - Submittal Procedures.
  - .2 Samples to include nameplates, labels, tags, lists of proposed legends.

### **1.3 QUALITY ASSURANCE**

- .1 Quality assurance submittals: submit following in accordance with section 01 33 00 - Submittal Procedures.
- .2 Health and Safety:
  - .1 Do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

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

- .1 Packing, shipping, handling and unloading:
  - .1 Deliver, store and handle in accordance with section 01 61 00 - Common Product Requirements.
  - .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Waste Management and Disposal:
  - .1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with section 01 74 21 - Construction/Demolition Waste Management and Disposal.
  - .2 Dispose of unused paint and coating material at official hazardous material collections site approved by Departmental Representative.
  - .3 Do not dispose of unused paint coating material into sewer system, into streams, lakes, onto ground or in locations where it will pose health or environmental hazard.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURER'S EQUIPMENT NAMEPLATES**

- .1 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.

### **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 laminated plastic or white anodized aluminum, matte finish, with square corners, letters accurately aligned and machine engraved into core.

.3 Sizes:

- .1 Conform to following table:

Size #	Sizes	Number of lines	Height of letters
	(mm)		(mm)
1	10 x 50	1	3
2	13 x 75	1	5
3	13 x 75	2	3
4	20 x 100	1	8
5	20 x 100	2	5
6	20 x 200	1	8
7	25 x 125	1	12
8	25 x 125	2	8
9	35 x 200	1	20

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

.4 Locations:

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

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

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

## 2.3 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 PIPING SYSTEMS GOVERNED BY CODES

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

## 2.5 IDENTIFICATION OF PIPING SYSTEMS

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

<b>Outside diameter of piping or insulation (mm)</b>	<b>Height of letters (mm)</b>
30	13
50	19
150	32
250	63
More then 250	88

- .4 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.
- .5 Extent of background colour marking:
  - .1 To full circumference of pipe or insulation.
  - .2 Length to accommodate pictogram, full length of legend and arrows.
- .6 Materials for background colour marking, legend, arrows:
  - .1 Pipes and tubing 20 mm and smaller: waterproof and heat-resistant pressure sensitive plastic marker tags.
  - .2 Other pipes: pressure sensitive plastic-coated cloth 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 °C.
  - .3 Acceptable products: W.H. Brady; Seton Name Plate Corp.; S.M.S. Replacement materials or products: approved by addendum according to Instructions to bidders.
  - .4 Paint: conform to CAN/CGSB 1.60.
- .7 Colours and Legends:
  - .1 Where not listed, obtain direction from Departmental Representative.
  - .2 Colours for legends, arrows: to following table:

Background color	Legend / Arrows
Yellow	Black
Green	White
Red	White

- .3 Background colour marking and legends for piping systems:

Contents	Background color marking	Legend
Domestic cold water supply	Green	DOM. CWS
Sanitary	Green	SAN
Plumbing vent	Green	SAN. VENT

## **2.6 IDENTIFICATION DUCTWORK SYSTEMS**

- .1 50 mm high stencilled letters and directional arrows 150 mm long x 50 mm high.
- .2 Colours: back, or co-ordinated with base colour to ensure strong contrast.

## **2.7 VALVES, CONTROLLERS**

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

## **2.8 CONTROLS COMPONENTS IDENTIFICATION**

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

## **2.9 LANGUAGE**

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

## **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 TIMING**

- .1 Provide identification only after painting has been completed.

### **3.3 INSTALLATION**

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

### **3.4 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 to identify include, among others, the:
  - .1 Pre-action fire alarm system;
  - .2 Air conditioning systems;
  - .3 Air terminal units;
  - .4 Transfer fans.

### **3.5 LOCATION OF IDENTIFICATION ON PIPING AND DUCTWORK SYSTEMS**

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

### **3.6 VALVES, CONTROLLERS**

- .1 Valves and operating controllers, except at plumbing fixtures, radiation, or where in plain sight of equipment they serve: Secure tags with non-ferrous chains or closed "S" hooks.
- .2 Install one copy of flow diagrams, valve schedules mounted in frame behind non-glare glass where directed by Departmental Representative. Provide one copy (reduced in size if required) in each operating and maintenance manual.
- .3 Number valves in each system consecutively.

### **3.7 CLEANING**

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

**END OF SECTION**

## **PART 1 - GENERAL**

### **1.1 QUALIFICATIONS OF TAB PERSONNEL**

- .1 Submit names of personnel to perform TAB to Departmental Representative within 30 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-1-2002.
  - .2 National Environmental Balancing Bureau (NEBB) TABES, Procedural Standards for Testing, Adjusting, Balancing of Environmental Systems-1998.
  - .3 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA), HVAC TAB HVAC Systems - Testing, Adjusting and Balancing-2002.
- .4 Recommendations and suggested practices contained in the TAB Standard: mandatory.
- .5 Use TAB Standard provisions, including checklists, and report forms to satisfy Contract requirements.
- .6 Use TAB Standard for TAB, including qualifications for TAB Firm and Specialist and calibration of TAB instruments.
- .7 Where instrument manufacturer calibration recommendations are more stringent than those listed in TAB Standard, use manufacturer's recommendations.
- .8 TAB Standard quality assurance provisions such as performance guarantees form part of this contract:
  - .1 For systems or system components not covered in TAB Standard, use TAB procedures developed by TAB Specialist.
  - .2 Where new procedures, and requirements, are applicable to Contract requirements have been published or adopted by body responsible for TAB Standard used (AABC, NEBB, or TABB), requirements and recommendations contained in these procedures and requirements are mandatory.

## **1.2 PURPOSE OF TAB**

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

## **1.3 EXCEPTIONS**

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

## **1.4 CONSTRUCTION**

- .1 HVAC equipment must be operational at the end of each work. These facilities must be operational, tested, in order not to return to the premises completed.

## **1.5 COORDINATION**

- .1 Schedule time required for TAB (including repairs, re-testing) into project construction and completion schedule to ensure completion before acceptance of project.
- .2 The Departmental Representative defines requirements for the servo systems.
- .3 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 Departmental Representative adequacy of provisions for TAB and other aspects of design and installation pertinent to success of TAB
- .2 Review specified standards and report to Departmental 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 Notify Departmental Representative 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 weatherstripping, sealing, and caulking.
  - .3 Pressure, leakage, other tests specified elsewhere in other sections.
  - .4 Provisions for TAB installed and operational.
  - .5 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, 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 Departmental 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 Departmental Representative.

## **1.13 ACTION AND INFORMATIONAL SUBMITTALS**

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

## **1.14 PRELIMINARY TAB REPORT**

- .1 Submit for checking and approval of Departmental 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 Calculations procedures.
  - .4 Summaries.
- .2 The preliminary report must be provided by the Contractor before the provisional acceptance of the work.



### **1.15 TAB REPORT**

- .1 Format in accordance with referenced standard.
- .2 TAB report to show results in same units as presented in drawings and to include:
  - .1 Project record drawings.
  - .2 System schematics.
- .3 Submit 6 copies of TAB Report to Departmental Representative for verification and approval, in both official languages in D-ring binders, complete with index tabs.

### **1.16 VERIFICATION**

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

### **1.17 SETTINGS**

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

### **1.18 COMPLETION OF TAB**

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

### **1.19 AIR SYSTEMS**

- .1 Standard: TAB to most stringent of this section or TAB standards of AABC, NEBB, SMACNA or ASHRAE.
- .2 Do TAB of systems, equipment, components, controls prescribed in contractual documents.
- .3 Qualifications: personnel performing TAB current member in good standing of AABC or NEBB and qualified to standards of AABC or NEBB.

- .4 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, dewpoint), duct cross-sectional area, RPM, electrical power, voltage, noise, vibration.
- .5 Locations of equipment measurements: to include as appropriate:
  - .1 Inlet and outlet of dampers, filter, heat and cold coil, fan, other equipment causing changes in conditions.
  - .2 At controllers, controlled devices.
- .6 Locations of systems measurements to include as appropriate: main ducts, main branch, sub-branch, run-out (or grille, register or diffuser).

## **1.20 OTHER TAB REQUIREMENTS**

- .1 General requirements applicable to work specified in 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.
- .3 Zone pressure differences:
  - .1 Adjust HVAC systems, equipment, controls to establish specified air pressure differentials, with systems in every possible combination of normal operating modes.
- .4 Smoke management systems:
  - .1 Test for proper operation of all smoke and fire dampers, sensors, detectors, installed as component parts of air systems specified in other sections.

## **1.21 POST-OCCUPANCY TAB**

- .1 Measure dry bulb temperature, wet bulb temperature and % relative humidity, air velocity, air flow patterns, NC levels, in occupied zone.
- .2 Participate in systems checks twice during Warranty Period - #1 approximately three (3) months after acceptance and #2 within one (1) month of termination of Warranty Period.

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**PART 2 - PRODUCTS**

**2.1 NOT USED**

.1 Not Used.

**PART 3 - EXECUTION**

**3.1 NOT USED**

.1 Not Used.

**END OF SECTION**



## **PART 1 - GENERAL**

### **1.1 RELATED REQUIREMENTS**

- .1 Section 21 05 01 - Common Work Results - Mechanical.
- .1 Section 23 05 00 - Common Work Results for HVAC.
- .2 Section 23 31 13 01 - Metal Ducts - Low Pressure to 500 Pa.

### **1.2 REFERENCES**

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

### **1.3 SUBMITTALS**

- .1 Submit documents and samples in accordance with section 01 33 00 - Submittal Procedures.
- .2 Test Reports: submit certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties. Include pressure test information and results as follows:
  - .1 Submit proposed report form and test report format to Departmental Representative for approval at least three (3) months before proposed date of first series of tests. Do not start tests until approval received in writing from Departmental Representative.
  - .2 Prepare report of results and submit to Departmental Representative within 48 hours of completion of tests. Include:
    - .1 Schematic of entire system.
    - .2 Schematic of section under test showing test site.
    - .3 Required and achieved static pressures.
    - .4 Orifice differential pressure at test sites.
    - .5 Permissible and actual leakage flow rate (L/s) for test sites.

- .6 Witnessed certification of results.
- .3 Include test reports in final TAB report.
- .4 Certificates:
  - .1 Submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .5 Instructions:
  - .1 Submit manufacturer's installation instructions.
- .6 Manufacturer's field reports specified:
  - .1 Submit reports specified.

#### **1.4 QUALITY ASSURANCE**

- .1 Pre-Installation Meetings:
  - .1 Convene pre-installation meeting one (1) week prior to beginning work of this Section and on-site installations:
    - .1 Verify project requirements.
    - .2 Review installation and substrate conditions.
    - .3 Co-ordination with other building subtrades.
    - .4 Review manufacturer's installation instructions and warranty requirements.
  - .2 Health and Safety:
    - .1 Do construction occupational health and safety in accordance with section 01 35 29.06 - Health and Safety.

### **PART 2 - PRODUCTS**

#### **2.1 TEST INSTRUMENTS**

- .1 Test apparatus to include:
  - .1 Fan capable of producing required static pressure.

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

## **2.2 EQUIPMENT LEAKAGE TOLERANCES**

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

## **PART 3 - EXECUTION**

### **3.1 MANUFACTURER'S INSTRUCTIONS**

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

### **3.2 TEST PROCEDURES**

- .1 Maximum lengths of ducts to be tested consistent with capacity of test equipment.
- .2 Section of duct to be tested to include:
  - .1 Fittings, branch ducts, tap-ins.
- .3 Repeat tests until specified pressures are attained. Bear costs for repairs and repetition to tests.

- .4 Base partial system leakage calculations on SMACNA HVAC Air Duct Leakage Test Manual.
- .5 Seal leaks that can be heard or felt, regardless of their contribution to total leakage.

### **3.3 SITE TOLERANCES**

- .1 System leakage tolerances specified are stated as percentage of total flow rate handled by system. Pro-rate specified system leakage tolerances. Leakage for sections of duct systems: not to exceed total allowable leakage.
- .2 Leakage tests on following systems not to exceed specified leakage rates.
  - .1 Small duct systems up to 250 Pa: leakage 2 %.
- .3 Evaluation of test results to use surface area of duct and pressure in duct as basic parameters.

### **3.4 TESTING**

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

### **3.5 FIELD QUALITY CONTROL**

- .1 Manufacturer's Field Services:
  - .1 Have manufacturer of products, supplied under this Section, review Work involved in the handling, installation/application, protection and cleaning, of its product(s) and submit written reports, in acceptable format, to verify compliance of Work with Contract.
  - .2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
  - .3 Schedule site visits, to review Work, at stages listed:
    - .1 After delivery and storage of products, and when preparatory Work, or other Work, on which the Work of this Section depends, is complete but before installation begins.



- .2 One during progress of Work at 60% complete.
- .3 Upon completion of the Work, after cleaning is carried out.
- .4 Obtain reports, within three (3) days of review, and submit, immediately, to Departmental Representative.
- .2 Performance Verification:
  - .1 Departmental Representative to witness tests and to verify reported results.
  - .2 To be certified by same TAB agency approved by Departmental Representative to undertake TAB on this project.

### **3.6 CLEANING**

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

**END OF SECTION**



## **PART 1 - GENERAL**

### **1.1 RELATED REQUIREMENTS**

- .1 Section 21 05 01 - Common Work Results - Mechanical.
- .2 Section 23 05 00 - Common Work Results for HVAC.
- .3 Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.

### **1.2 REFERENCES**

- .1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE).
  - .1 ANSI/ASHRAE/IESNA 90.1-04, SI; Energy Standard for Buildings Except Low-Rise Residential Buildings.
- .2 American Society for Testing and Materials International, (ASTM).
  - .1 ASTM B209M-07, Specification for Aluminum and Aluminum Alloy Sheet and Plate (Metric).
  - .2 ASTM C335-05, Test Method for Steady State Heat Transfer Properties of Horizontal Pipe Insulation.
  - .3 ASTM C411-05, Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.
  - .4 ASTM C449/C449M-00, Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.
  - .5 ASTM C547-07, Specification for Mineral Fiber Pipe Insulation.
  - .6 ASTM C553-02, Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
  - .7 ASTM C612-04, Specification for Mineral Fiber Block and Board Thermal Insulation.
  - .8 ASTM C795-03, Specification for Thermal Insulation for Use with Austenitic Stainless Steel.
  - .9 ASTM C921-03, Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.
- .3 Thermal Insulation Association of Canada (TIAC): National Insulation Standards (2005).

- .4 Canadian General Standards Board (CGSB).
  - .1 CGSB 51-GP-52Ma-89, Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.
- .5 Underwriters Laboratories of Canada (ULC)
  - .1 CAN/ULC-S102-03, Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.
  - .2 CAN/ULC-S701-05, Standard for Thermal Insulation, Polystyrene, Boards and Pipe Covering.

### **1.3 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, jacket, and other accessories.
- .2 The thickness of insulation is to cover all components of the element to be insulated, such as reinforcements, side rails, "T" joints, flanges, etc.

### **1.4 SUBMITTALS**

- .1 Submit documents and samples in accordance with section 01 33 00 - Submittal Procedures.
- .2 Samples:
  - .1 Submit for approval:
    - .1 Complete assembly of each type of insulation system, insulation, coating, and adhesive proposed. Mount sample on 12 mm plywood board. Affix typewritten label beneath sample indicating service.

### **1.5 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.
- .2 Work must be done by skilled workers in insulation.

## 1.6 QUALITY ASSURANCE

- .1 Quality of work: To National Insulation Standards (2005) from Thermal Insulation Association of Canada (TIAC).
- .2 The Contractor responsible for the installation of mechanical insulation shall keep a copy of this manual quality standard as a reference.

## 1.7 WASTE MANAGEMENT AND DISPOSAL

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

## 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 Thermal conductivity ("k" factor) not to exceed specified values at 24 °C mean temperature when tested in accordance with ASTM C335.
- .2 Insulation type **D-1**: Rigid mineral fibre board to ASTM C612, with factory applied vapour retarder jacket to CGSB 51-GP-52Ma.
  - .1 Maximum "k" factor: 0.0337 W/m•°C at 24 °C mean temperature.
  - .2 Maximum temperature: 120 °C.
  - .3 Acceptable products: Manson AK Board FSK; Owens Corning; Knauf. Replacement materials or products: approved by addendum according to Instructions to bidders.
- .3 Insulation type **D-2**: Mineral fibre blanket to ASTM C553 faced with factory applied vapour retarder jacket to CGSB 51-GP-52Ma.
  - .1 Mineral fibre: to ASTM C553.
  - .2 Jacket: to CGSB 51-GP-52Ma.

- .3 Maximum "k" factor: 0.035 W/m•°C at 24 °C mean temperature.
- .4 Maximum temperature: 120 °C.
- .5 Density: 24 kg/m<sup>3</sup>.
- .6 Acceptable products: Manson AK Board FSK; Owens Corning; Knauf.  
Replacement materials or products: approved by addendum according to Instructions to bidders.

## **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 Insulation adhesive: compatible with insulation.
  - .3 Acceptable products: Fattal Thermocanvas; Owens Corning; Knauf.  
Replacement materials or products: approved by addendum according to Instructions to bidders.

## **2.4 ACCESSORIES**

- .1 Vapour retarder lap adhesive:
  - .1 Water based, fire retardant type, compatible with insulation.
- .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, treated with dilute fire retardant lagging adhesive to ASTM C921.
- .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, reinforced, 75 mm wide minimum.

- .7 Contact adhesive: quick-setting.
- .8 Canvas adhesive: washable.
- .9 Tie wire: 1.5 mm stainless steel.
- .10 Banding: 19 mm wide, 0.5 mm thick stainless steel.
- .11 Facing: 25 mm stainless steel hexagonal wire mesh stitched on both faces of insulation or one face of insulation with expanded metal lath on other face.
- .12 Fasteners: 4 mm diameter pins with 35 mm diameter or square clips, length to suit thickness of insulation.

### **PART 3 - EXECUTION**

#### **3.1 PRE-INSTALLATION REQUIREMENTS**

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

#### **3.2 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 section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.
  - .1 Apply high compressive strength insulation where insulation may be compressed by weight of ductwork.
- .6 Fasteners: install at 300 mm on centre in horizontal and vertical directions, minimum two (2) rows each side.

### 3.3 DUCTWORK INSULATION SCHEDULE

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

	<b>NETWORKS AND EQUIPMENTS</b>	<b>INSULATION THICKNESS mm</b>	<b>INSULATION TYPE</b>
.1	Apparent evacuation air ducts whose largest dimension does not exceeds 1 000 mm.	50	D-1
.2	Apparent evacuation air ducts whose largest dimension exceeds 1 000 mm.	75	D-1
.3	The fresh air supply air ducts, from the louver to the mixing box, box included.	75	D-1
.3	The complete supply air ducts.	50	D-2

### 3.4 FINISHING

.1 Exposed air ducts located inside the building: canvas jacket.

### 3.5 CLEANING

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

**END OF SECTION**



## **PART 1 - GENERAL**

### **1.1 RELATED REQUIREMENTS**

- .1 Section 21 05 01 - Common Work Results - Mechanical.
- .2 Section 23 05 00 - Common Work Results for HVAC.
- .3 Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.

### **1.2 REFERENCES**

- .1 American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE).
  - .1 ASHRAE Standard 90.1-01, Energy Standard for Buildings Except Low-Rise Residential Buildings (IESNA co-sponsored; ANSI approved; Continuous Maintenance Standard).
- .2 American Society for Testing and Materials International (ASTM).
  - .1 ASTM B209M-04, Standard Specification for Aluminum and Aluminum Alloy Sheet and Plate.
  - .2 ASTM C335-04, Standard Test Method for Steady State Heat Transfer Properties of Horizontal Pipe Insulation.
  - .3 ASTM C411-04, Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.
  - .4 ASTM C449/C449M-00, Standard Specification for Mineral Fiber-Hydraulic Setting Thermal Insulating and Finishing Cement.
  - .5 ASTM C533-2004, Calcium Silicate Block and Pipe Thermal Insulation.
  - .6 ASTM C547-2003, Mineral Fiber Pipe Insulation.
  - .7 ASTM C795-03, Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.
  - .8 ASTM C921-03a, Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.
- .3 Canadian General Standards Board (CGSB).
  - .1 CGSB 51-GP-52Ma-89, Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.

- .2 CAN/CGSB-51.53-95, Poly (Vinyl Chloride) Jacketting 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-S102-03, Surface Burning Characteristics of Building Materials and Assemblies.
  - .2 CAN/ULC-S701-01, Thermal Insulation, Polystyrene, Boards and Pipe Covering.
  - .3 CAN/ULC-S702-1997, Thermal Insulation, Mineral Fibre, for Buildings.
  - .4 CAN/ULC-S702.2-03, Thermal Insulation, Mineral Fibre, for Buildings, Part 2: Application Guidelines.

### **1.3 DEFINITIONS**

- .1 For 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 SUBMITTAL PROCEDURES**

- .1 Submit documents and samples in accordance with section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .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.
    - .1 Submit three copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 01 33 00 - Submittal Procedures.
- .3 Shop Drawings:
  - .1 Submit shop drawings in accordance with section 01 33 00 - Submittal Procedures.
- .4 Samples:
  - .1 Submit samples in accordance with section 01 33 00 - Submittal Procedures.
  - .2 Submit for approval: complete assembly of each type of insulation system, insulation, coating, and adhesive proposed. Mount sample on 12 mm plywood board. Affix label beneath sample indicating service.
- .5 Quality assurance submittals: submit following in accordance with section 01 33 00 - Submittal Procedures.
  - .1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
  - .2 Instructions: submit manufacturer's installation instructions.
- .6 Departmental Representative will make available 1 copy of systems supplier's installation instructions.

## **1.5 QUALITY ASSURANCE**

- .1 Qualifications:
- .2 Installer: specialist in performing work of this Section, and have at least 3 years successful experience in this size and type of project, qualified to standards of TIAC.
- .3 Health and Safety:
  - .1 Do construction occupational health and safety in accordance with section 01 35 29.06 - Health and Safety Requirements.

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

- .1 Packing, shipping, handling and unloading:
  - .1 Deliver, store and handle in accordance with manufacturer's written instructions and section 01 61 00 - Common Product Requirements.
  - .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.
  - .3 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.
- .3 Waste Management and Disposal:
  - .1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with section 01 74 21 - Construction/Demolition Waste Management and Disposal.
  - .2 Place excess or unused insulation and insulation accessory materials in designated containers.
  - .3 Divert unused metal materials from landfill to metal recycling facility approved by Departmental Representative.
  - .4 Dispose of unused adhesive material at official hazardous material collections site approved by Departmental Representative.

## **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 The materials must be tested in accordance with ASTM C411.

## 2.2 INSULATION

- .1 Thermal conductivity ("k" factor) not to exceed specified values at 24°C mean temperature when tested in accordance with ASTM C335.
- .2 Insulation type **P-3**: flexible unicellular tubular elastomer.
  - .1 Insulation: to CAN/CGSB-51.40.
  - .2 Maximum "K" factor: 0.039 W/m•°C at 24 °C mean temperature.
  - .3 Temperature range: -57 °C to 105 °C.
  - .4 Certified by manufacturer: free of potential stress corrosion cracking corrodants.
  - .5 Acceptable products: Armaflex- AP. Replacement materials or products: approved by addendum according to Instructions to bidders.

## 2.3 ADHESIVES, TAPES AND BANDS

- .1 Insulation securement
  - .1 Tape: self-adhesive, aluminum, reinforced, 50 mm wide minimum
  - .2 Contact adhesive: quick setting.
  - .3 Canvas adhesive: washable.
  - .4 Tie wire: 1.5 mm diameter stainless steel.
  - .5 Bands: stainless steel, 19 mm wide, 0.5 mm thick.
- .2 For **P-3** insulation type:
  - .1 Contact adhesive: quick setting glue drying in the open air for sealing the transverse and longitudinal joints insulation.
    - .1 Acceptable products: RUBATEX, model 373. Replacement materials or products: approved by addendum according to Instructions to bidders.
  - .2 Overlap adhesive:
    - .1 Acceptable products: Armstrong 520, Foster 85-20 without asbestos fiber, to cover 5 m<sup>2</sup>/L. Replacement materials or products: approved by addendum according to Instructions to bidders.

- .3 Coating material for insulation type P-3 coating be installed on any exposed piping inside the building, water-based, semi-gloss finish flexible for indoor and outdoor application, white and can be applied by brush or spray jet.
- .1 Acceptable products: RUBATEX, model 374. Replacement materials or products: approved by addendum according to Instructions to bidders.

## **2.4 JACKETS**

- .1 Aluminum:
  - .1 To ASTM b209.
  - .2 Thickness: 0.50 mm sheet.
  - .3 Finish: smooth
  - .4 Joining: longitudinal and circumferential slip joints with 50 mm laps.
  - .5 Fittings: 0.5 mm thick die-shaped fitting covers with factory-attached protective liner.
  - .6 Metal jacket banding and mechanical seals: stainless steel, 19 mm wide, 0.5 mm thick at 300 mm spacing.
  - .7 Acceptable products: Permaclad. Replacement materials or products: approved by addendum according to Instructions to bidders.

## **2.5 ACCEPTABLE PRODUCTS**

- .1 Specified products or equivalent approved Owens Corning, Johns Manville, Knauf, Certain Teed. Replacement materials or products: approved by addendum according to Instructions to bidders.

## **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 Install saddles and protection shells:
  - .1 Install high strength compressive insulation, suitable for service conditions, when no saddle or no protection shells the insulation is planned.
- .6 Ensure that the insulation surfaces and elements to be insulated are clean and dry during installation of insulation and during the application of a finish.
- .7 Apply materials, accessories and jackets and apply finish coatings according to manufacturer's recommendations and these requirements; apply the finish coating at least two layers.

### **3.4 INSULATION**

- .1 Insulation installation: to ANSI/NFPA 90A and ANSI/NFPA 90B.
- .2 Multiple layer insulation: offset joint of each layer.
- .3 Seal and finish the ends of insulation, exposed or not, with cement.
- .4 Expansion joint: provide joints to allow free expansion and contraction of piping without damaging insulation or coating.

### **3.5 INSULATION FIXING**

- .1 Fix each insulation section with tapes at 900 mm on center and at least one tape at each ends and one on the center of each insulation section.

### **3.6 TABLEAU - PIPING INSULATION**

- .1 Includes valves, valve bonnets, flanges and fittings unless otherwise specified.

- .2 Do not insulate exposed run outs to plumbing fixtures, chrome plated piping, valves, fittings.
- .3 Thickness of insulation as listed in following table:

APPLICATION	FLUID TEMPERATURE °C	INSULATION TYPE
.1 Suction gas and liquid refrigerant systems, insulation thickness of 19 mm.	--	P-3
2 Domestic cold water, insulation thickness of 19 mm (pipe for outside water output).	--	P-3

### **3.7 FINISHES**

- .1 Exposed indoors: Coating material for insulation type P-3.
- .2 Installation: to appropriate TIAC code.

### **3.8 CLEANING**

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

**END OF SECTION**



## **PART 1 - GENERAL**

### **1.1 RELATED REQUIREMENTS**

- .1 Section 21 05 01 - Common Work Results - Mechanical.
- .2 Section 23 05 00 - Common Work Results for HVAC.
- .3 Section 22 42 01 - Plumbing Specialties and Accessories.
- .4 Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.

### **1.2 REFERENCES**

- .1 American Society for Testing and Material (ASTM).
  - .1 ASTM E202-04, Standard Test Methods for Analysis of Ethylene of Glycols and Propylene Glycols.

### **1.3 POTABLE WATER SYSTEMS**

- .1 When cleaning is completed and system filled:
  - .1 Verify performance of equipment and systems as specified in other sections.
  - .2 Check for proper operation of water hammer arrestors. Run one outlet for 10 seconds, then shut of water immediately. If water hammer occurs, replace water hammer arrestor or recharge air chambers. Repeat for each outlet and flush valve.
  - .3 Confirm water quality consistent with supply standards, verifying that no residuals remain resulting from flushing and/or cleaning.

### **1.4 SANITARY AND STORM DRAINAGE SYSTEMS**

- .1 Buried systems: perform tests prior to back-filling. Perform hydraulic tests to verify grades and freedom from obstructions.
- .2 Ensure that traps are fully and permanently primed.
- .3 Ensure that fixtures are properly anchored, connected to system.
- .4 Operate flush valves, tank and operate each fixture to verify drainage and no leakage.

- .5 Cleanouts: refer to section 22 42 01 - Plumbing Specialties and Accessories.

## **1.5 REPORTS**

- .1 In accordance with section 01 91 13 - General Commissioning (Cx) Requirements: Reports, supplemented as specified herein.

## **1.6 TRAINING**

- .1 In accordance with section 01 91 13 - General Commissioning (Cx) Requirements: Training of O M Personnel, supplemented as specified herein.

## **PART 2 - PRODUCTS**

### **2.1 NOT USED**

- .1 Not used.

## **PART 3 - EXECUTION**

### **3.1 NOT USED**

- .1 Not used.

## **END OF SECTION**

## **PART 1 - GENERAL**

### **1.1 REFERENCES**

- .1 American Society of Mechanical Engineers (ASME)
  - .1 ASME B16.22-01, Wrought Copper and Copper Alloy Solder - Joint Pressure Fittings.
  - .2 ASME B16.24-02, Cast Copper Pipe Flanges and Flanged Fittings: Class 150, 300, 400, 600, 900, 1500 and 2500.
  - .3 ASME B16.26-88, Cast Copper Alloy Fittings for Flared Copper Tubes.
  - .4 ASME B31.5-01, Refrigeration Piping and Heat Transfer Components.
- .2 American Society for Testing and Materials International (ASTM)
  - .1 ASTM A307-04, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
  - .2 ASTM B280-03, Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service.
- .3 Canadian Standards Association (CSA International)
  - .1 CSA B52-99, Mechanical Refrigeration Code.
- .4 Environment Canada (EC)
  - .1 EPS 1/RA/1-96, Environmental Code of Practice for the Elimination of Fluorocarbon Emissions from Refrigeration and Air Conditioning Systems.
- .5 Health Canada / Workplace Hazardous Materials Information System (WHMIS)
  - .1 Material Safety Data Sheets (MSDS).

### **1.2 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submittals in accordance with section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's printed product literature, specifications and datasheet for piping, fittings and equipment.

- .3 Test Reports:
  - .1 Submit certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties.
- .4 Certificates:
  - .1 Submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .5 Instructions:
  - .1 Submit manufacturer's installation instructions.
- .6 Closeout submittals:
  - .1 Submit maintenance and engineering data for incorporation into manual specified in section 01 78 00 - Closeout Submittals.

### **1.3 QUALITY ASSURANCE**

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

### **1.4 WASTE MANAGEMENT AND DISPOSAL**

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

## **PART 2 - PRODUCTS**

### **2.1 TUBING**

- .1 Processed for refrigeration installations, deoxidized, dehydrated and sealed.
  - .1 Hard copper: to ASTM B280, type ACR.
  - .2 Annealed copper: to ASTM B280, with minimum wall thickness as per CSA B52 and ASME B31.5.

### **2.2 FITTINGS**

- .1 Service: design pressure 2070 kPa and temperature 121 °C.

- .2 Brazed:
  - .1 Fittings: wrought copper to ASME B16.22.
  - .2 Joints: silver solder, copper-phosphorous, 95% Cu-5%P and non-corrosive flux.
- .3 Flanged:
  - .1 Bronze or brass, to ASME B16.24, Class 150 and Class 300.
  - .2 Gaskets: suitable for service.
  - .3 Bolts, nuts and washers: to ASTM A307, heavy series.
- .4 Flared:
  - .1 Bronze or brass, for refrigeration, to ASME B16.26.

## **2.3 PIPE SLEEVES**

- .1 Hard copper or steel, sized to provide 6 mm clearance around between sleeve and uninsulated pipe or between sleeve and insulation.

## **2.4 VALVES**

- .1 22 mm and under: Class 500, 3.5 Mpa, globe or angle non-directional type, diaphragm, packless type, with forged brass body and bonnet, moisture proof seal for below freezing applications, brazed connections.
- .2 Over 22 mm: Class 375, 2.5 Mpa, globe or angle type, diaphragm, packless type, back-seating, cap seal, with cast bronze body and bonnet, moisture proof seal for below freezing applications, brazed connections.

## **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 GENERAL**

- .1 Install in accordance with CSA B52, EPS1/RA/1 and ASME B31.5.

### **3.3 BRAZING PROCEDURES**

- .1 Bleed inert gas into pipe during brazing.
- .2 Remove valve internal parts, solenoid valve coils, sight glass.
- .3 Do not apply heat near expansion valve and bulb.

### **3.4 PIPING INSTALLATION**

- .1 General:
  - .1 Soft annealed copper tubing: bend without crimping or constriction.
- .2 Hot gas lines:
  - .1 Pitch at least 1:240 down in direction of flow to prevent oil return to compressor during operation.
  - .2 Provide trap at base of risers greater than 2400 mm high and at each 7600 mm thereafter.
  - .3 Provide inverted deep trap at top of risers.
  - .4 Provide double risers for compressors having capacity modulation.
    - .1 Large riser: install traps as specified.
    - .2 Small riser: size for 5.1 m/s at minimum load. Connect upstream of traps on large riser.

### **3.5 PRESSURE AND LEAK TESTING**

- .1 Close valves on factory charged equipment and other equipment not designed for test pressures.
- .2 Leak test to CSA B52 before evacuation to 2MPa and 1MPa on high and low sides respectively.
- .3 Test Procedure: build pressure up to 35 kPa with refrigerant gas on high and low sides. Supplement with nitrogen to required test pressure. Test for leaks with electronic or halide detector. Repair leaks and repeat tests.

### 3.6 FIELD QUALITY CONTROL

- .1 Site Tests/Inspection:
  - .1 Close service valves on factory charged equipment.
- .2 Ambient temperatures to be at least 13 °C for at least 12 hours before and during dehydration.
- .3 Use copper lines of largest practical size to reduce evacuation time.
- .4 Use two-stage vacuum pump with gas ballast on 2nd stage capable of pulling 5 Pa absolute and filled with dehydrated oil.
- .5 Measure system pressure with vacuum gauge. Take readings with valve between vacuum pump and system closed.
- .6 Triple evacuate system components containing gases other than correct refrigerant or having lost holding charge as follows:
  - .1 Twice to 14 Pa absolute and hold for 4 hours.
  - .2 Break vacuum with refrigerant to 14 kPa.
  - .3 Final to 5 Pa absolute and hold for at least 12 h.
  - .4 Isolate pump from system, record vacuum and time readings until stabilization of vacuum.
  - .5 Submit test results to Departmental Representative.
- .7 Charging:
  - .1 Charge system through filter-drier and charging valve on high side. Low side charging not permitted.
  - .2 With compressors off, charge only amount necessary for proper operation of system. If system pressures equalize before system is fully charged, close charging valve and start up. With unit operating, add remainder of charge to system.
  - .3 Re-purge charging line if refrigerant container is changed during charging process.

- .8 Checks:
  - .1 Make checks and measurements as per manufacturer's operation and maintenance instructions.
  - .2 Record and report measurements to Departmental Representative.
- .9 Manufacturer's Field Services:
  - .1 Have manufacturer of products, supplied under this Section, review Work involved in the handling, installation/application, protection and cleaning, of its products and submit written reports, in acceptable format, to verify compliance of Work with Contract.
  - .2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
  - .3 Schedule site visits, to review Work, at stages listed:
    - .1 After delivery and storage of products, and when preparatory Work, or other Work, on which the Work of this Section depends, is complete but before installation begins.
    - .2 Twice during progress of Work at 25% and 90% complete.
    - .3 Upon completion of the Work, after cleaning is carried out.
  - .4 Obtain reports, within three (3) days of review, and submit, immediately, to Departmental Representative.

### **3.7 DEMONSTRATION**

- .1 Instructions:
  - .1 Post instructions in frame with glass cover in accordance with section 01 78 00 - Closeout Submittals and CSA B52.

### **3.8 CLEANING**

- .1 Proceed in accordance with section 01 74 11 - Cleaning.

**END OF SECTION**



## **PART 1 - GENERAL**

### **1.1 RELATED REQUIREMENTS**

- .1 Section 21 05 01 - Common Work Results - Mechanical.
- .2 Section 23 05 00 - Common Work Results for HVAC.
- .3 Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.
- .4 Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment.
- .5 Section 23 05 49 01 - Seismic Restraint Systems (SRS) - Type P2 Buildings.
- .6 Section 23 05 53 01 - Mechanical Identification.
- .7 Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.
- .8 Section 23 05 94 - Pressure Testing of Ducted Air Systems.
- .9 Section 23 33 00 - Air Duct Accessories.

### **1.2 REFERENCES**

- .1 American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE).
- .2 American Society for Testing and Materials International, (ASTM).
  - .1 ASTM A480/A480M-03c, Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet and Strip.
  - .2 ASTM A635/A635M-02, Standard Specification for Steel, Sheet and Strip, Heavy-Thickness Coils, Carbon, Hot Rolled.
  - .3 ASTM A653/A653M-03, Standard Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process.
- .3 Department of Justice Canada (Jus).
  - .1 Canadian Environmental Protection Act (CEPA), 1999, c. 33.
- .4 Health Canada/Workplace Hazardous Materials Information System (WHMIS).
  - .1 Material Safety Data Sheets (MSDS).

- .5 National Fire Protection Association (NFPA).
  - .1 NFPA 90A-02, Standard for the Installation of Air-Conditioning and Ventilating Systems.
  - .2 NFPA 90B-02, Standard for the Installation of Warm Air Heating and Air-Conditioning Systems.
  - .3 NFPA 96-01, Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations.
- .6 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA).
  - .1 SMACNA HVAC Duct Construction Standards - Metal and Flexible, 2nd Edition 1995 and Addendum No. 1, 1997.
  - .2 SMACNA HVAC Air Duct Leakage Test Manual, 1985, 1st Edition.
  - .3 IAQ Guideline for Occupied Buildings Under Construction 1995, 1st Edition.

### **1.3 SUBMITTALS**

- .1 Submit documents and samples in accordance with section 01 33 00 - Submittals Procedures.
- .2 Shop drawings and data sheets:
  - .1 Shop drawings and specifications shall include the following
    - .1 Sealants;
    - .2 Fittings and accessories;
    - .3 All conduits 1:25
- .3 Submit sealing test report for approval prior to installation of insulation.

### **1.4 QUALITY ASSURANCE**

- .1 Certification of Ratings:
  - .1 Catalogue or published ratings shall be those obtained from tests carried out by manufacturer or independent testing agency signifying adherence to codes and standards.
- .2 Health and Safety:
  - .1 Do construction occupational health and safety in accordance with section 01 35 29.06 - Health and Safety Requirements.

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

- .1 Protect on site stored or installed absorptive material from moisture damage.

## **1.6 WASTE MANAGEMENT AND DISPOSAL**

- .1 Separate waste materials for reuse and recycling in accordance with section 01 74 21 - Construction/Demolition Waste Management and Disposal.
- .2 Remove from site and dispose of packaging materials at appropriate recycling facilities.
- .3 Collect and separate for disposal paper, plastic, polystyrene, corrugated cardboard, packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.
- .4 Separate for reuse and recycling and place in designated containers steel, metal, plastic waste in accordance with Waste Management Plan.
- .5 Place materials defined as hazardous or toxic in designated containers.
- .6 Handle and dispose of hazardous materials in accordance with CEPA, TDGA, Regional and Municipal regulations.
- .7 Fold up metal and plastic banding, flatten and place in designated area for recycling.

## **PART 2 - PRODUCTS**

### **2.1 SEAL CLASSIFICATION**

- .1 Classification as follows:

<b>Maximum Pressure</b>	<b>SMACNA Seal Class</b>
500 Pa	B (SMACNA)

- .2 Seal classification:
  - .1 Class B: longitudinal seams, transverse joints and connections made airtight with sealant, tape or combination thereof.

### **2.2 SEALANT**

- .1 Transverse joints:
  - .1 Round and rectangular ducts with clip joints or linchpin joint:
    - .1 Adhesive laminated tape kraft/canvas/aluminum ULC approved.

- .1 Acceptable products: MACtac FSK; Venture Tape FSK. Replacement materials or products: approved by addendum according to Instructions to bidders.
- .2 Flanged and T joints.
  - .1 Sealing tape.
    - .1 Acceptable products: Ductmate 440 Gasket tape. Replacement materials or products: approved by addendum according to Instructions to bidders.
- .2 Longitudinal joints:
  - .1 Round ducts.
    - .1 Adhesive laminated tape kraft/canvas/aluminum ULC approved.
      - .1 Acceptable products: MACtac FSK. Replacement materials or products: approved by addendum according to Instructions to bidders.
  - .2 Rectangular ducts.
    - .1 Sealant in tube.
      - .1 Acceptable products: Mulco-Butyle; Ductmate n° 5511M. Replacement materials or products: approved by addendum according to Instructions to bidders.
- .3 General:
  - .1 For service temperature higher than -7 °C.
    - .1 Sealant: Sealant for air ducts, water based, ULC approved, having a flame spread rating of not more than 25 and a smoke density rating of not more than 50, which can be used in a range of operating temperatures from -7 °C to 93 °C.
      - .1 Acceptable products: Duro Dyne DWN. Replacement materials or products: approved by addendum according to Instructions to bidders.
  - .2 For service temperature lower or equal to -7 °C.
    - .1 Sealant: sealant for air ducts, polymer-based, fireproof, oil resistant and can withstand temperatures from -30 °C to 93 °C.

- .1 Acceptable products: Duro Dyne S-2; Foster 30-02; 3M, EC-800. Replacement materials or products: approved by addendum according to Instructions to bidders.

## **2.3 TAPE**

- .1 Tape: polyvinyl treated, open weave fiberglass tape, 50 mm wide.
  - .1 Acceptable products: Duro Dyne FT-2. Replacement materials or products: approved by addendum according to Instructions to bidders.

## **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. Centreline radius: 1.0 times width of duct.
  - .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:
    - .1 90° entry on branch: with balancing damper on branch closest to main duct.
    - .2 45° entry on branch: Centreline radius 1.0 times width of duct and with balancing damper on branch closest to main duct.
  - .2 Round main and branch:
    - .1 Enter main duct with conical connection.

- .5 Transitions:
  - .1 Diverging: 20° maximum included angle.
  - .2 Converging: 30° maximum included angle.
- .6 Offsets:
  - .1 90° elbows or radiused elbows, as indicated.
- .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 Design criterion: for a pressure of 500 Pa.
- .3 Thickness, fabrication and reinforcement: to ASHRAE and SMACNA.
- .4 Joints:
  - .1 Joints in accordance with ASHRAE and SMACNA for the following uses:
    - .1 Ducts for which the largest dimension is equal to or less than 1 200 mm or 900 mm diameter.
    - .2 Prefabricated flanged joints, trademark, for air ducts, for the following uses:
      - .1 Ducts for which the largest dimension is more than 1 200 mm or 900 mm diameter.
      - .2 Acceptable products: Ductmate Canada. Replacement materials or products: approved by addendum according to Instructions to bidders.

## 2.8 STAINLESS STEEL

- .1 To ASTM A480/A480M, type 304, brushed finish.
- .2 Thickness, fabrication and reinforcement: to ASHRAE, SMACNA and as indicated:
  - .1 Design criteria: 500 Pa pressure.
- .3 Joints: flanged (or continuously welded in an inert atmosphere).
- .4 Use: duct section receiving cooling coils with drip basin.

## 2.9 DIELECTRIC SEALS

- .1 Install dielectric seals to places where aluminum conduits are connected to ducts made of galvanized steel or stainless steel.

## 2.10 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 mm.
- .2 Hanger configuration: to ASHRAE and SMACNA.
- .3 Hangers: galvanized steel angle with galvanized steel rods to ASHRAE and SMACNA and following table:

<b>DUCT SIZE (mm)</b>	<b>ANGLE SIZE (mm)</b>	<b>ROD DIAMETER (mm)</b>
Up to 750	25 x 25 x 3	6
751 to 1 050	40 x 40 x 3	6
1 051 to 1 500	40 x 40 x 3	10
1 501 to 2 100	50 x 50 x 3	10
2 101 to 2 400	50 x 50 x 5	10
2 401 and over	50 x 50 x 6	10

- .4 Upper hanger attachments:
  - .1 For concrete: manufactured concrete inserts.
    - .1 Acceptable products: Myatt fig. 485. Replacement materials or products: approved by addendum according to Instructions to bidders.

- .2 For steel joist: manufactured joist clamp or steel plate washer.
  - .1 Acceptable products: Anvil fig. 61 or 86 for joist clamp, and Anvil fig. 60 for steel plate washer. Replacement materials or products: approved by addendum according to Instructions to bidders.
- .3 For steel beams: manufactured beam clamps.
  - .1 Acceptable products: Anvil fig. 60. Replacement materials or products: approved by addendum according to Instructions to bidders.

### **PART 3 - EXECUTION**

#### **3.1 GENERAL**

- .1 Do work in accordance with NFPA 90A, NFPA 90B, ASHRAE and SMACNA.
- .2 Do not break continuity of insulation vapour barrier with hangers or rods. Insulate strap hangers 100 mm beyond insulated duct. Ensure diffuser is fully seated.
- .3 Support risers in accordance with ASHRAE and 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.

#### **3.2 HANGERS**

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

<b>DUCT SIZE (mm)</b>	<b>SPACING (mm)</b>
Up to 1 500	3 000
1 501 and over	2 500

#### **3.3 WATERTIGHT DUCT**

- .1 Provide watertight duct for:
  - .1 Fresh air intake and exhaust.
  - .2 Minimum 1 000 mm from duct mounted humidifier in all directions; these conduits are made of stainless steel drip basin (the coil should be inserted into the pipe)
  - .3 As indicated.



- .2 Form bottom of horizontal duct without longitudinal seams. Solder or weld joints of bottom and side sheets. Seal other joints with duct sealer.
- .3 Install, at the bottom of vertical main ducts, a 150 mm depth drip pan, solder or weld all joints.
- .4 Install, at the following locations, a NPS1¼ drain fitting connected to a deep "P" trap. The water seal must be at least 1.5 times the static pressure measured at this place but not less than 300 mm:
  - .1 At the bottom of the vertical duct drip pans.
  - .2 At the lower point of the watertight horizontal ducts
  - .3 As indicated.

### **3.4 SEALING AND TAPING**

- .1 Apply sealant to outside of joint to manufacturer's recommendations.
- .2 Bed tape in sealant and recoat with minimum of one coat of sealant to manufacturer's recommendations.
- .3 Seal all openings in ducts, such as openings for instrumentation, the linkage of registers, coils, etc. using a sealer or a neoprene or silicone gasket, while allowing normal movement of equipment installed in the ducts.

### **3.5 LEAKAGE TESTS**

- .1 Refer to section 23 05 94 - Pressure Testing of Ducted Air Systems.
- .2 In accordance with SMACNA HVAC Duct Leakage Test Manual.
- .3 Do leakage tests in sections.
- .4 Make trial leakage tests as instructed to demonstrate workmanship.
- .5 Do not install additional ductwork until trial test has been passed.
- .6 Test section minimum of 30 m long with not less than three branch takeoffs and two 90° elbows.
- .7 Complete test before performance insulation or concealment Work.

**END OF SECTION**



## **PART 1 - GENERAL**

### **1.1 RELATED REQUIREMENTS**

- .1 Section 21 05 01 - Common Work Results - Mechanical.
- .2 Section 23 05 00 - Common Work Results for HVAC.
- .1 Section 23 31 13 01 - Metal Ducts - Low Pressure to 500 Pa.

### **1.2 REFERENCES**

- .1 Canadian Standard Association (CSA).
  - .1 CSA B228.1, Pipes, Ducts and Fittings for Residential Type Air-Conditioning.
- .2 Sheet Metal and Air-Conditioning Contractors' National Association (SMACNA).
  - .1 SMACNA - HVAC Duct Construction Standards - Metal and Flexible.
- .3 Underwriters Laboratories of Canada (ULC).

### **1.3 SUBMITTALS**

- .1 Submit documents and samples in accordance with section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's printed product literature, specifications and data sheet. Indicate the following:
    - .1 Flexible connections;
    - .2 Duct access doors;
    - .3 Turning vanes;
    - .4 Instrument test ports.
- .3 Test Reports:
  - .1 Certification of ratings: catalogue or published ratings to be those obtained from tests carried out by manufacturer or independent testing agency signifying adherence to codes and standards.

- .4 Certificates:
  - .1 Submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .5 Instructions:
  - .1 Submit manufacturer's installation instructions.
- .6 Manufacturer's Field Reports:
  - .1 Manufacturer's field reports specified.

#### **1.4 CLOSEOUT SUBMITTALS**

- .1 Submit maintenance and engineering data for incorporation into manual specified in section 01 78 00 - Closeout Submittals.

#### **1.5 QUALITY ASSURANCE**

- .1 Pre-Installation Meetings:
  - .1 Convene pre-installation meeting one (1) week prior to beginning work of this Section and on-site installations:
    - .1 Verify project requirements.
    - .2 Review installation and substrate conditions.
    - .3 Co-ordination with other building subtrades.
    - .4 Review manufacturer's installation instructions and warranty requirements.
- .2 Health and Safety:
  - .1 Do construction occupational health and safety in accordance with section 01 35 29.06 - Health and Safety Requirements.

#### **1.6 WASTE MANAGEMENT AND DISPOSAL**

- .1 Separate waste materials for reuse and recycling in accordance with section 01 74 21 - Construction/Demolition Waste Management and Disposal.
- .2 Remove from site and dispose of packaging materials at appropriate recycling facilities.

- .3 Collect and separate for disposal paper, plastic, polystyrene, corrugated cardboard, packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan (WMP).
- .4 Separate for reuse and recycling and place in designated containers steel, metal, plastic waste in accordance with Waste Management Plan (WMP).
- .5 Divert unused metal materials from landfill to metal recycling facility as approved by Departmental Representative.

## **PART 2 - PRODUCTS**

### **2.1 GENERAL**

- .1 Manufacture in accordance with:
  - .1 CSA B228.1;
  - .2 SMACNA - HVAC, Duct Construction Standard.

### **2.2 FLEXIBLE CONNECTIONS**

- .1 Frame: galvanized sheet metal frame 1.3 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 -40 °C to 90 °C, density of 1.3 kg/m<sup>2</sup>.
  - .2 Asbestos fiber cloth treated with acrylic resins, non-combustible, meeting the standards of environmental protection, withstand a temperature rating of 480 °C, conform to the ASTM AAAA class, density of 0.920 kg / m<sup>2</sup>, approved by the ULC (S109).

### **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, 20 mm x 10 mm.

- .4 Hardware:
  - .1 Up to 1000 mm: piano hinge and minimum two sash locks Duro-Dyne SL-1.
  - .2 Doors over 1000 mm: piano hinge and three handles operable from both sides.
  - .3 Hold open devices.

## **2.4 TURNING VANES**

- .1 Factory or shop fabricated, single thickness or 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.
- .5 Acceptable products: IP1 or IP2 from Duro Dyne. Replacement materials or products: approved by addendum according to Instructions to bidders.

## **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 MANUFACTURER'S INSTRUCTIONS**

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

### **3.2 INSTALLATION**

- .1 Flexible Connections:
  - .1 Install in following locations:
    - .1 Inlets and outlets of exhaust and return air fans.
    - .2 As indicated.

- .2 Length of connection: 150 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:
    - .1 450 mm x 1 000 mm for person size entry.
    - .2 300 mm x 300 mm for servicing entry.
    - .3 300 mm x 450 mm for viewing.
    - .4 As indicated.
  - .2 Access door locations:
    - .1 Control dampers.
    - .2 Devices requiring maintenance.
    - .3 Required by code.
    - .4 Elsewhere as indicated.
  - .3 Servicing access door location:
    - .1 Fire and smoke dampers.
    - .2 Control dampers.
    - .3 Devices requiring maintenance.
    - .4 Required by code.
    - .5 Elsewhere as indicated.

- .3 Instrument Test Ports:
  - .1 General:
    - .1 Install in accordance with recommendations of SMACNA and in accordance with manufacturer's instructions.
    - .2 Locate to permit easy manipulation of instruments.
    - .3 Install insulation port extensions as required.
    - .4 Locations:
      - .1 For traverse readings:
        - .1 Inlets and outlets of fan systems.
        - .2 And as indicated.
      - .2 For temperature readings:
        - .1 Downstream of junctions of two converging air streams of different temperatures.
        - .2 And as indicated.
  - .4 Turning vanes:
    - .1 Install in accordance with recommendations of SMACNA and as indicated.

### **3.3 FIELD QUALITY CONTROL**

- .1 Manufacturer's Field Services
  - .1 Have manufacturer of products, supplied under this Section, review Work involved in the handling, installation/application, protection and cleaning, of its products and submit written reports, in acceptable format, to verify compliance of Work with Contract.
  - .2 Manufacturer's Field Services: provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.



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

### **3.4 CLEANING**

- .1 Perform cleaning operations as specified in section 01 74 11 - Cleaning.

**END OF SECTION**



## **PART 1 - GENERAL**

### **1.1 RELATED REQUIREMENTS**

- .1 Section 21 05 01 - Common Work Results - Mechanical.
- .2 Section 23 05 00 - Common Work Results for HVAC.
- .1 Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.
- .2 Section 23 31 13 01 - Metal Ducts - Low Pressure to 500 Pa.

### **1.2 REFERENCES**

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

### **1.3 SUBMITTALS**

- .1 Submit documents and samples in accordance with section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Datasheets should include the following:
    - .1 Product characteristics;
    - .2 Performance criteria.
- .3 Certificates:
  - .1 Submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .4 Instructions:
  - .1 Submit manufacturer's installation instructions.

### **1.4 QUALITY ASSURANCE**

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

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

- .1 Packing, shipping, handling and unloading
  - .1 Deliver, store and handle in accordance with section 01 61 00 - Common Product Requirements.

## **1.6 WASTE MANAGEMENT AND DISPOSAL**

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

## **PART 2 - PRODUCTS**

### **2.1 GENERAL**

- .1 Manufacture to SMACNA standards.

### **2.2 SPLITTER DAMPERS**

- .1 Fabricate from same material as duct but one sheet metal thickness heavier, with appropriate stiffening.
- .2 Single or double thickness construction.
- .3 Control rod with locking device and position indicator.
- .4 Rod configuration to prevent end from entering duct.
- .5 Pivot: piano hinge.
- .6 Folded leading edge.

### **2.3 SINGLE BLADE DAMPERS**

- .1 Fabricate from same material as duct, but one sheet metal thickness heavier. V-groove stiffened.
- .2 Size and configuration to recommendations of SMACNA, except maximum height 250 mm.
- .3 Locking quadrant with shaft extension to accommodate insulation thickness.
- .4 Inside and outside end bearings.
- .5 Channel frame of same material as adjacent duct, complete with angle stop.

### **2.4 MULTI-BLADED DAMPERS**

- .1 Factory manufactured of material compatible with duct.

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

## **2.5 BACKDRAFT DAMPERS**

- .1 Registers automatic gravity everal single blade or blades, aluminum, counterweight or spring, as required.
- .2 Frame profile, extruded aluminum 2.3 mm thick.
- .3 Extruded aluminum blades 1.2 mm thick vinyl trim ensuring good sealing.
- .4 Bearings: Bearings synthetic.
- .5 Connecting flanges: registers the type to be inserted into the ducts is not acceptable.
- .6 Acceptable products: Tamco 7000, Ruskin BD2/A2, Nailor. Replacement materials or products: approved by addendum according to Instructions to bidders.

## **PART 3 - EXECUTION**

### **3.1 MANUFACTURER'S INSTRUCTIONS**

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

### **3.2 INSTALLATION**

- .1 Install in accordance with recommendations of SMACNA and in accordance with manufacturer's instructions.
- .2 Locate balancing dampers in each branch duct, for supply, return and exhaust systems and where indicated.
- .3 Installer multi-bladed dampers with opposed blades in the secondary ducts whose height exceeds 250 mm, and in all major branches
- .4 Install single blade damper in the secondary ducts leading to a register of a diffuser: duct height must not exceed 250 mm.
- .5 Runouts to registers and diffusers: install single blade damper located as close as possible to main ducts.

- .6 Dampers: vibration free.
- .7 Ensure damper operators are observable and accessible.
- .8 Install splitter dampers duct with a pant form only.

### **3.3 CLEANING**

- .1 Proceed in accordance with section 01 74 11 - Cleaning.

**END OF SECTION**

## **PART 1 - GENERAL**

### **1.1 REFERENCES**

- .1 American Society for Testing and Materials International (ASTM).
  - .1 ASTM A653/A653M-04, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by Hot-Dip Process.
  - .2 ASTM A525M-90, Specification for General Requirements for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process.
- .2 Sheet Metal and Air Contractors' National Association (SMACNA).

### **1.2 SUBMITTALS**

- .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Indicate the following:
    - .1 Product characteristics;
    - .2 Performance criteria;
    - .3 Constraints;
    - .4 Performance data.
- .3 Certificates:
  - .1 Submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .4 Instructions:
  - .1 Submit manufacturer's installation instructions.

### **1.3 CLOSEOUT SUBMITTALS**

- .1 Provide maintenance data for incorporation into manual specified in section 01 78 00 - Closeout Submittals.

### **1.4 QUALITY ASSURANCE**

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

.2 Certificates:

- .1 Catalogue or published ratings those obtained from tests carried out by manufacturer or those ordered by manufacturer from independent testing agency.

**1.5 DELIVERY, STORAGE, AND HANDLING**

.1 Packing, shipping, handling and unloading:

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

**1.6 WASTE MANAGEMENT AND DISPOSAL**

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

**PART 2 - PRODUCTS**

**2.1 MOTORIZED MULTI-LEAF DAMPERS**

- .1 Opposed blade type, except dampers located near mixing boxes of air handling units which has to be parallel blade type or as indicated on drawings.
- .2 Flanged type dampers only if one of the dimensions is less or equal to 500 mm or if there is no maintenance access to the mechanism.
- .3 Dampers without insulation: return air. Insulated dampers: outside air and exhaust air.
- .4 Materials:
- .1 Damper without insulation:
- .1 Extruded aluminum frame and blade with a thickness of 2.05 mm. Airfoil design blades with a width from 125 mm to 155 mm. Frame dimensions are 25 mm x 100 mm x 25 mm for each side. Aluminum hexagonal profile swivelling rod of 12 mm, attached to the blade. Bearings are to be composed of a Celcon inner bearing fixed to an aluminum hexagon blade pin, rotating within a polycarbonate outer bearing inserted in the frame. Rods are designed to avoid friction; resulting in no metal-to-metal or metal-to-plastic contact.
- .2 Insulated damper (outside air and exhaust):
- .1 Extruded aluminum frame and blade with a thickness of 2.05 mm. Extruded aluminum airfoil design blades with a width from 125 mm to 155 mm. Blades shall be internally insulated with polyurethane foam and



have thermal barrier. Frames shall have a minimum depth of 100 mm and shall be insulated with polystyrene foam having RSI-088, on minimum of three sides. Bearings are to be composed of a Celcon inner bearing fixed to an aluminum hexagon blade pin, rotating within a polycarbonate outer bearing inserted in the frame.

- .5 Dimensions:
  - .1 Blades width: minimum 125 mm, maximum 155 mm. Blade length: maximum 1 200 mm.
  - .2 Modular dimensions: maximum width of 1 200 mm and maximum height of 2 400 mm.
  - .3 Multi-leaf dampers must have stiffeners and transverse coupling rods.
  - .4 Dampers shall be made to size required without blanking off free area.
- .6 Performance:
  - .1 Maximal leakage: 50 L/s.m<sup>2</sup> for a static pressure of 1.0 kPa.
  - .2 Temperature range for insulated dampers: from -40 °C to 68 °C.
  - .3 Temperature range for dampers without insulation: from -40 °C to 100 °C.
  - .4 Maximum velocity of 5 m/s.
- .7 Acceptable products:
  - .1 Damper without insulation: Tamco, model T.A. 1000; Trolec, model VAP-90-MB; Nailor, serie 2000; Alumavent, models 3160 and 3165. Replacement material or products: approved by addendum according to Instructions to bidders.
  - .2 Insulated damper: Tamco, model T.A. 9000; Trolec, model VAP-I-90-MB; Nailor, serie 2000-IBF; Alumavent, models 3960 and 3965. Replacement materials or products: approved by addendum according to Instructions to bidders.

## **PART 3 - EXECUTION**

### **3.1 MANUFACTURER'S INSTRUCTIONS**

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

### **3.2 INSTALLATION**

- .1 Install insulated dampers for outside air intake and exhaust air exit.
- .2 Install where indicated.

- .3 Install in accordance with recommendations of SMACNA and manufacturer's instructions.
- .4 Install dampers so that blades are horizontal.
- .5 Install dampers in vertical ducts or ducts with slope so that the blades are horizontal.
- .6 Seal multiple damper modules with silicon sealant, non transparent, UL listed and to NFPA-90A.
- .7 Install access door adjacent to each damper.

### **3.3 CLEANING**

- .1 Proceed in accordance with section 01 74 11 - Cleaning.

**END OF SECTION**

## **PART 1 - GENERAL**

### **1.1 RELATED SECTIONS**

- .1 Section 21 05 01 - Common Work Results - Mechanical.
- .2 Section 23 05 00 - Common Work Results for HVAC.
- .3 Section 23 05 13 - Common Motors Requirements for HVAC Equipment.
- .4 Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment.
- .5 Section 23 05 49 01 - Seismic Restraint Systems (SRS) - Type P2 Buildings.
- .6 Section 23 05 53 01 - Mechanical Identification.
- .7 Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.
- .8 Section 23 33 00 - Air Duct Accessories.

### **1.2 REFERENCES**

- .1 Air-Conditioning, Heating and Refrigeration Institute (AHRI).
  - .1 AHRI 210/240, Performance Rating of Unitary Air-Conditioning and Air-Source Heat Pump Equipment.
  - .2 AHRI 270, Sound Rating of Outdoor Unitary Equipment.
  - .3 ANSI/AHRI 430, Central Station Air Handling Units.
- .2 Air Movement and Control Association International (AMCA).
  - .1 AMCA 99-2003, Standards Handbook.
- .3 American National Standards Institute (ANSI)/Air Movement and Control Association International (AMCA).
  - .1 ANSI/AMCA 210-1999, Laboratory Methods of Testing Fans for Certified Aerodynamic Performance Rating.
  - .2 ANSI/AMCA 300-1996, Reverberant Room Method for Sound Testing of Fans.
  - .3 AMCA 301-1990, Methods for Calculating Fan Sound Ratings from Laboratory Test Data.

- .4 American National Standards Institute (ANSI)/American Bearing Manufacturers Association (ABMA).
  - .1 ANSI/ABMA 9, Load Ratings and Fatigue Life for Ball Bearings.
  - .2 ANSI/ABMA 11, Load Ratings and Fatigue Life for Roller Bearings.
- .5 American National Standards Institute (ANSI)/American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE).
  - .1 ANSI/ASHRAE 51, Laboratory Methods of Testing Fans for Certified Aerodynamic Performance Rating.
- .6 Canadian General Standards Board (CGSB).
  - .1 CAN/CGSB 1.181-99, Ready-Mixed Organic Zinc-Rich Coating.
- .7 National Fire Protection Association (NFPA).
  - .1 NFPA 90A, Standard for the Installation of Air-Conditioning and Ventilating Systems.
- .8 Sheet Metal and Air-Conditioning Contractor's National Association (SMACNA).
  - .1 SMACNA, HVAC Duct Construction Standards.
- .9 Underwriters Laboratories (UL).
  - .1 UL 900, Test Performance of Air Filter Units.

### **1.3 PERFORMANCE REQUIREMENTS**

- .1 Catalogued or published ratings for manufactured items: obtained from tests carried out by manufacturer or those ordered by manufacturer from independent testing agency signifying adherence to codes and standards in force.
- .2 Provide the test certificates.
- .3 Capacity: flow rate, total static pressure, BHP, W, efficiency, revolutions per minute, power, model, size, sound power data and as indicated on schedule.

## **1.4 SUBMITTALS**

- .1 Product Data:
  - .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.
    - .1 Submit three (3) copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with section 01 33 00 - Submittal Procedures.
- .2 Shop Drawings:
  - .1 Submit shop drawings and product data in accordance with section 01 33 00 - Submittal Procedures.
  - .2 Provide the following information:
    - .1 Fan performance curves showing point of operation, BHP, kW and efficiency;
    - .2 Sound rating data at point of operation;
    - .3 Motors, sheaves, bearings, shaft details;
    - .4 Minimum performance achievable with variable speed controllers and variable inlet vanes as appropriate.
- .3 Certificates:
  - .1 Submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .4 Instructions:
  - .1 Submit manufacturer's installation instructions.

## **1.5 CLOSEOUT SUBMITTALS**

- .1 Provide operation and maintenance data for incorporation into manual specified in section 01 78 00 - Closeout Submittals.

## **1.6 HEALTH AND SAFETY REQUIREMENTS**

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

## **1.7 MAINTENANCE**

- .1 Extra Materials:
  - .1 Provide maintenance materials in accordance with section 01 78 00 - Closeout Submittals.
  - .2 Furnish list of individual manufacturer's recommended spare parts for equipment, include:
    - .1 A list of spare parts recommended by each manufacturer, such as bearings and seals;
    - .2 Addresses of suppliers;
    - .3 List of specialized tools necessary for adjusting, repairing or replacing.

## **1.8 DELIVERY, STORAGE, AND HANDLING**

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

## **1.9 WASTE MANAGEMENT AND DISPOSAL**

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

## **PART 2 - PRODUCTS**

### **2.1 FANS - GENERAL**

- .1 Characteristics: as indicated in Fans Schedule.
- .2 Fans: statically and dynamically balanced, constructed in conformity with AMCA 99.
- .3 Sound ratings: comply with AMCA 301, tested to AMCA 300. Supply unit with AMCA certified sound rating seal.

- .4 Performance ratings: based on tests performed in accordance with ANSI/AMCA 210 and ANSI/ASHRAE 51. Supply unit with AMCA certified rating seal, except for propeller fans smaller than 300 mm diameter.
- .5 Motors:
  - .1 In accordance with section 23 05 13 - Common Motors Requirements for HVAC Equipment, supplemented as specified herein.
  - .2 For use with variable speed controllers.
  - .3 Sizes as indicated in Fans Schedule.
- .6 Accessories and hardware: matched sets of V-belt drives, adjustable slide rail, motor bases, belt guards, coupling guards fan inlet and outlet safety screens as indicated and as specified in section 23 05 13 - Common Motors Requirements for HVAC Equipment, inlet and outlet dampers and vanes and as indicated
- .7 Factory primed before assembly in colour standard to manufacturer.
- .8 Scroll casing drains: as indicated.
- .9 Bearing lubrication systems plus extension lubrication tubes where bearings are not easily accessible.
- .10 Vibration isolation: to section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment.
- .11 Flexible connections: to section 23 33 00 - Air Duct Accessories.

## **2.2 CABINET FANS - GENERAL PURPOSE**

- .1 Fan characteristics and construction: the same as centrifugal fans axial flow, with direct drive motor.
- .2 Fans must comply with arrangements 1 and 9 of the AMCA and as indicated, with reinforced flanges, ports smooth admission and long radius of curvature and fixed blades guidelines.
- .3 Accessories: Adapters for connection to air ducts, adjusting speed controller LT-30 light amber indication walking motion sensor (automatic start control) shock suspension element.
- .4 Acceptable products: Greenheck, SQ Varigreen; JENcoFAN, JID; Cook, Penn, Aerovent, SCBD. Replacement materials or products: approved by addendum according to Instructions to bidders.

## **PART 3 - EXECUTION**

### **3.1 MANUFACTURER'S INSTRUCTIONS**

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

### **3.2 FAN INSTALLATION**

- .1 Install fans as indicated, complete with resilient mountings specified in section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment, flexible electrical leads and flexible connections in accordance with section 23 33 00 - Air Duct Accessories.
- .2 Provide sheaves and belts required for final air balance.
- .3 Access doors and access panels to be easily accessible.

### **3.3 ANCHOR BOLTS AND TEMPLATES**

- .1 Size anchor bolts to withstand seismic acceleration and velocity forces.

### **3.4 CLEANING**

- .1 Proceed in accordance with section 01 74 11 - Cleaning.

**END OF SECTION**



## **PART 1 - GENERAL**

### **1.1 RELATED REQUIREMENTS**

- .1 Section 21 05 01 - Common Work Results - Mechanical.
- .2 Section 23 05 00 - Common Work Results for HVAC.
- .3 Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.
- .4 Section 23 33 46 - Flexible Ducts.

### **1.2 REFERENCES**

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

### **1.3 SUBMITTALS**

- .1 Submit documents and samples in accordance with section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Indicate following:
    - .1 Capacity;
    - .2 Throw and terminal velocity;
    - .3 Noise criteria;
    - .4 Pressure drop;
    - .5 Neck velocity;
    - .6 The material and thickness of materials.
- .3 Certificates:
  - .1 Submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

- .4 Instructions:
  - .1 Submit manufacturer's installation instructions.

#### **1.4 CLOSEOUT SUBMITTALS**

- .1 Submit maintenance and engineering data for incorporation into manual specified in section 01 78 00 - Closeout Submittals.
- .2 Extra Materials:
  - .1 Include:
    - .1 Keys for volume control adjustment.
    - .2 Keys for air flow pattern adjustment.

#### **1.5 QUALITY ASSURANCE**

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

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

- .1 Packing, shipping, handling and unloading
  - .1 Deliver, store and handle in accordance with section 01 61 00 - Common Product Requirements.
- .2 Delivery and Acceptance Requirements: deliver materials and equipment to site in original packaging, which must be labeled with the name and address of the manufacturer.
- .3 Storage and handling:
  - .1 Store materials and equipment so that they do not rest directly on the floor, in a clean, dry, well ventilated place, in accordance with the manufacturer's recommendations.
  - .2 Store diffusers, distribution boxes, registers and grilles to protect against bumps, dents, scratches and scrapes.
  - .3 Replace materials and equipment damaged by materials and new equipment.

## **1.7 WASTE MANAGEMENT AND DISPOSAL**

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

## **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 Standard products whose characteristics meet the requirements and specifications with regard to capacity, pressure drop, terminal velocity, the scope of the jet, noise level and speed at the point of maximum constriction (neck) and the outlet.
- .2 Frames:
  - .1 Steel frame: primed stamped steel, colled rolled, with visible welded joints and miter joints in corners.
  - .2 Aluminum frame: aluminum extruded, satin finish with mechanical fasteners and miter joints at the corners.
  - .3 Full perimeter gaskets.
  - .4 Concealed fasteners.
  - .5 Concealed manual volume control damper operators.
  - .6 Colour: as directed by Departmental Representative.
  - .7 Acceptable products: E.H. Price; Nailor; Anemostat; Titus. Replacement materials or products: approved by addendum according to Instructions to bidders.

### **2.3 MANUFACTURED UNITS**

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

## **PART 3 - EXECUTION**

### **3.1 MANUFACTURER'S INSTRUCTIONS**

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

### **3.2 INSTALLATION**

- .1 Install in accordance with manufacturers instructions.
- .2 Install with flat head cadmium plated screws in countersunk holes where fastenings are visible.
- .3 Install, for each grille and diffuser, balancing dampers.

### **3.3 CLEANING**

- .1 Proceed in accordance with section 01 74 11 - Cleaning.

**END OF SECTION**

## **PART 1 - GENERAL**

### **1.1 REFERENCES**

- .1 American National Standards Institute (ANSI)/National Fire Protection Association (NFPA).
  - .1 ANSI/NFPA 96-04, Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations.
- .2 American Society for Testing and Materials International (ASTM).
  - .1 ASTM E90-04, Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.
- .3 Health Canada/Workplace Hazardous Materials Information System (WHMIS).
  - .1 Material Safety Data Sheets (MSDS).
- .4 Sheet Metal and Air-Conditioning Contractors' National Association (SMACNA).
- .5 Society of Automotive Engineers (SAE).

### **1.2 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 Product Data:
  - .1 Indicate following:
    - .1 Pressure drop;
    - .2 Face area;
    - .3 Free area.
- .3 Certificates:
  - .1 Submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

- .4 Instructions:
  - .1 Submit manufacturer's installation instructions.
- .5 Test Reports:
  - .1 Submit certified data from independent laboratory substantiating acoustic and aerodynamic performance to ASTM E90.

### **1.3 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.

### **1.4 QUALITY ASSURANCE**

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

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

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

### **1.6 WASTE MANAGEMENT AND DISPOSAL**

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

## **PART 2 - PRODUCTS**

### **2.1 FIXED LOUVERS**

- .1 Construction: welded with exposed joints ground flush and smooth.
- .2 Material: extruded aluminum alloy 6063-T5 of 2.05 mm thick for blades and frames.

- .3 Blade: stormproof pattern with centre watershed in blade, 45° angle, reinforcing bosses and maximum blade length of 1500 mm.
- .4 Frame, head, sill and jamb: U or L shape, one piece extruded aluminum, minimum 3 mm thick with approved caulking slot, integral to unit.
- .5 Mullions: at 1500 mm maximum centres.
- .6 Fastenings: stainless steel SAE-194-8F with SAE-194-SFB nuts and resilient neoprene washers between aluminum and head of bolt, or between nut, ss washer and aluminum body.
- .7 Screen: 12 mm mesh, 1.6 mm diameter wire aluminum or stainless steel birdscreen on inside face of louvers in formed U-frame or L-frame.
- .8 Finish: factory applied enamel, fluocarbon, inert resine KYNAR @500 (70 %). Colour: to Departmental Representative.
- .9 Thickness:
  - .1 50 mm for louvers less than 610 mm high.
  - .2 100 mm for louvers between 610 mm and 1 830 mm high.
  - .3 150 mm for louvers higher than 1 830 mm.
- .10 Acceptable products: TROLEC, model HW for outside air intake and model HZ for exhaust air; Cometal; Price; Ventex. Replacement materials or products: approved by addendum according to Instructions to bidders.

## **2.2 SCREENS**

- .1 Aluminum, removable for cleaning, installed on inside face of louvers.
- .2 Use: for all outside air intake without filters.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- .1 In accordance with manufacturer's and SMACNA recommendations.
- .2 Reinforce and brace as indicated and to CNB.
- .3 Anchor securely into opening. Seal with caulking to ensure weather tightness.

- .4 Install gooseneck hoods, gravity relief vents and louver shed on roof base of minimum 508 mm high.

### **3.2 CLEANING**

- .1 Proceed in accordance with section 01 74 11 - Cleaning.

**END OF SECTION**



## **PART 1 - GENERAL**

### **1.1 RELATED REQUIREMENTS**

- .1 Section 21 05 01 - Common Work Results - Mechanical.
- .2 Section 23 05 00 - Common Work Results for HVAC.
- .3 Section 23 81 40 - Air and Water Source Unitary Heat Pumps.

### **1.2 REFERENCES**

- .1 American National Standards Institute/National Fire Prevention Association (ANSI/NFPA)
  - .1 ANSI/NFPA 96-04, Ventilation Control and Fire Protection of Commercial Cooking Operations.
- .2 American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE)
  - .1 ASHRAE 52.1-1992, Gravimetric And Dust Spot for Testing Air-Cleaning Devices Used in General Ventilation for Removing Particulate Matter (ANSI Approved).
  - .2 ASHRAE 52.2-2007, Method of Testing General Ventilation Air Cleaning Devices for Removal Efficiency by Particle Size.
- .3 Canadian General Standards Board (CGSB)
  - .1 CAN/CGSB-115.10-M90, Disposable Air Filters for the Removal of Particulate Matter from Ventilating Systems.
  - .2 CAN/CGSB-115.11-M85, Filters, Air, High Efficiency, Disposable, Bag Type.
  - .3 CAN/CGSB-115.12-M85, Filters, Air, Medium Efficiency, Disposable, Bag Type.
  - .4 CAN/CGSB-115.13-85, Filter Media, Automatic Roll.
  - .5 CAN/CGSB-115.14-M91, High Efficiency Cartridge Type Supported Air Filters for the Removal of Particulate Matter from Ventilating Systems.
  - .6 CAN/CGSB-115.15-M91, High Efficiency Rigid Type Air Filters for Removal of Particulate Matter from Ventilating Systems.
  - .7 CAN/CGSB-115.16-M82, Activated Carbon for Odor Removal from Ventilating Systems.
  - .8 CAN/CGSB-115.18-M85, Filter, Air, Extended Area Panel Type, Medium Efficiency.

- .9 CAN/CGSB-115.20-95, Polarized Media Air Filter.
- .4 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  - .1 Material Safety Data Sheets (MSDS).
- .5 Underwriters' Laboratories of Canada ULC -S111-[95], Standard Method of Fire Tests for Air Filter Units.
  - .1 ULC-S649-1993, Exhaust Hoods and Related Controls for Commercial and Institutional Kitchens.

### **1.3 SUBMITTALS**

- .1 Submit documents and samples in accordance with section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's printed product literature, specifications and datasheet. Include product characteristics, performance criteria, and limitations.
- .3 Shop Drawings:
  - .1 Indicate following:
    - .1 Filter casings characteristics;
    - .2 Filter characteristics.
- .4 Certificates:
  - .1 Submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
  - .2 The Contractor shall provide for each type of filter, a certificate of conformity issued by an independent laboratory, indicating MERV filter
- .5 Instructions:
  - .1 Submit manufacturer's installation instructions.
    - .1 Departmental Representative will make available one (1) copy of systems supplier's installation instructions.

### **1.4 CLOSEOUT SUBMITTALS**

- .1 Provide maintenance data for incorporation into manual specified in section 01 78 00 - Closeout Submittals.

## **1.5 QUALITY ASSURANCE**

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

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

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

## **1.7 WASTE MANAGEMENT AND DISPOSAL**

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

## **1.8 MAINTENANCE**

- .1 Extra Materials:
  - .1 Provide maintenance materials in accordance with section 01 78 00 - Closeout Submittals.
  - .2 Furnish list of individual manufacturer's recommended spare parts for equipment such as frames and filters, addresses of suppliers, list of specialized tools necessary for adjusting, repairing or replacing for inclusion in operating manual.
  - .3 Spare filters: in addition to filters installed immediately prior to acceptance by the Departmental Representative, supply one (1) complete set of filters for each filter unit or filter bank in accordance with section 01 78 00 - Closeout Submittals.

## **PART 2 - PRODUCTS**

### **2.1 GENERAL**

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

## **2.2 ACCESSOIRES**

- .1 Holding frame: permanent "T" section 100 mm construction of extruded aluminum, 1.6 mm thick, except where specified.
- .2 Seals: to ensure leakproof 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.
- .5 Media box: side access type for installation of filters in air duct.
- .6 Acceptable products: Farr, model 4P Glide/Pack AAF, model Accessar II Polyseal. Replacement materials or products: approved by addendum according to Instructions to bidders.

## **2.3 COTTON PANEL FILTERS**

- .1 Disposable pleated reinforced dry media: to CAN/CGSB 115.18.
- .2 Holding frame: galvanized steel, or slide in channel for side access.
- .3 Performance: average atmospheric dust spot efficiency 30 % to ASHRAE 52.1 and MERV 8 according to ASHRAE 52.2.
- .4 Fire Rated: to ULC -S111.
- .5 Nominal thickness: 50 mm.
- .6 Acceptable products: as indicated on schedule. Replacement materials or products: approved by addendum according to Instructions to bidders.

## **2.4 FILTERS GAUGES**

- .1 Dial type: Diaphragm actuated, direct reading.
- .2 Range: according to the initial pressure drop and the final pressure drop.
- .3 Quantity: a manometer by filter bank.
- .4 Permanent identifiers to initial pressure drop and final pressure drop recommended by manufacturers.
- .5 Acceptable products: Magnahelic, series 2000. Replacement materials or products: approved by addendum according to Instruction to bidders.

## **PART 3 - EXECUTION**

### **3.1 MANUFACTURER'S INSTRUCTIONS**

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

### **3.2 INSTALLATION GENERAL**

- .1 Install in accordance with manufacturer's recommendations and with adequate space for access, maintenance and replacement.
- .2 Before the approval of work, conduct tests to verify the integrity of the installation
- .3 Before installing filter panels, the contractor must obtain certification from an independent laboratory confirming the classification MERV of each filter used.

### **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 Proceed in accordance with section 01 74 11 - Cleaning.

**END OF SECTION**



## **PART 1 - GENERAL**

### **1.1 REFERENCES**

- .1 American Society of Heating, Refrigerating and Air-Conditioning Engineers.
  - .1 ASHRAE 52, Method of Testing Air Cleaning Devices Used in General Ventilation for Removing Particulate Matter.
- .2 Canadian Standard Association (CSA)/CSA International.
  - .1 CSA C22.2 n° 46, Electric radiators.

### **1.2 SUBMITTALS**

- .1 Submittals in accordance with section 01 33 00 - Submittal procedures.
- .2 Shop drawings and technical data:
  - .1 Shop drawings and technical data must include the following:
    - .1 Support details of the heating element.
    - .2 Nominal power in kW, voltage and number of phases.
    - .3 The power flux of the heating element and the maximum temperature of the duct.
    - .4 The maximum outlet temperature.
    - .5 Space limitations.
    - .6 Details of the heater support.
    - .7 Operating limits.
    - .8 Required clearance with respect to combustible materials.
    - .9 Internal components wiring diagram.
    - .10 The minimum required airflow.
    - .11 The pressure loss at minimum air flow and operating conditions.

### 1.3 CLOSEOUT SUBMITTALS

- .1 Submit maintenance and engineering data for incorporation into manual specified in section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data sheet must include the following:
  - .1 A description of the apparatus, including the manufacturer's name, type, model, year of manufacture and the power;
  - .2 The relevant details related to the operation and maintenance;
  - .3 A list of recommended spare parts.

### 1.4 WASTE MANAGEMENT AND DISPOSAL

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

## **PART 2 - PRODUCTS**

### 2.1 ELECTRIC DUCT HEATERS

- .1 Duct heaters (insertion type):
  - .1 Manufactured according to CSA standards with approved tag;
  - .2 Approved for zero emission with any combustible material.
- .2 Heating elements made of helical wire resistance NiCr 60 (grade C).
- .3 Heating elements power density:
  - .1 The power density of the heating elements must consider the minimum speed of air and temperature to ensure maximum durability and safe operation of heaters, but the density should not exceed the maximum listed below.
  - .2 When the air velocity through the coil is greater than 2.28 m/s, provide elements for which the maximum density is 6 W/cm<sup>2</sup>. When the air velocity through the coil is less than 2.28 m/s, provide low density elements as listed in the table below:

Minimum air velocity m/s	0,5	1	1,5	2,28
Maximum element density W/cm <sup>2</sup>	1,1	2,8	4,5	6



- .4 Casing of appropriate gauge galvanized steel, with flanges attached to the installation without opening the control box.
- .5 Controls:
  - .1 Factory pre-wired control devices and mounted in a control box. Supply circuits and control are connected to the thermostat using terminal connections.
  - .2 Proportional or modulating control devices, mounted in an enclosure approved by the CSA, are the following:
    - .1 Magnetic contactors;
    - .2 Proportional SSR (SSR) with detection of, and switching to zero or modulating controller SCR;
    - .3 HEC Electronic controller with thermal detection sensors;
    - .4 Pressure differential switch required to ensure that the elements are not activated if there is no airflow;
    - .5 Control transformer with control circuit protection fuse;
    - .6 Load fuse.
    - .7 Main switch without fuse;
    - .8 Primary thermal protection probe with automatic reset;
    - .9 Secondary thermal protection probe with manual reset.
- .6 Accessories:
  - .1 Protective grid on each side.
- .7 Specifications: see table on plans.
- .8 Acceptable products: Delta Sélec, model DS; Neptronic, model CI00H; Thermolec, model SC. Replacement materials or products: approved by addendum according to Instructions to bidders.

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## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- .1 Install electrical heaters in accordance with manufacturer's instructions in a way you can easily remove the ventilation ducts.
- .2 Coordinate connections to the power supply with the Division Electricity and control devices with Section « Integrated Automation ».

### **3.2 TESTS**

- .1 Perform required tests in accordance with Division 26.

**END OF SECTION**

## **PART 1 - GENERAL**

### **1.1 RELATED REQUIREMENTS**

- .1 Section 23 23 00 - Refrigerant Piping.
- .2 Section 23 31 13 01 - Metal Ducts - Low Pressure to 500 Pa.

### **1.2 REFERENCES**

- .1 American National Standards Institute/Air-Conditioning and Refrigeration Institute (ANSI/ARI)
  - .1 ANSI/HARI 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
  - .1 HARI 320-1998, Standard for Water-Source Heat Pumps.
- .4 CSA International
  - .1 CAN/CSA-C656-F05 (C2010), Performance standard for split-system and single-package air conditioners and heat pumps.
- .5 Environment Canada (EC) / environmental protection service (EPS)
  - .1 EPS 1/RA/2F-1996, Environmental Code of practice for elimination of fluorocarbon 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 SUBMITTALS**

- .1 Submit documents and samples in accordance with section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Submit product data and instructions and manufacturer's literature for compressor/condenser units and external cooling coils groups. Product data should include product characteristics, performance criteria, physical size, finish and limitations.

### **1.4 CLOSEOUT SUBMITTALS**

- .1 Submit maintenance and engineering data for incorporation into manual specified in section 01 78 00 - Closeout Submittals.
- .2 Operating and maintenance records: provide instructions on the operation and maintenance of the compressor unit/condenser, which will be incorporated into the manual O and M.

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

- .1 Deliver, store and handle materials in accordance with section 01 61 00 - Common Product Requirements.
- .2 Delivery and Acceptance Requirements: deliver materials and equipment to site in original packaging, which must be labeled with the name and address of the manufacturer.
- .3 Storage and handling:
  - .1 Store materials and equipment so that they do not rest directly on the floor, in a clean, dry, well ventilated place, in accordance with the manufacturer's recommendations.
  - .2 Store compressor/condenser units to protect against bumps, dents, scratches and scrapes.
  - .3 Replace materials and equipment damaged by new materials and equipment.

### **1.6 WARRANTY**

- .1 For the air conditioning system, the warranty period of 12 months is extended to 60 months.

## **PART 2 - PRODUCTS**

### **2.1 DESCRIPTION**

- .1 Compressor/condenser unit must be CSA approved and stamped AHRI of CSA certification.

### **2.2 REFRIGERANTS**

- .1 Refrigerant type: R-410a.

### **2.3 DRAIN PANS CONDENSATE**

- .1 Drain pans condensate to be placed under the internal batteries must be designed and constructed to ensure complete evacuation of water recovered and must be installed so that cleaning can be performed easily

### **2.4 COMPRESSOR - CONDENSER UNIT**

- .1 Compressor/condenser unit characteristics must be registered and comply with AHRI 520.
- .2 The set must include the following items:
  - .1 Direct drive compressor "SCROLL" type condenser air, one or two fans cooling the condenser, all factory mounted.
  - .2 Install between the compressor and the support vibration dampers neoprene or rubber.
  - .3 Required accessories:
    - .1 Accumulation tank liquid with safety valve and liquid shut-off valve;
    - .2 Silencer on the discharge pipe of the compressor;
    - .3 Shut-off valves on the suction and the discharge of the compressor;
    - .4 Pan heater;
    - .5 Control of pressure oil connected to the compressor and spun at the control cabinet;
    - .6 High and low pressure control connected to the compressor and spun at the control cabinet;

- .7 Capacity control with bypass of hot gas, solenoid valve and pressure control connected to the compressor and extruded to the control unit;
  - .8 Oil separator with fittings and valves for oil return to the compressor;
  - .9 Accumulator suction with internal exchanger with hot gas or electric heating;
  - .10 Ambient low temperature system.
- .3 Control cabinet enamelled steel with hinged door, mounted in the compressor/condenser unit, including the following accessories:
- .1 Transformer control circuit;
  - .2 Fuse control circuit;
  - .3 Main switch;
  - .4 Connection block for pressure control and oil pressure;
  - .5 Timer defrost;
  - .6 The cabinet is completely factory prewired.
- .4 Acceptable products: REF PLUS. Replacement material or products: approved by addendum according to Instructions to bidders.
- .5 Performance data system CD-01:
- .1 Compressor/condenser air unit for outdoor installation: the power of the device must be at least 37.2 kW when the saturation temperature is 35 °C. The maximum output power of the motors must be 8 kW. The refrigerant used shall be R-410a. The group must include:
    - .1 A 10 HP compressor;
    - .2 Two cooling fans;
    - .3 An evaporator coil;
    - .4 The following accessories:
      - .1 "Hot gas by-pass" Sportlan Mecanic 5 tons system (ASC required on the DX coil system DX);

- .2 Pressure control: adjustable high pressure c/a flexible standard control;
  - .3 Accessories on standard liquid 5/8;
  - .4 Suction accessories;
  - .5 On the suction filter STD-1-3/8;
  - .6 Time relay- MARS 32392;
  - .7 Transformer 24 Volts;
  - .8 Low temperature accessories.
- .2 Power supply: 600 V, 3 phases, 60 Hz.
  - .3 Model: OCZ-100-1H1-8.
  - .4 Cooling:
    - .1 Total cooling capacity: at least 37.2 kW:
    - .2 Ambient temperature: 35°C.
- .6 Performance data system CD-02:
    - .1 Compressor/condenser air unit for outdoor installation: the power of the device must be at least 25 kW when the saturation temperature is 35 °C. The maximum output power of the motors must be 6 kW. The refrigerant used shall be R-410a. The group must include:
      - .1 A 7 HP compressor;
      - .2 Two cooling fans;
      - .3 An evaporator coil;
      - .4 The following accessories:
        - .1 "Hot gas by-pass" Sportlan Mecanic 5 tons system (ASC required on the DX coil system DX);
        - .2 Pressure control: adjustable high pressure c/a flexible standard control;
        - .3 Accessories on standard liquid 5/8;

- .4 Suction accessories;
  - .5 On the suction filter STD-1-3/8;
  - .6 Time relay- MARS 32392;
  - .7 Transformer 24 Volts;
  - .8 Low temperature accessories.
- .2 Power supply: 600 V, 3 phases, 60 Hz.
  - .3 Model: OCZ-070-1H1-8.
  - .4 Cooling:
    - .1 Total cooling capacity: at least 25 kW.
    - .2 Ambient temperature: 35°C.

## **2.5 COOLING BATTERIES**

- .1 Description:
  - .1 Power: confirmed by the manufacturer, according to data on the actual temperatures of the cooling fluid, at the inlet and outlet of the coil, and according to the air temperature involved; provide these data with the shop drawings.
  - .2 Installation in the supply line, according to section 23 31 13 01 - Metal Ducts - Low Pressure to 500 Pa.
- .2 General:
  - .1 Cleanable tubular coils: straight tubes with copper headers.
  - .2 Planar fins coils: tubes attached to the fins by mechanical means.
  - .3 All nonferrous metal tubes and collectors: mounting by soldering.
  - .4 Maximum tube length: 3.6 m unless otherwise indicated.
  - .5 Coils tested at the factory: pressurized air and submerged state.
  - .6 Coil of 4 to 6 rows of tubes with 8 to 10 fins per inch (nominal gauge).
  - .7 Aluminum fins mechanically bonded to seamless copper tubes.



- .8 Fittings and accessories for refrigerant piping mounted outside of the envelope, all factory installed.
- .3 Power: ARI approved and confirmed by the manufacturer, according to the data on the actual temperatures of the heating fluid and cooling at the inlet and outlet of the coil, and according to the air temperature involved; provide the shop drawings.
  - .1 Unless otherwise indicated, dehumidification coils must be designed for a face velocity of 2.5 m/s.
  - .2 Pressure drop in cooling coils: more than 125 Pa.
- .4 Envelopes coils:
  - .1 Mounting: designed for bolting to other elements (assembly inside the air duct).
  - .2 Stainless steel: sheet stamped steel 1.6 mm thick.
  - .3 Tube supports: allowing free expansion and contraction.
  - .4 Supports: built in stainless steel in "U" or double brackets, or supports approved pattern. Copper coils mounted on brass brackets.
  - .5 Shutter plate: same material as that of the envelope, to prevent bypass of the airflow. Seal the passage openings in the pipe jacket as recommended by the SMACNA.
- .5 Refrigerant coils, direct expansion system.
  - .1 Flat coils arranged to prevent the accumulation of oil. Distributors must ensure equal distribution of the refrigerant at all circuits. Seals refrigerant tube welded or soldered to the silver. Coil drained, then filled with nitrogen and sealed before being shipped on site.
  - .2 Tubing: copper.
  - .3 Fins: aluminum.
  - .4 Headers: copper.
  - .5 Test pressure: according to the Canadian Code of refrigeration. Drain pipes and nitrogen load.
- .6 Acceptable products: Refplus; Aerofin; Heatcraft; Vapac. Replacement material or products: approved by addendum according to Instructions to bidders.
- .7 Performance specifications of systems SDX-01 and SDX-02: See table on plan M04.

## **2.6 REFRIGERANT PIPING**

- .1 Piping connecting the outdoor coil, the compressor and the inner battery pack, and having the valves and the devices for adjusting the flow of refrigerant necessary.
- .2 Refer to section 23 23 00 - Refrigerant Piping.

## **2.7 REFRIGERANT ACCESSORIES**

- .1 Flexible couplings:
  - .1 Flexible couplings: the flexible couplings having a nominal diameter equal to or less than 10 mm should be soft copper wound. When the diameter exceeds 10 mm, it must be made of a flexible hose bronze seamless coated braid formed of bronze wire. Connections must be protected by a neoprene envelope factory sealed, when installed in a place where there is risk of frost.
- .2 Fittings:
  - .1 Valves shall comply with ASME B16-34.
  - .2 Service valves:
    - .1 Forged brass valves, class 500, when the pressure is equal to or less than 3.5 MPa; cast bronze valves and without packing, class 375, when the pressure is equal to or less than 2.5 MPa.
    - .2 Valves installed in locations where the temperature is below the freezing point must be sealed and moisture-proof.
    - .3 Valves shall be type rear sealing gasket and check valve ball for inspection and replacement under pressure.
    - .4 The valves must include a pressure gauge for regulating capillary connection with sealed and removable inspection plug.
  - .3 Stop valves:
    - .1 Stop valves of nominal outside diameter less than or equal to 22 mm: membrane, without stuffing, to support incorporated body and forged brass cap assembly, valve type, straight or square, non-directional.
    - .2 Stop valves of nominal outside diameter equal to or greater than 28 mm: heavy duty spherical body or square and with a hard thick nylon, self-aligning sealing.

- .4 Traps, drain valves, charging valves, globe valves, with an outlet fitting brazed or flared collar, provided with a stern socket wrench and a sealed and removable inspection plug.
- .3 Safety valves:
  - .1 Safety valves fitted with a fusible plug or rupture disc, forged brass body.
  - .2 Rectifiable seat valve, forged brass body.
  - .3 Double valves: conform to the specifications or requirements of the code, arranged at least one is still in working condition.
- .4 Check valves:
  - .1 Check valve piston guided and spring, with forged brass body, flared tube fittings for nominal outside diameter less than or equal to 22 mm.
  - .2 Non-return valve piston guided and spring return, provided with a bolt cap or a cover plate, with tin-welded by capillarity fittings to nominal outside diameter equal to or greater than 28 mm.
- .5 Solenoid valves:
  - .1 It shall be possible to replace the solenoid coil in place without the need to remove the valve from the pipeline. When used for discharging refrigerant, these valves must be fitted with a manually operated stem. The coils are calibrated according to the operating temperature.
  - .2 Solenoid valves installed upstream of thermostatic expansion valves and strainers.
- .6 Regulators: comply with the requirements of ASHRAE 17 standards.
  - .1 Regulators of the thermostatic type provided with an external equalizer device and a superheat control. The capacity and load of the bulb must agree to the terms of service. Temperature of the liquid sub cooling of 10 °C.
- .7 Evaporation pressure regulator:
  - .1 Automatic direct action or with a powered external detector or internally (change can be made on site) valve; rod manually operated to discharge the refrigerant. Provide in the external pilot supply line, a solenoid valve that allows the controller to also act as a stop valve. Provide a pressure control device with adjustable setpoint, electrically operated subject to a temperature sensor incorporated.

- .8 Suction pressure regulators:
  - .1 Automatic valve installed in the suction side of the compressor at low pressure and mid pressure used to prevent motor overload at the time of the evacuation of the refrigerant and defrost. The pressure gauge must be in between 0 and 275 kPa with a calculate pressure drop at 3.5 to 7 kPa.
- .9 Hot gases derivations:
  - .1 Equipped with an external or internal equalizer (change can be made on site). The gauge pressure should be adjusted to be between 0 and 275 kPa at need. The electrical installation must include a device for the automatic positioning of the shutter.
- .10 Dehydrators:
  - .1 Dehydrators mounted on liquid lines: in accordance with ARI standard 710, UL approved and tested at a pressure of 3.5 MPa.
  - .2 The capacity of the dehydrators must comply with directions and be at least equal to the nominal cooling capacity of the system established by the manufacturer, taking into account the type of refrigerant used
  - .3 The dehydrators with exterior diameter equal or greater than 16 mm must be renewable cartridge type and be installed as indicated. Provide shutoff valves and safety valves.
  - .4 Dehydrators mounted on the suction line must have the characteristics of the dehydrator mounted on the liquid line and comply with the manufacturer's specifications for installation in suction line. The pressure drop should be used depending on the refrigerant and the suction pressure of the installation.
- .11 Light:
  - .1 Liquid sight glass, double glass mounted on the liquid line upstream of each evaporator of the expansion valve. Indicator changes color in the presence of moisture.
- .12 Silencers:
  - .1 Silencers must be mounted on the compressor, as shown on the drawings or as recommended by the compressor's manufacturer.
- .13 Oil separator:
  - .1 A float valve must ensure the automatic return of the trapped oil to the compressor crankcase. The unheated oil separators shall be insulated.

- .14 Buffer tank:
  - .1 The buffer tank must have an overcapacity of 25% compared to the volume of refrigerant to evacuate or the capacity to meet the requirements of provincial code. This capacity must be expressed in kilograms of liquid refrigerant at 32 °C.
  - .2 Provide re-evaporation of the liquid refrigerant back to the compressor.

### **PART 3 - EXECUTION**

#### **3.1 TEST**

- .1 Verification of conditions: before proceed with the installation of compressor/condenser unit, make sure the status of surfaces and supports previously implement under other sections or contracts is acceptable and can be perform the work in accordance with manufacturer's written instructions.
  - .1 Perform a visual inspection of surfaces/supports in the presence of Departmental Representative.
  - .2 Immediately inform the Departmental Representative of any unacceptable conditions detected.
  - .3 Start the installation work only after correcting unacceptable conditions and received the written approval of the Departmental Representative.

#### **3.2 GENERAL**

- .1 Install equipment where indicated and in accordance with the manufacturer's instructions.
- .2 Install the compressor/condenser exterior units on structural support.
- .3 Mount the units on vibration dampers.
- .4 Secure equipment with the bolts holding in accordance with the manufacturer's recommendations.
- .5 Connect the refrigeration piping.
- .6 Install equipment so that it is possible to access all the component elements and remove, if necessary, for maintenance.

### **3.3 COOLING COIL ASSEMBLY**

- .1 Install the coils where indicated and in accordance with the manufacturer's instructions.
- .2 Install the cooling coils in a section of 304 stainless steel duct. Fittings shall be extended to the outside of the duct and through flexible seal attached to the inner and outer walls (grommets). A drip pan must be provided in the coil and it must be provided with a drain hose.

### **3.4 CONDENSATE DRAIN PANS**

- .1 Install condensate drain pans so that the water cannot accumulate and they are easily accessible for cleaning.

### **3.5 STARTUP AND COMMISSIONING OF EQUIPMENT**

- .1 Ask the manufacturer to certify the quality of execution of the installation work.
- .2 Ask the manufacturer to be present at the time of initiation devices and certify performance.
- .3 Submit written reports start-up and commissioning of the equipment at the Departmental Representative.

### **3.6 ACTIVITIES TO COMPLETION OF WORK**

- .1 The manufacturer shall provide the necessary instructions to operating personnel orally and in writing.

### **3.7 CLEANING**

- .1 Proceed in accordance with section 01 74 11 - Cleaning.
  - .1 Leave work area clean at the end of each working day.
- .2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment, in accordance with section 01 74 11 - Cleaning.
  - .1 Remove bins and recycling bins from site and dispose of materials at appropriate facilities.

### **3.8 PROTECTION**

- .1 Protect installed equipment and components against damage during construction.
- .2 Repair damage to adjacent materials and equipment for the installation of compressor / condenser units.

**END OF SECTION**





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**Division 25 / Integrated Automation**

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## **PART 1 - GENERAL**

### **1.1 SUMMARY**

- .1 Content section
  - .1 Methods and procedures to be followed for starting, testing and commissioning of an energy management control system (EMCS) of the building, including:
    - .1 Start-Up testing and verification systems.
    - .2 Verifying the proper operation of components.
    - .3 Functional tests performed on site.

### **1.2 RELATED SECTIONS**

- .1 Section 21 05 01 - Common Work Results - Mechanical.
- .2 Section 23 05 00 - Common Work Results for HVAC.
- .3 Section 25 05 01 - EMCS: General Requirements.

### **1.3 DEFINITIONS**

- .1 For additional acronyms and definitions refer to section 25 05 01 - EMCS: General Requirements.
- .2 AEL: ratio between total test period less any system downtime accumulated within that period and test period.
- .3 Downtime: results whenever EMCS is unable to fulfill required functions due to malfunction of equipment defined under responsibility of EMCS contractor. Downtime is measured by duration, in time, between time that Contractor is notified of failure and time system is restored to proper operating condition. Downtime not to include following:
  - .1 Outage of main power supply in excess of back-up power sources, provided that:
    - .1 Automatic initiation of back-up was accomplished.
    - .2 Automatic shut-down and re-start of components was as specified.
  - .2 Failure of communications link provided that:
    - .1 Controller automatically and correctly operated in stand-alone mode.

- .2 Failure was not due to failure of any specified EMCS equipment.
- .3 Functional failure resulting from individual sensor inputs or output devices, provided that:
  - .1 System recorded said fault.
  - .2 Equipment defaulted to fail-safe mode.
  - .3 AEL of total of all input sensors and output devices is at least [99] % during test period.

#### **1.4 DESIGN REQUIREMENTS**

- .1 Confirm with Departmental Representative that Design Criteria and Design Intentions are still applicable.
- .2 Commissioning personnel to be fully aware of and qualified to interpret Design Criteria and Design Intentions.

#### **1.5 SUBMITTALS**

- .1 Submittals in accordance with section 01 33 00 - Submittal Procedures.
- .2 Report to each construction phase: submit report to Departmental Representative.
  - .1 Report to each construction phase should include measurements, settings and certified test results.
  - .2 Bear signature of commissioning technician and supervisor
  - .3 Report format to be approved by Departmental Representative before commissioning is started.
  - .4 Revise "as-built" documentation, commissioning reports to reflect changes, adjustments and modifications to EMCS as set during commissioning and submit to Departmental Representative in accordance with section 01 78 00 - Closeout Submittals.
  - .5 Recommend additional changes and/or modifications deemed advisable in order to improve performance, environmental conditions or energy consumption.
- .3 Final Report: submit report to Departmental Representative.
  - .1 The final report should include measurements of each phase of construction, the final settings of all the new construction and the certified test results.

- .2 Bear signature of commissioning technician and supervisor
- .3 Report format to be approved by Departmental Representative before commissioning is started.
- .4 Revise "as-built" documentation, commissioning reports to reflect changes, adjustments and modifications to EMCS as set during commissioning and submit to Departmental Representative in accordance with section 01 78 00 - Closeout Submittals.
- .5 Recommend additional changes and/or modifications deemed advisable in order to improve performance, environmental conditions or energy consumption.

## **1.6 CLOSEOUT SUBMITTALS**

- .1 Provide documentation, O M Manuals, and training of O M personnel for review of Departmental Representative before interim acceptance in accordance with section 01 78 00 - Closeout Submittals.

## **1.7 COMMISSIONING**

- .1 Do commissioning in accordance with section 01 91 13 - General Commissioning (Cx) Requirements.
- .2 Carry out commissioning under direction of Departmental Representative and in presence of Departmental Representative and Commissioning Manager.
- .3 Inform, and obtain approval from, Departmental Representative in writing at least 7 days prior to commissioning or each test. Indicate:
  - .1 Location and part of system to be tested or commissioned.
  - .2 Testing/commissioning procedures, anticipated results.
  - .3 Names of testing/commissioning personnel.
- .4 Correct deficiencies, re-test in presence of Departmental Representative until satisfactory performance is obtained.
- .5 Acceptance of tests will not relieve Contractor from responsibility for ensuring that complete systems meet every requirement of Contract.
- .6 Load system with project software.
- .7 Perform tests as required.

## **1.8 COMPLETION OF COMMISSIONING**

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

## **1.9 ISSUANCE OF FINAL CERTIFICATE OF COMPLETION**

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

## **PART 2 - PRODUCTS**

### **2.1 EQUIPMENT**

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

## **PART 3 - EXECUTION**

### **3.1 PROCEDURES**

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

- .6 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 meter at source and to BECC.
  - .7 After setting, test zero and span in 10 % increments through entire range while both increasing and decreasing pressure.
  - .8 Departmental Representative 0.5 to mark instruments tracking within % in both directions as "approved for installation".
  - .9 Transmitters above 5% error will be rejected.
  - .10 DP switches to open and close within 2% of setpoint.
- .2 Completion Testing.
  - .1 General: test after installation of each part of system and after completion of mechanical and electrical hook-ups, to verify correct installation and functioning.

- .2 Include following activities:
  - .1 Test and calibrate field hardware including stand-alone capability of each controller.
  - .2 Verify each A-to-D convertor.
  - .3 Test and calibrate each AI using calibrated digital instruments.
  - .4 Test each DI to ensure proper settings and switching contacts.
  - .5 Test each DO to ensure proper operation and lag time.
  - .6 Test each AO to ensure proper operation of controlled devices. Verify tight closure and signals.
  - .7 Test operating software.
  - .8 Test application software and provide samples of logs and commands.
  - .9 Verify each CDL including energy optimization programs.
  - .10 Debug software.
  - .11 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 start-up testing.
- .3 Final Start-up Testing: Upon satisfactory completion of tests, perform point-by-point test of entire system under direction of Departmental Representative and PWGSC Commissioning Manager and provide:
  - .1 Two (2) technical personnel capable of re-calibrating field hardware and modifying software.
  - .2 Detailed daily schedule showing items to be tested and personnel available.
  - .3 Departmental Representative's acceptance signature to be on executive and applications programs.
  - .4 Commissioning to commence during final startup testing.
  - .5 O M personnel to assist in commissioning procedures as part of training.
  - .6 Commissioning to be supervised by qualified supervisory personnel and Departmental Representative.



- .7 Commission systems considered as life safety systems before affected parts of the facility are occupied.
- .8 Operate systems as long as necessary to commission entire project.
- .9 Monitor progress and keep detailed records of activities and results.
- .4 Final Operational Testing: to demonstrate that EMCS functions in accordance with contract requirements.
  - .1 Prior to beginning of test demonstrate that operating parameters (setpoints, alarm limits, operating control software, sequences of operation, trends, graphics and CDL's) have been implemented to ensure proper operation and operator notification in event of off-normal operation.
    - .1 Repetitive alarm conditions to be resolved to minimize reporting of nuisance conditions.
  - .2 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.
  - .3 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.
  - .4 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.
  - .5 Correct defects when they occur and before resuming tests.
- .3 Essais d'achèvement final de construction regroupant toutes les phases de construction
  - .1 Faire les vérifications des essais d'achèvement après l'installation totale des systèmes, afin de valider l'installation et le fonctionnement.
  - .2 Les essais d'achèvement final doivent comprendre ce qui suit :
    - .1 Essai puis étalonnage de tout le matériel local et essai de la fonction autonome de chaque contrôleur;

- .2 Vérification de chaque convertisseur analogique-numérique;
  - .3 Essai puis étalonnage de chaque EA à l'aide d'instruments numériques étalonnés;
  - .4 Essai de chaque EN pour vérifier les réglages et s'assurer du bon fonctionnement des contacts;
  - .5 Essai de chaque SN afin de s'assurer de son bon fonctionnement et de vérifier le retard;
  - .6 Essai de chaque SA pour vérifier le fonctionnement des dispositifs contrôlés; vérifier la fermeture et les signaux;
  - .7 Essai des logiciels d'exploitation;
  - .8 Essai des logiciels d'application; l'Entrepreneur doit fournir des exemples de toutes les procédures d'entrée en communication et de toutes les commandes;
  - .9 Vérification de chaque description de logique de commande, y compris celles des programmes d'optimisation de l'énergie;
  - .10 Correction des anomalies du logiciel;
  - .11 Prévoir une liste de vérification des points sous forme de tableau, et comprenant la désignation des points, l'extension de la désignation, le type de point et l'adresse, les limites hautes et basses, les éléments techniques. Prévoir, sur la liste, un espace réservé au technicien responsable de la mise en service et au Représentant Ministériel. Ce document sera utilisé pour les essais finals de phase avant démarrage.
- .3 Essais de fonctionnement final des systèmes : ces essais visent à valider que les fonctions du SGE sont exécutées conformément à toutes les exigences contractuelles.
- .1 Avant de commencer les essais des travaux, démontrer que les paramètres d'exploitation (points de consigne, limites des alarmes, fonctionnement des logiciels, séquences de marche, tendances, affichages graphiques, et logiques de commande) ont été mis en œuvre pour s'assurer que l'installation fonctionne correctement et que l'opérateur est toujours informé en cas de fonctionnement anormal.
    - .1 Toute situation d'alarmes à répétition doit être réglée afin de réduire au maximum le signalement d'alarmes injustifiées ou intempestives.
    - .2 Les essais doivent permettre de démontrer entre autres :

- .1 Le bon fonctionnement de tous les points surveillés et contrôlés;
- .2 Le fonctionnement et la capacité des séquences, des rapports, des algorithmes spéciaux de contrôle, des diagnostics et des logiciels.
- .3 Les systèmes sont acceptés:
  - .1 Si le fonctionnement du matériel constitutif du système SGE satisfait à l'ensemble des critères de performance; le temps de panne défini à la présente section ne doit pas dépasser la durée admissible calculée pour ce site;
  - .2 Si les conditions du contrat ont été satisfaites.
- .4 En cas de défaut d'atteindre le NMF prescrit durant la période d'essais, prolonger cette dernière au jour le jour jusqu'à ce que le NMF soit obtenu.
- .5 Corriger toutes les anomalies au fur et à mesure qu'elles se produisent et avant de reprendre les essais.
- .4 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 01 79 00 - Demonstration and Training.

**END OF SECTION**



## **PART 1 - GENERAL**

### **1.1 RELATED REQUIREMENTS**

- .1 Section 21 05 01 - Common Work Results - Mechanical.
- .2 Section 23 05 00 - Common Work Results for HVAC.
- .3 Section 25 05 01 - EMCS: General Requirements.

### **1.2 DEFINITIONS**

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

### **1.3 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 10 days prior to anticipated date of beginning of training.
  - .1 List name of trainer, and type of visual and audio aids to be used.
  - .2 Show co-ordinated interface with other EMCS mechanical and electrical training programs.
- .3 Submit reports within one week after completion of training program that training has been satisfactorily completed.

### **1.4 QUALITY ASSURANCE**

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

### **1.5 INSTRUCTIONS**

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

## **1.6 TIME FOR INSTRUCTION**

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

## **1.7 TRAINING MATERIALS**

- .1 Provide equipment, visual and audio aids, and materials for classroom training.
- .2 Supply manual for each trainee, describing in detail data included in each training program.
  - .1 Review contents of manual in detail to explain aspects of operation and maintenance (O&M).
- .3 All training documents must be delivered in seven (7) copies.

## **1.8 TRAINING PROGRAM**

- .1 Training courses must be in French and must be given during normal working hours. Documents such as maintenance manuals, as-built drawings, user manuals and other relevant documents must be given at the beginning of the courses.
- .2 To be in 2 phases over 6 month period.
- .3 Phase 1: 1 day program to begin before 10 day test period at time mutually agreeable to Contractor, Departmental Representative, Engineer and PWGSC Commissioning Manager.
  - .1 Train O&M personnel in functional operations and procedures to be employed for system operation.
  - .2 Supplement with on-the-job training during 10 day test period.
  - .3 Include:
    - .1 Overview of system architecture;
    - .2 Communication network;
    - .3 Notions about local processing unit operation;
    - .4 System data reading;
    - .5 Software commands and equipments operation;
    - .6 Operator control and control interventions;
    - .7 Calibration of data acquisition devices;
    - .8 Preventive maintenance.
- .4 Include detailed training on operator interface functions for control of mechanical systems, CDL's for each system, and elementary preventive maintenance.

- .4 Phase 2: 1 day program to begin 8 weeks after acceptance for operators, equipment maintenance personnel and programmers.
  - .1 Provide multiple instructors on pre-arranged schedule. Include at least following:
    - .1 Operator training: provide operating personnel, maintenance personnel and programmers with condensed version of Phase 1 training.
    - .2 Equipment maintenance training: provide personnel with 1/2 days training within 1 day period in maintenance of EMCS equipment, including general equipment layout, trouble shooting and preventive maintenance of EMCS components, maintenance and calibration of sensors and controls.
    - .3 Programmers: provide personnel with 1/2 days training within 1 day period in following subjects:
      - .1 Programming of the controllers;
      - .2 Programming of the central station;
      - .3 Graphics creation;
      - .4 Report generation;
      - .5 Historic creation and management.

## **1.9 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 RELATED REQUIREMENTS**

- .1 Section 09 91 23 - Interior Painting.
- .2 Section 21 05 01 - Common Work Results - Mechanical.
- .3 Section 23 05 00 - Common Work Results for HVAC.
- .4 Section 25 05 02 - EMCS: Shop Drawings, Product Data and Review Process.
- .5 Section 25 05 54 - EMCS: Identification.
- .6 Section 25 90 01 - EMCS: Site Requirements Applications and Systems Sequences of Operation.

### **1.2 REFERENCES**

- .1 American National Standards Institute (ANSI)/The Instrumentation, Systems and Automation Society (ISA).
  - .1 ANSI/ISA 5.5-1985, Graphic Symbols for Process Displays.
- .2 American National Standards Institute (ANSI)/ Institute of Electrical and Electronics Engineers (IEEE).
  - .1 ANSI/IEEE 260.1-1993, American National Standard Letter Symbols Units of Measurement (SI Units, Customary Inch-Pound Units, and Certain Other Units).
- .3 American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE).
  - .1 ASHRAE STD 135-R2001, BACNET - Data Communication Protocol for Building Automation and Control Network.
- .4 Canadian Standards Association (CSA International).
  - .1 CAN/CSA-Z234.1-89(R1995), Canadian Metric Practice Guide.
- .5 Consumer Electronics Association (CEA).
  - .1 CEA-709.1-B-2002, Control Network Protocol Specification.
- .6 Department of Justice Canada (Jus).
  - .1 Canadian Environmental Assessment Act (CEAA), 1995, c. 37.
  - .2 Canadian Environmental Protection Act (CEPA), 1999, c. 33.

- .7 Electrical and Electronic Manufacturers Association (EEMAC).
  - .1 EEMAC 2Y-1-1958, Light Gray Colour for Indoor Switch Gear.
- .8 Health Canada/Workplace Hazardous Materials Information System (WHMIS).
  - .1 Material Safety Data Sheets (MSDS).
- .9 Transport Canada (TC).
  - .1 Transportation of Dangerous Goods Act (TDGA), 1992, c. 34.

### **1.3 ACRONYMS AND ABBREVIATIONS**

- .1 Acronyms used in EMCS:
  - .1 AEL - Average Effectiveness Level.
  - .2 AI - Analog Input.
  - .3 AIT - Agreement on International Trade.
  - .4 AO - Analog Output.
  - .5 BACnet - Building Automation and Control Network.
  - .6 BC(s) - Building Controller(s).
  - .7 BECC - Building Environmental Control Center.
  - .8 CAD - Computer Aided Design.
  - .9 CDL - Control Description Logic.
  - .10 CDS - Control Design Schematic.
  - .11 COSV - Change of State or Value.
  - .12 CPU - Central Processing Unit.
  - .13 DI - Digital Input.
  - .14 DO - Digital Output.
  - .15 DP - Differential Pressure.
  - .16 ECU - Equipment Control Unit.

- .17 EMCS - Energy Monitoring and Control System.
- .18 HVAC - Heating, Ventilation, Air Conditioning.
- .19 IDE - Interface Device Equipment.
- .20 I/O - Input/Output.
- .21 ISA - Industry Standard Architecture.
- .22 LAN - Local Area Network.
- .23 LCU - Local Control Unit.
- .24 MCU - Master Control Unit.
- .25 NAFTA - North American Free Trade Agreement.
- .26 NC - Normally Closed.
- .27 NO - Normally Open.
- .28 OS - Operating System.
- .29 O&M - Operation and Maintenance.
- .30 OWS - Operator Work Station.
- .31 PC - Personal Computer.
- .32 PCI - Peripheral Control Interface.
- .33 PCMCIA - Personal Computer Micro-Card Interface Adapter.
- .34 PID - Proportional, Integral and Derivative.
- .35 RAM - Random Access Memory.
- .36 SP - Static Pressure.
- .37 ROM - Read Only Memory.
- .38 TCU - Terminal Control Unit.
- .39 USB - Universal Serial Bus.
- .40 UPS - Uninterruptible Power Supply.
- .41 VAV - Variable Air Volume.

## 1.4 DEFINITIONS

- .1 Point: may be logical or physical.
  - .1 Logical points: values calculated by system such as setpoints, totals, counts, derived corrections and may include, but not limited to result of and statements in CDL's.
  - .2 Physical points: inputs or outputs which have hardware wired to controllers which are measuring physical properties, or providing status conditions of contacts or relays which provide interaction with related equipment (stop, start) and valve or damper actuators.
- .2 Point Name: composed of two parts, point identifier and point expansion.
  - .1 Point identifier: comprised of three descriptors, "area" descriptor, "system" descriptor and "point" descriptor, for which database to provide 25 character field for each point identifier. "System" is system that point is located on.
    - .1 Area descriptor: building or part of building where point is located.
    - .2 System descriptor: system that point is located on.
    - .3 Point descriptor: physical or logical point description. For point identifier "area", "system" and "point" will be shortforms or acronyms. Database must provide 25 character field for each point identifier.
  - .2 Point expansion: comprised of three fields, one for each descriptor. Expanded form of 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 GENERAL CONDITIONS**

- .1 All general conditions of the architecture, mechanical and electrical specifications are an integral part of this section.
- .2 The work of this section shall be a separate portion under the responsibility of the Contractor.
- .3 The Contractor in regulation must have an experience of at least 10 years in automatic regulation and a relevant experience in the installation of digital controls.
- .4 Only digital control products that meet ASHRAE 135-95 (NATIVE - BACNET) will be accepted. In the event of a future integration, it is imperative that the control sequence programming is performed with BACNET type points. Upon delivery of As-Built drawings, the Contractor in regulation must submit the complete detailed list of each input and output points for each equipment and control modules by specifying their BACNET number. All BACNET identification names of the modules and the points will be awarded with the As-Built drawings.
- .5 The Contractor shall include with its tender, all BACnet (PICS) certificates of each software and controller to be found to comply.
- .6 Gateways are not acceptable. Products must be "Native BACnet".
- .7 The following type BACnet objects must be read, created and canceled:
  - .1 Analog input, analog output, analog value, binary input, binary output, binary value, agenda, schedule, PID loop, controller, history log and alarms and trends readings.
- .8 The Contractor shall include in its tender envelope its certificate of registration to ISO 9001.
- .9 Only authorized to tender the contractor VCI:
  - .1 Authorized distributors or manufacturers of original equipment offering the full range of equipment as existing required for the work;
  - .2 Whose basic activity is the supply, installation and commissioning of digital control systems;
  - .3 Having qualified service personnel able to answer a call 24 hours on 24, 365 days a year.

## **1.6 REQUIRED UNIQUE QUALITY**

- .1 All command, control and regulation devices must comply with indications and specifications below.
- .2 Unless otherwise specified in these specifications or drawings, equipment must come from a single manufacturer, which must also install, calibrate and be able to assure the service.
- .3 Once installed, the system of command, control and regulation must be of integrated security.
- .4 The required quality of the equipment and the systems is determined in this section by the specifications of the products "DELTA CONTRÔL" distributed and installed by "RÉGULVAR".

## **1.7 SCOPE OF WORKS**

- .1 The work included with this section consists of, but is not limited to, the design, the drawing, the provision of labour, the required equipment, the installation, the electrical connections, the adjustments, and the start-up and commissioning of all supplied systems. The graphics development for new equipments, graphics update for existing system and sequence of operations programming are also to be included for the proper operation of systems and accessories described in specifications and/or the plans.
- .2 The control Contractor must provide all necessary appliances and accessories to carry out the operation and the sequences described on the specifications and plans. The control Contractor must be present during the balancing testing of the systems. The control Contractor must connect his system to existing BAS located in the existing commercial building. The contractor must coordinate with the Departmental Representative, the General contractor and the contractors the schedule of dismantling, in order to maintain the operation satisfactory within the building during the construction and the transfer periods.
- .3 The Contractor, of this section is responsible for the correct way of installation and must provide assistance and guidance to the way and place these accessories are to be installed in order to achieve correct control strategies.
- .4 Connect the 120 V electrical supplies on emergency power for the controls from electrical panels or junction boxes provided for this purpose by the electrical Contractor.
- .5 Supply and install any required power supply equipment including, but not limited to, 120V/24 V transformers, relays, terminal boards. Provide the control connections 120 V or less for all regulation equipment in this project.
- .6 Perform tests and simulation of functioning of systems operation sequences before the demonstration to the Departmental Representative and each phase of the work completed so to move and occupy the space during other phases of work.

- .7 Provide test and calibration equipment necessary for all control equipment and accessories to Departmental Representative.
- .8 Provide the following documents:
  - .1 Workshop drawings for all control equipment and accessories at each phase;
  - .2 Workshop drawing for points lists, system schematics, sequences, and network risers;
  - .3 Warranties and certificates;
  - .4 Instruction manuals (booklets);
  - .5 Electronic As-Built (Visio, Excel, Word, PDF, DMP etc.).
- .9 Provide training of technical staff.
- .10 Provide two (2) copies of the panel keys and thermostat setting keys and any other necessary tools for the control equipment operation/maintenance included in this section.
- .11 All opening and cutting required by this section must be done by the Contractor.
- .12 All equipment used will be standard, properly manufactured for a specific system, and will not be designed and fabricated specially for this project. All equipment used must be carefully verified and approved by the Departmental Representative before the installation phase.
- .13 Provide and install the network system including all data processing equipment, softwares, probes, regulation equipments, wiring, electrical connections, transmission cables and all appropriated equipment. The Control Contractor will also be responsible for the verification, setting and adjustment of the system.
- .14 Ensure that current detectors are adjusted to detect a broken or slipped belt on a motor pulley.
- .15 The automatic control system will be DDC, including:
  - .1 General application controller (CAG) BACNET, 32 bits;
  - .2 Specific application controller (CAS), 16 bits;
  - .3 Terminal application controller (CAT);
  - .4 Operator interface BACNET;
  - .5 Regulation components;
  - .6 Data transmission network and software;

- .7 System must integrate to existing centralized system.
- .16 The Contractor shall control into its software, in the format "Bitmap" and for consultation purposes, all electromechanical engineer plans for this project and no additional charge. Departmental Representative will provide a disk autoCAD plans for inclusion in the control software.
- .17 The latest version of the programmable software or central software will be installed at the end of the project. All revisions during the annual coverage will be supplied and installed without cost.
- .18 Point names and equipment identification will follow the existing procedure in place. All new identifications must be approved by Departmental Representative.

## **1.8 SYSTEM DESCRIPTION**

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



- .5 Software has to include:
  - .1 Input and output commands and messages from operator-initiated functions and field related changes and alarms as defined in CDL's or assigned limits (i.e. commands relating to day-to-day operating functions and not related to system modifications, additions, or logic re-definitions).
  - .2 Graphic "display" functions, point commands to turn systems on or off, manually override automatic control of specified hardware points. To be in French and English at specified OWS and to be able to operate one terminal in English and second in French. Point name expansions in both languages.
  - .3 Reporting function such as trend log, trend graphics, alarm report logs, energy report logs, maintenance generated logs.

## **1.9 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Make submittals in accordance with section 01 33 00 - Submittal Procedures and 25 05 02 - EMCS: Shop Drawings, Product Data and Review Process.
- .2 Submit for review:
  - .1 Equipment list and systems manufacturers within 15 days after award of contract.
  - .2 List existing field control devices to be re-used included in bid.
- .3 Quality Control:
  - .1 Provide equipment and material from manufacturer's regular production, CSA certified, manufactured to standard quoted plus additional specified requirements.
  - .2 Where CSA certified equipment is not available submit such equipment to inspection authorities for special inspection and approval before delivery to site.
  - .3 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.
  - .4 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.
  - .5 For materials whose compliance with organizational standards/codes/specifications is not regulated by organization using its own listing or label as proof of compliance, furnish certificate stating that material complies with applicable referenced standard or specification.

- .6 Permits and fees: in accordance with general conditions of contract.
- .7 Submit certificate of acceptance from authority having jurisdiction to Departmental Representative.
- .8 Existing devices intended for re-use: submit test report.

### **1.10 HEALTH AND SAFETY**

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

### **1.9 WASTE MANAGEMENT DISPOSAL**

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

## **PART 2 - PRODUCTS**

### **2.1 EQUIPMENT**

- .1 Control Network Protocol and Data Communication Protocol: to 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 QUALITY ASSURANCE**

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

### **3.2 MANUFACTURER'S RECOMMENDATIONS**

- .1 Installation: to manufacturer's recommendations.

### **3.3 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.

### **3.4 INSTALLATION**

- .1 The Supplier of the EMCS system will install the control and monitoring equipment, but not as subcontracted work. Electricians trained and experienced in this type of work are required to execute the work. These electricians must be regularly employed by the Supplier.
- .2 The operating installation condition will include the electrical diagrams, on field and on plant wiring, labour, monitoring, setting and verification.
- .3 The systems and systems controls must be installed by qualified personnel with a permit issued by the Provincial authority.
- .4 All wiring must follow the buildings lines in an orderly fashion.
- .5 Locate the thermostats, ambient temperature sensors and moisture sensors at 1,600 mm of the floor, as per indications. Request the exact position to the Departmental Representative.
- .6 Submit for approval the supports and register actuators location.
- .7 The building operation and regulation system must be designed, installed and commissioned in order to be immediately usable and functional.

**END OF SECTION**



## **PART 1 - GENERAL**

### **1.1 RELATED REQUIREMENTS**

- .1 Section 21 05 01 - Common Work Results - Mechanical.
- .2 Section 23 05 00 - Common Work Results for HVAC.
- .3 Section 25 05 01 - EMCS: General Requirements.
- .4 Section 25 01 11 - EMCS: Start-up, Verification and Commissioning.

### **1.2 DEFINITIONS**

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

### **1.3 DESIGN REQUIREMENTS**

- .1 Preliminary Design Review: to contain following contractor and systems information.
  - .1 Location of local office.
  - .2 Description and location of installing and servicing technical staff.
  - .3 Location and qualifications of programming design and programming support staff.
  - .4 List of spare parts.
  - .5 Location of spare parts stock.
  - .6 Names of sub-contractors and site-specific key personnel.
  - .7 Sketch of site-specific system architecture.
  - .8 Specification sheets for each item including memory provided, programming language, speed, type of data transmission.
  - .9 Descriptive brochures.
  - .10 Sample CDL and graphics (systems schematics).
  - .11 Response time for each type of command and report.
  - .12 Item-by-item statement of compliance.
  - .13 Proof of demonstrated ability of system to communicate utilizing [Proprietary Communications Protocol BACnet.

## **1.4 SUBMITTALS**

- .1 Submittals in accordance with section 01 33 00 - Submittal Procedures and coordinate with requirements in this section.
- .2 Submit preliminary design document within 5 working days after tender closing and before contract award, for review by Departmental Representative.
- .3 Shop Drawings to consist of (3) hard copies and (1) soft copy of design documents, shop drawings, product data and software.
- .4 Hard copy to be completely indexed and coordinated package to assure compliance with contract requirements and arranged in same sequence as specification and cross-referenced to specification section and paragraph number.
- .5 Soft copy to be in Autocad - latest version and Microsoft Word latest version format, structured using menu format for easy loading and retrieval on OWS.

## **1.5 PRELIMINARY SHOP DRAWING REVIEW**

- .1 Submit preliminary shop drawings within 10 working days of award of contract and include following:
  - .1 Specification sheets for each item. To include manufacturer's descriptive literature, manufacturer's installation recommendations, specifications, drawings, diagrams, performance and characteristic curves, catalogue cuts, manufacturer's name, trade name, catalogue or model number, nameplate data, size, layout, dimensions, capacity, other data to establish compliance.
  - .2 Detailed system architecture showing all points associated with each controller including, signal levels, pressures where new EMCS ties into existing control equipment.
  - .3 Spare point capacity of each controller by number and type.
  - .4 Controller locations.
  - .5 Auxiliary control cabinet locations.
  - .6 Single line diagrams showing cable routings, conduit sizes, spare conduit capacity between control centre, field controllers and systems being controlled.
  - .7 Valves: complete schedule listing including following information: designation, service, manufacturer, model, point ID, design flow rate, design pressure drop, required Cv, Valve size, actual Cv, spring range, pilot range, required torque, actual torque and close off pressure (required and actual).

- .8 Dampers: sketches showing module assembly, interconnecting hardware, operator locations, operator spring range, pilot range, required torque, actual torque.
- .9 Flow measuring stations: complete schedule listing designation, service, point ID, manufacturer, model, size, velocity at design flow rate, manufacturer, model and range of velocity transmitter.

## **1.6 DETAIL SHOP DRAWING REVIEW**

- .1 Submit detailed shop drawings within 15 working days after award of contract and before start of installation and include following:
  - .1 Corrected and updated versions (hard copy only) of submissions made during preliminary review.
  - .2 Wiring diagrams.
  - .3 Piping diagrams and hook-ups.
  - .4 Interface wiring diagrams showing termination connections and signal levels [for equipment to be supplied by others.
  - .5 Shop drawings for each input/output point, sensors, transmitters, showing information associated with each particular point including:
    - .1 Sensing element type and location.
    - .2 Transmitter type and range.
    - .3 Associated field wiring schematics, schedules and terminations.
    - .4 Complete Point Name Lists.
    - .5 Setpoints, curves or graphs and alarm limits (high and low, 3 types critical, cautionary and maintenance), signal range.
    - .6 Software and programming details associated with each point.
    - .7 Manufacturer's recommended installation instructions and procedures.
    - .8 Input and output signal levels or pressures where new system ties into existing control equipment.
- .6 Control schematics, narrative description, CDL's fully showing and describing automatic and manual procedure required to achieve proper operation of project, including under complete failure of EMCS.

- .7 Graphic system schematic displays of air and water systems with point identifiers and textual description of system, and typical floor plans as specified.
- .8 Complete system CDL's including companion English language explanations on same sheet but with different font and italics. CDL's to contain specified energy optimization programs.
- .9 Listing and example of specified reports.
- .10 Listing of time of day schedules.
- .11 Mark up to-scale construction drawing to detail control room showing location of equipment and operator work space.
- .12 Type and size of memory with statement of spare memory capacity.
- .13 Full description of software programs provided.
- .14 Sample of "Operating Instructions Manual" to be used for training purposes.
- .15 Outline of proposed start-up and verification procedures. Refer to section 25 01 11 - EMCS: Start-up, Verification and Commissioning.

## **1.7 QUALITY ASSURANCE**

- .1 Preliminary Design Review Meeting: Convene meeting within 20 working days of award of contract to:
  - .1 Undertake functional review of preliminary design documents, resolve inconsistencies.
  - .2 Resolve conflicts between contract document requirements and actual items (e.g.: points list inconsistencies).
  - .3 Review interface requirements of materials supplied by others.
  - .4 Review "Sequence of Operations".
- .2 Contractor's programmer to attend meeting.
- .3 Departmental Representative retains right to revise sequence or subsequent CDL prior to software finalization without cost to Departmental Representative.



## **PART 2 - PRODUCTS**

### **2.1 NOT USED**

.1 Not Used.

## **PART 3 - EXECUTION**

### **3.1 NOT USED**

.1 Not Used.

**END OF SECTION**



## **PART 1 - GENERAL**

### **1.1 RELATED REQUIREMENTS**

- .1 Section 25 05 01 - EMCS: General Requirements.
- .2 Section 25 05 02 - EMCS: Submittals and Review Process.
- .3 Section 25 01 11 - EMCS: Start-up, Verification and Commissioning.

### **1.2 DEFINITIONS**

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

### **1.3 SUBMITTALS**

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

### **1.4 AS-BUILTS**

- .1 Provide 1 copy of detailed shop drawings generated in Section 25 05 02 - EMCS: Submittals and Review Process; and include:

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

## **1.5 O&M MANUALS**

- .1 Custom design O&M Manuals (both hard and soft copy) to contain material pertinent to this project only and to provide full and complete coverage of subjects referred to in this Section.
- .2 Provide 3 complete sets of hard and soft copies prior to system or equipment tests
- .3 Include complete coverage in concise language, readily understood by operating personnel using common terminology of functional and operational requirements of system. Do not presume knowledge of computers, electronics or in-depth control theory.
- .4 Functional description to include:
  - .1 Functional description of theory of operation.
  - .2 Design philosophy.
  - .3 Specific functions of design philosophy and system.

- .4 Full details of data communications, including data types and formats, data processing and disposition data link components, interfaces and operator tests or self-test of data link integrity.
- .5 Explicit description of hardware and software functions, interfaces and requirements for components in functions and operating modes.
- .6 Description of person-machine interactions required to supplement system description, known or established constraints on system operation, operating procedures currently implemented or planned for implementation in automatic mode.
- .5 System operation to include:
  - .1 Complete step-by-step procedures for operation of system including required actions at each OWS.
  - .2 Operation of computer peripherals, input and output formats.
  - .3 Emergency, alarm and failure recovery.
  - .4 Step-by-step instructions for start-up, back-up equipment operation, execution of systems functions and operating modes, including key strokes for each command so that operator need only refer to these pages for keystroke entries required to call up display or to input command.
- .6 Software to include:
  - .1 Documentation of theory, design, interface requirements, functions, including test and verification procedures.
  - .2 Detailed descriptions of program requirements and capabilities.
  - .3 Data necessary to permit modification, relocation, reprogramming and to permit new and existing software modules to respond to changing system functional requirements without disrupting normal operation.
  - .4 Software modules, fully annotated source code listings, error free object code files ready for loading via peripheral device
  - .5 Complete program cross reference plus linking requirements, data exchange requirements, necessary subroutine lists, data file requirements, other information necessary for proper loading, integration, interfacing, program execution.
  - .6 Software for each Controller and single section referencing Controller common parameters and functions.
- .7 Maintenance: document maintenance procedures including inspection, periodic preventive maintenance, fault diagnosis, repair or replacement of defective components, including

calibration, maintenance, repair of sensors, transmitters, transducers, controller and interface firmware's, plus diagnostics and repair/replacement of system hardware.

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

## **PART 2 - PRODUCTS**

### **2.1 NOT USED**

- .1 Not Used.

## **PART 3 - EXECUTION**

### **3.1 NOT USED**

- .1 Not Used.

**END OF SECTION**

## **PART 1 - GENERAL**

### **1.1 RELATED REQUIREMENTS**

- .1 Section 21 05 01 - Common Work Results - Mechanical.
- .2 Section 23 05 00 - Common Work Results for HVAC.
- .3 Section 25 05 01 - EMCS: General Requirements.

### **1.2 REFERENCES**

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

### **1.3 DEFINITIONS**

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

### **1.4 SYSTEM DESCRIPTION**

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

### **1.5 SUBMITTALS**

- .1 Submittals in accordance with section 01 33 00 - Submittal Procedures; supplemented and modified by requirements of this section.
- .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.
- .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 Identify by stick-on labels using point identifier.
- .2 Location: as directed by Departmental Representative.
- .3 Letter size: to suit, clearly legible.

## **2.4 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.

## **2.5 WIRING**

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



## **2.6 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 RELATED REQUIREMENTS**

- .1 Section 21 05 01 - Common Work Results - Mechanical.
- .2 Section 23 05 00 - Common Work Results for HVAC.
- .3 Section 25 05 01 - EMCS: General Requirements.

### **1.2 REFERENCES**

- .1 Canada Labour Code (R.S. 1985, c. L-2)/Part I - Industrial Relations.
- .2 Canadian Standards Association (CSA International).
  - .1 CSA Z204-94(R1999), Guidelines for Managing Indoor Air Quality in Office Buildings.

### **1.3 DEFINITIONS**

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

### **1.4 SUBMITTALS**

- .1 Submittals in accordance with section 01 33 00 - Submittal Procedures.
- .2 Submit detailed preventative maintenance schedule for system components to Departmental Representative.
- .3 Submit detailed inspection reports to Departmental Representative.
- .4 Submit dated, maintenance task lists to Departmental Representative and include the following sensor and output point detail, as proof of system verification:
  - .1 Point name and location.
  - .2 Device type and range.

- .3 Measured value.
- .4 System displayed value.
- .5 Calibration detail
- .6 Indication if adjustment required,
- .7 Other action taken or recommended.
- .5 Submit network analysis report showing results with detailed recommendations to correct problems found.
- .6 Records and logs: in accordance with section 01 78 00 - Closeout Submittals.
  - .1 Maintain records and logs of each maintenance task on site.
  - .2 Organize cumulative records for each major component and for entire EMCS chronologically.
  - .3 Submit records to Departmental Representative, after inspection indicating that planned and systematic maintenance have been accomplished.
- .7 Revise and submit to Departmental Representative in accordance with section 01 78 00 - Closeout Submittals; "As-built drawings" documentation and commissioning reports to reflect changes, adjustments and modifications to EMCS made during warranty period.

## **1.5 WARRANTY**

- .1 All software components, parts and units provided by the manufacturer must be warranty (parts and labour warranty) against material and manufacture faulty for one year.
- .2 Provide services, materials, and equipment to maintain EMCS for specified warranty period. Provide detailed preventative maintenance schedule for system components as described in Submittal article.
- .3 Emergency Service Calls:
  - .1 Initiate service calls when EMCS is not functioning correctly.
  - .2 Qualified control personnel to be available during warranty period to provide service to "CRITICAL" components whenever required at no extra cost.
  - .3 Furnish Departmental Representative with telephone number where service personnel may be reached at any time.

- .4 Service personnel to be on site ready to service EMCS within 2 hours after receiving request for service.
- .5 Perform Work continuously until EMCS restored to reliable operating condition.
- .4 Operation: foregoing and other servicing to provide proper sequencing of equipment and satisfactory operation of EMCS based on original design conditions and as recommended by manufacturer.
- .5 Work requests: record each service call request, when received separately on approved form and include:
  - .1 Serial number identifying component involved.
  - .2 Location, date and time call received.
  - .3 Nature of trouble.
  - .4 Names of personnel assigned.
  - .5 Instructions of work to be done.
  - .6 Amount and nature of materials used.
  - .7 Time and date work started.
  - .8 Time and date of completion.
- .6 Provide system modifications in writing.
  - .1 No system modification, including operating parameters and control settings, to be made without prior written approval of Departmental Representative.

## **1.6 MAINTENANCE**

- .1 The Contractor shall be able to offer testing, inspection, reparation and maintenance services during the lifetime au the system, 24 hours on 24.
- .2 The average time for repair work, from the time the service representative of the Contractor is on site with required material must not exceed 2 hours.
- .3 The service technician must be on site 3 hours after the call of the Departmental Representative.

## **1.7 SERVICE CONTRACTS**

- .1 Provide in-depth technical expertise and assistance to Departmental Representative and Commissioning Manager in preparation and implementation of service contracts and in-house preventive maintenance procedures.
- .2 Service Contracts to include:
  - .1 Annual verification of field points for operation and calibration.
  - .2 6 responses to emergency calls during day, per year.
  - .3 2 responses to emergency calls during silent hours per year.
  - .4 Complete inventory of installed system.

## **PART 2 - PRODUCTS**

### **2.1 NOT USED**

- .1 Not Used.

## **PART 3 - EXECUTION**

### **3.1 FIELD QUALITY CONTROL**

- .1 Perform as minimum (3) three minor inspections and one major inspection (more often if required by manufacturer) per year. Provide detailed written report to Departmental Representative as described in Submittal article.
- .2 Perform inspections during regular working hours, 08:00 to 4:30 pm, Monday through Friday, excluding statutory holidays.
- .3 Following inspections are minimum requirements and should not be interpreted to mean satisfactory performance:
  - .1 Perform calibrations using test equipment having traceable, certifiable accuracy at minimum 50% greater than accuracy of system displaying or logging value.
  - .2 Check and calibrate each field input/output device in accordance with Canada Labour Code - Part I and CSA Z204.
  - .3 Provide dated, maintenance task lists, as described in Submittal article, as proof of execution of complete system verification.

- .4 Minor inspections to include, but not limited to:
  - .1 Perform visual, operational checks to BC's, peripheral equipment, interface equipment and other panels.
  - .2 Check equipment cooling fans as required.
  - .3 Review system performance with Departmental Representative to discuss suggested or required changes.
- .5 Major inspections to include, but not limited to:
  - .1 Clean OWS(s) peripheral equipment, BC(s), interface and other panels, micro-processor interior and exterior surfaces.
  - .2 Check signal, voltage and system isolation of BC(s), peripherals, interface and other panels.
  - .3 Verify calibration/accuracy of each input and output device and recalibrate or replace as required.
  - .4 Provide mechanical adjustments, and necessary maintenance on printers.
  - .5 Run system software diagnostics as required.
  - .6 Install software and firmware enhancements to ensure components are operating at most current revision for maximum capability and reliability.
    - .1 Perform network analysis and provide report as described in section 01 33 00 - Submittal Procedures.
- .6 Rectify deficiencies revealed by maintenance inspections and environmental checks.
- .7 Continue system debugging and optimization.
- .8 Testing/verification of occupancy and seasonal-sensitive systems to take place during four (4) consecutive seasons, after facility has been accepted, taken over and fully occupied.
  - .1 Test weather-sensitive systems twice: first at near winter design conditions and secondly under near summer design conditions.

**END OF SECTION**





## **PART 1 - GENERAL**

### **1.1 RELATED REQUIREMENTS**

- .1 Section 21 05 01 - Common Work Results - Mechanical.
- .2 Section 23 05 00 - Common Work Results for HVAC.
- .3 Section 25 05 01 - EMCS: General Requirements.

### **1.2 REFERENCES**

- .1 Canadian Standards Association (CSA International).
  - .1 CSA T529-95(R2000), Telecommunications Cabling Systems in Commercial Buildings (Adopted ANSI/TIA/EIA-568-A with modifications).
  - .2 CSA T530-99(R2004), Commercial Building Standard for Telecommunications Pathways and Spaces (Adopted ANSI/TIA/EIA-569-A with modifications).
- .2 Institute of Electrical and Electronics Engineers (IEEE)/Standard for Information technology - Telecommunications and information exchange between systems - Local and metropolitan area networks - Specific requirements.
  - .1 IEEE Std 802.3TM-2002, Part 3: Carrier sense multiple access with collision detection (CSMA/CD) access method and physical layer specifications.
- .3 Telecommunications Industries Association (TIA)/Electronic Industries Alliance (EIA)
  - .1 TIA/EIA-568-March 2004, Commercial Building Telecommunications Cabling Standards Set, Part 1 General Requirements Part 2 Balanced Twisted-Pair Cabling Components Part 3 Optical Fiber Cabling Components Standard.
  - .2 TIA/EIA-569-A-December 2001, Commercial Building Standard for Telecommunications Pathways and Spaces.
- .4 Treasury Board Information Technology Standard (TBITS).
  - .1 TBITS 6.9-2000, Profile for the Telecommunications Wiring System in Government Owned and Leased Buildings - Technical Specifications.

### **1.3 DEFINITIONS**

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

## **1.4 SYSTEM DESCRIPTION**

- .1 Data communication network to link Operator Workstations and Master Control Units (MCU) in accordance with CSA T529 TIA/EIA-568 and CSA T530 TIA/EIA-569-A and TBITS 6.9.
  - .1 Provide reliable and secure connectivity of adequate performance between different sections (segments) of network.
  - .2 Allow for future expansion of network, with selection of networking technology and communication protocols.
- .2 Data communication network to include, but not limited to:
  - .1 LAN-SGE,
  - .2 Modems,
  - .3 Network interface cards,
  - .4 Network management hardware and software,
  - .5 Network components necessary for complete network.

## **1.5 DESIGN REQUIREMENTS**

- .1 Local Area Network (LAN-SGE).
  - .1 High speed, high performance, local area network over which UCP and OWSs communicate with each other directly on peer to peer basis in accordance with IEEE 802.3/Ethernet Standard.
  - .2 EMCS-LAN to: BACnet.
  - .3 Each EMCS-LAN to be capable of supporting at least 50 devices.
  - .4 Support of combination of UCP and OWSs directly connected to EMCS-LAN.
  - .5 High speed data transfer rates for alarm reporting, quick report generation from multiple controllers, upload/download information between network devices. Bit rate to be 10 Megabits per second minimum.
  - .6 Detection and accommodation of single or multiple failures of either OWSs, UCP or network media. Operational equipment to continue to perform designated functions effectively in event of single or multiple failures.

- .7 Commonly available, multiple sourced, networking components and protocols to allow system to co-exist with other networking applications including office automation.
- .2 Dynamic Data Access:
  - .1 LAN to provide capabilities for OWSs, either network resident or connected remotely, to access point status and application report data or execute control functions for other devices.
  - .2 Access to data to be based upon logical identification of building equipment.
- .3 Network Medium:
  - .1 Network medium: shielded twisted cable compatible with network protocol to be used within buildings.

## **PART 2 - PRODUCTS**

### **2.1 NOT USED**

- .1 Not Used.

## **PART 3 - EXECUTION**

### **3.1 NOT USED**

- .1 Not Used.

**END OF SECTION**



## **PART 1 - GENERAL**

### **1.1 RELATED REQUIREMENTS**

- .1 Section 21 05 01 - Common Work Results - Mechanical.
- .2 Section 23 05 00 - Common Work Results for HVAC.
- .3 Section 25 05 01 - EMCS: General Requirements.
- .4 Section 25 05 02 - EMCS: Shop Drawings, Product Data and Review Process.
- .5 Section 25 05 03 - EMCS: Project Record Documents.
- .6 Section 25 30 02 - EMCS: Field Control Devices.
- .7 Section 25 90 01 - EMCS: Site Requirements Applications and Systems Sequences of Operation.

### **1.2 REFERENCES**

- .1 American Society of Heating, Refrigeration and Air-Conditioning Engineers, Inc. (ASHRAE).
  - .1 ASHRAE 2003, Applications Handbook, SI Edition.
- .2 Canadian Standards Association (CSA International).
  - .1 C22.2 No.205-M1983(R1999), Signal Equipment.
- .3 Institute of Electrical and Electronics Engineers (IEEE).
  - .1 IEEE C37.90.1-02, Surge Withstand Capabilities (SWC) Tests for Relays and Relay Systems Associated with Electric Power Apparatus.
- .4 Public Works and Government Services Canada (PWGSC)/Real Property Branch/Architectural and Engineering Services.
  - .1 MD250005 2009, Energy Monitoring and control Systems (EMCS) Design Guidelines.

### **1.3 SUBMITTALS**

- .1 Make submittals in accordance with section 01 33 00 - Submittal Procedures and Section 25 05 02 - EMCS: Shop Drawings, Product Data and Review Process.
  - .1 Submit product data sheets for each product item proposed for this project.

## **1.4 MAINTENANCE PROCEDURES**

- .1 Provide manufacturers recommended maintenance procedures for insertion in section 25 05 03 - EMCS: Project Record Documents.

## **PART 2 - PRODUCTS**

### **2.1 GENERAL DESCRIPTION**

- .1 Minimum requirements of the system:
  - .1 The computerized control system must meet the specifications of the specification in order to ensure compatibility with future hardware and software. If a computerized control system manages the unique aspects of this specification in a different way, the Contractor shall notify the control engineer in the 7 days preceding the date of tender.
  - .2 However, the following will be considered as absolute requirements and unavoidable:
    - .1 BACNET conformity:
      - .1 The operator interfaces and the general application controllers shall be connected by an inter-network of communication BACNET. All communications taking place on this inter-network shall comply with BACnet, ASHRAE Standard 135-1995. The product must be "Native BACNET".
      - .2 The inter-network communication BACNET shall comply with ISO 8802-3 (Ethernet) for operator interfaces and general application controllers. If the general application controller of the suggested system does not meet minimum speed data link / physical layer, an independent network router BACNET or general application controller BACNET that meets these requirements must be provided in order to route each individual controller of the system to the local high speed network.
    - .2 Communication mechanism:
      - .1 Communication services taking place on the communication network BACNET shall ensure a transfer of value and operator interface that is transparent at the architecture level of the inter-network:
        - .1 Connecting a operator interface unit to any controller of the communication network BACNET must allow the operator to interface with all other controllers as if this interface is directly connected to other controllers. Operators must be able to view and edit data, status information, reports, the operating

- system, custom programs, etc., of all controllers from any controller of the communication network BACNET.
- .2 All values in the database (objects, software variables and custom program variables) of any controller must be read from any other controller on the communications network for the transfer of value the inter-network should not have to be performed by an operator.
  - .3 All objects and all of object characteristics must be easily viewed and shared and that, at the whole system.
- .3 Only one level of graphical interface will be installed on this project. This graphical interface level must be available to all workstations, actuals or futures, including portables.
  - .4 The graphic software is existing and the new graphic must be integrated to the system CONTINUUM 1.93 on the client station / located in the mechanical room.
- .2 Operating environment:
    - .1 The computerized control system of the building will consist of one or more panels of independent centralized first level management (PGC) operating without the services of an operator. The units will be programmed from an existing operator station (IBM compatible PC) central or portable. The portable as central may be connected and disconnected without affecting the operation of controllers and complete system.
    - .2 The operating system of computerized control system shall be available in French.
- .3 System possibilities:
    - .1 The central will allow the system operator a large number of interventions without having to move. It will produce analysis reports, graphs, alarms, historical, control of load, lowering and other energy saving or control features. The PGC will be able to replace conventional controls for HVAC systems, such as analog controllers, relays, switches, sequencers, specific programs and strategies for saving energy.
- .4 Man/machine interface:
    - .1 The central control station or laptop can be plugged into any PGC and have access to all programming thereof and all network data in a transparent manner. Control stations can be connected at high speed communication PGC controllers.

## **2.2 DIGITAL CONTROLLER STRUCTURE**

- .1 General application controllers (CAG):
  - .1 BACNET compliance:
    - .1 Each general application controller shall be connected to BACNET network and will build on the data link protocol / physical layer ISO 8802-3 (Ethernet). Each controller must communicate directly with BACNET equipment over Ethernet network using the "Read" and "Write" services, as defined in clauses 15.5 and 15.8 of ASHRAE Standard 135-95. PICS of this product are required.
    - .2 The controller of the building should at least meet the requirements of a Class 3 BACNET device.
    - .3 The types of standard BACNET objects that should be supported in reading and writing modes are: analog input, analog output, analog value, binary input, binary output, binary value, calendar, scheduling, PID loop, controller, history and alarm log.
  - .2 Autonomous operation:
    - .1 Each BCX will have a Motorola 32-bit Coldfire 66MHZ. Each CAG will be equipped with a built-in battery with a minimum capacity of 72 hours to maintain the real time clock function. The lifespan of the battery will be 10 years minimum.
    - .2 Each CAG will have 4 meg of RAM, expandable to 16 meg using conventional memory modules.
    - .3 Each CAG will use 1 meg of flash memory to support its operating system. The version of the operating system may be changed without changing any EPROM or EEPROM.
  - .3 Communication ports:
    - .1 RS232: The CAG should support at least one RS232 communication ports at 19200 Bauds that can operate simultaneously «multi-users». Each port can support the composition and the automatic response, BACNET.
    - .2 RS485: The CAG shall support RS485 BACNET MSTP port allowing communication with specific application controllers for sub-network at a speed of 39,200 Bauds.
    - .3 Intelli-net: The CAG shall support a communication port at 1 mega-bauds allowing communicating with others CAG from any anterior generation.



- .4 Ethernet: The GAC will support an Ethernet standard ISO 8802.3 communication port at 10 mega-bauds. This network will connect with other CAG or with PCs, BACNET.
- .4 Communication network:
  - .1 Each CAG must be addressable by DIP SWITCH. The network can be LAN-type or WAN-type. The amount of CAG connected to the network must be 1024. The network will be Ethernet type.
  - .2 Each CAG must be equipped with a warning light to indicate the status of the communication.
  - .3 If the CAG does not meet the minimum requirements in terms of speed data link/physical layer, an independent router BACNET network that meets these requirements can be provided. In this alternative, there must be a router by CAG.
- .5 Inputs and outputs:
  - .1 The CAG must be compatible with standard peripherals. Analog converters must have a minimum resolution of 12 bits for the inputs and 10 bits for outputs. All input and output connections for the general application controller shall be made using screw terminal plug that can be unplug to allow easy and quick maintenance.
  - .2 Each CAG will support one or more of the following type:
    - .1 Universal inputs:
      - .1 RTD or platinum 100 $\Omega$ ;
      - .2 RTD or platinum 1000 $\Omega$ ;
      - .3 Balco 500 $\Omega$ ;
      - .4 Thermistor 10K $\Omega$ ;
      - .5 4-20 mA;
      - .6 0-5 V DC;
      - .7 0-10 V DC;
      - .8 Dry contact.

Each entry will be provided with a light emitting diode whose intensity varies with the signal and is electrically protected against shorted connections.

Selecting the type of signal will be made by moving a jumper. No external or interface resistance of some sort will be acceptable.

.2 Universal outputs:

- .1 0-5 V DC;
- .2 0-10 V DC;
- .3 4-20 mA;
- .4 On or off.

Each output is equipped with a LED. The analog outputs shall be provided with a potentiometer for manual adjustment. The binary outputs are equipped with a manual override switch and a solid relay with LED and fuse. All switches bypass may be monitored to obtain an indication of the dynamic state of the switch.

.3 Pulsed input:

- .1 A pulsed input of 250 Hz.

.3 The CAG will have the following configuration:

- .1 32 universal inputs;
- .2 16 universal outputs;
- .3 3 expansions type:
  - .1 8 universal inputs / outputs;
  - .2 8 universal inputs / 16 binary outputs;
  - .3 32 universal inputs.
  - .4 For a total of 144 points.

.4 Free points:

- .1 Plan to provide 8 free points for inputs and 8 free points for outputs for each of the panels provided.

- .5 Mounting:
  - .1 Each controller will be mounted in a metal case with lock and key. The housing will be of type "CEMA 1" (standard), "CEMA 4" or "CEMA 12" (optional) as indicated plans.
    - .1 Dimensions: 450 x 600 x 100 mm;
    - .2 Weight: 9 kg;
    - .3 Operating conditions: 0 to 40 °C, humidity of 10 to 90 %.
- .2 Specific application controllers (CAS):
  - .1 General:
    - .1 The CAS (B3 family) must be "native BACNET" digital controllers and must be interconnected. The CAS shall be equipped with a on site programmable microprocessor, the control sequences will be fully programmable in the same manner as in the CAG. No CAS should have a preprogrammed sequence. Digital controllers whose programming are done at the manufacturer, and can not be modified, will be refused. The CAS will carry out their functions of control and energy management independently. The CAS should at least meet the requirements of a Class 3 BACNET device.
    - .2 The types of standard BACNET objects that should be supported in reading and writing modes are: analog input, analog output, analog value, binary input, binary output, binary value, calendar, scheduling, PID loop, controller, history and alarm log.
    - .3 The CAS must be BTL approved.
  - .2 Autonomous operation:
    - .1 Each CAS will use a processor of at least 16 bits to ensure processing of global routines with execution time of a program of 10 times per second. Each CAS will be provided with a nonvolatile memory EEPROM or FLASH to store the programming data
    - .2 Each CAS will have 128 K of RAM, 128 K of EEPROM and 32 K of FLASH memory.
  - .3 Network communication:
    - .1 The CAS shall be interconnected between them and to the CAG by a dedicated local network, BACNET MSTP type. Each controller must be equipped with an indicator light to show the status of communication.
    - .2 They shall be equipped with a RS-485 communication port for the connection of a CAT sub-network or addressable probes.

- .3 When used alone as a master board, the CAS will be equipped with an RS232 port, a real time clock and a battery capable of supporting the clock for 72 hours.
- .4 Inputs and outputs:
  - .1 The CAS shall use standard peripherals such as sensors, transmitters, actuators, and others. The analog to digital and digital to analog converters shall have a minimum resolution of 12 bits for the inputs and 8 bits for the outputs.
  - .2 The CAS will have a LCD at least 20 characters on 4 lines for displaying all points and setpoint and schedule modifications.
- .5 Mounting:
  - .1 Each controller will be mounted in a metal case with lock and key. The housing will be of type "CEMA 1" (standard), "CEMA 4" or "CEMA 12" (optional) as indicated plans.
    - .1 Dimensions: 178 x 114 x 38 mm;
    - .2 Weight: 1 kg;
    - .3 Operating conditions: 0 to 40 °C, humidity of 10 to 90 %.
- .3 Terminal application controllers (CAT):
  - .1 General:
    - .1 The CAT must be "native BACNET" digital controllers and must be interconnected between them and with the CAG or the CAS through a BACNET MSTP network. The Contractor shall provide a CAT for each terminal unit when a configurable controller is allowed only on the network architecture. The CAT model is chosen depending on the type and amount of points required for a given system. The CAT should at least meet the requirements of a Class 3 BACNET device.
    - .2 The types of standard BACNET objects that should be supported in reading and writing modes are: analog input, analog output, analog value, binary input, binary output, binary value, calendar, scheduling, PID loop, controller, history and alarm log.
    - .3 The CAT will carry out their functions of control and energy management independently.
    - .4 The CAT must be BTL approved.

- .2 Autonomous operation:
  - .1 Each CAT will be equipped with a non-volatile FLASH memory to store the programming data.
- .3 Network communication:
  - .1 The CAT will be interconnected between them and with the CAG by a dedicated local network, RS-485 BACNET MSTP or Delta Linknet type.
- .4 Inputs and outputs:
  - .1 The CAT shall use standard peripherals such as sensors, transmitters, actuators, and others.
  - .2 The CAT, when required, will be provided with a liquid crystal display 10 digits and 12 icons and a keyboard with 4 keys for interactive access to programming parameters.

## **2.3 COMMUNICATION BETWEEN PANELS**

- .1 The total system can contain up to 1 024 general application controllers. The controllers are interconnected through an Ethernet network with a communication speed between them of 10 000 000 bauds. All PGC will be able to interact via the communication network without the intervention of another computer or a central station. The network can have a total length of 3,500 m.

## **2.4 OPERATION SOFTWARES**

- .1 General:
  - .1 The CAG and CAS shall include management and standard control programs supplied by the manufacturer as well as a programming language similar to BASIC allowing making control loops suitable for the project.
  - .2 All programs must be modifiable by the operator either on line or on site. Changes, additions or subtractions to the programs must occur dynamically when it is running. The Contractor shall leave three copies on Compact Disc (CD) of the entire database. Management and standard control programs provided by the manufacturer must be able to make the following minimum functions.
    - .1 Digital control:
      - .1 Control algorithms must be available and resident within the CAG and CAS to allow self-adjusting loops in proportional, integral and derivative gain modes. Other modes such as increment, float and binary must also be available to accommodate the needs of the project. The input and output points should not be limited to their use of management or control.

- .2 Mathematical routines:
  - .1 These routines should include at least the basic arithmetic, binary logic, relational logic and fixed formulas, such as psychometric calculations.
- .3 Demand limits:
  - .1 The limitation program of the demand of CAG or CAS shall be able to control the energy consumption of the building from signals emitted by a pulse generator mounted on the building's electricity meter or a watt transducer or processor power supply circuit connected to the building or via a communication interface with an electricity meter using BACNET protocols.
  - .2 The limitation program of the demand shall be able to predict energy demand and take appropriate measures so that demand does not exceed the limit. When demand exceeds the limit, actions will be taken to reduce the charges in a predetermined way. When it indicates that the demand will not be exceed the limit, actions will be taken to reinstate the charges in a predetermined way.
  - .3 The parameters for demand limitation, the calculation frequency, time intervals and other relevant variables must be determined based on how electricity company calculates demand charges.
  - .4 The program must provide forecasts for demand limitation and perform control.
  - .5 Provide the required tools so the operator can make the following changes online and provide information and following reports every hour, day or month: total electricity consumption, peak demand, date and time of peak demand and daily peak demand.
- .4 Schedule:
  - .1 Each CAG or CAS must be able to support at least 100 BACNET schedule objects and 100 BACNET agenda objects in order to make the planning of objects in the system.
  - .2 Special schedules must be set for each day of the week and each schedule must have a maximum of 10 events.
  - .3 For the exception schedules, the operator should be able to select any day or period of the year as an exception schedule. Once an exception schedule will be executed, it will be abandoned and replaced by the normal schedule for the day of the week in question.

- .4 For the holiday schedule, the operator will be able to set schedules for special events and holidays. The dates of these schedules will be placed on the schedule calendar and must be repeated annually. The operator must be able to define the dates of each holiday period at least two years in advance.
- .5 Optimization:
  - .1 The optimization must include the starting and optimal shutdown of elements based on indoor and outdoor temperatures as well as unoccupied and updated temperatures. The optimization of boilers and chillers must include the adjustment of the supply temperature, demand limitation, set point modification, alternative control and schedules implementation.
- .6 Alarms:
  - .1 Each selected binary object must be set to activate the alarm in function of the state chosen by the operator. The operator must be able to automatically and manually disable the alarm.
  - .2 Each selected digital object shall be controlled by an alarm with parameters of low and high alarm limits. The operator should be able to automatically and manually disable the alarm.
  - .3 The alarms must be forwarded to the appropriate workstations and printers in function of the time and other conditions. An alarm must initiate sequences or impressions, be entered in the event log, send personalized messages and automatically display a graph corresponding to these elements.
- .7 Capacity of history log book:
  - .1 Each CAG or CAS must be able to record and save at least 200 features of programmable objects by the user using the BACNET Trend Log object (BACNET history journal). Multiple features can be entered in the log for each object with a minimum of 200 samples per object characteristics. Any object, system, physical or calculated, must be recorded in the log. Samples of time interval must be adjusted from the operator terminal. The beginning of the sampling can be triggered by planning objects and by the BACNET calendar or the overall programming.
  - .2 The operator must be able to configure the logging method according to the interval of time or to status or value change.

- .3 From their interface, operators who work on site and those who outdoors must have access to journals via remote communications and data must be stored on hard disk for future reference, in file, as a spreadsheet or database.
- .8 Temperature readjustment:
  - .1 CAG or CAS must provide the possibility to adjust the air or water supply temperature based on given conditions, such as room temperature, outside temperature and load.
  - .2 Each CAG or CAS must have the possibility to readjust a minimum of 120 control loops based on any of these parameters.
- .9 Maintenance control:
  - .1 The CAG or CAS software must be able to tabulate the instruction execution times for all objects of binary inputs. If necessary, an alarm with a high instruction execution time must be selected by the operator.
  - .2 The CAG and CAS must control the equipment status and send messages with respect to maintenance, depending on the execution time of instruction, start up and calendar deadlines, defined by user.

### **PART 3 - EXECUTION**

#### **3.1 LOCATION**

- .1 Location of Controllers must be as indicated in the plans and approved by Departmental Representative.

#### **3.2 INSTALLATION**

- .1 Install Controllers in secure locking enclosures as indicated or as directed by Departmental Representative.
- .2 Provide power to 120 V emergency equipment necessary for any UPS.
- .3 Install tamper locks on breakers of circuit breaker panel.
- .4 Use uninterruptible Power Supply (UPS) and emergency power when equipment must operate in emergency and co-ordinating mode.

**END OF SECTION**



## **PART 1 - GENERAL**

### **1.1 RELATED REQUIREMENTS**

- .1 Section 07 84 00 - Firestopping.
- .2 Section 21 05 01 - Common Work Results - Mechanical.
- .3 Section 23 05 00 - Common Work Results for HVAC.
- .4 Section 23 33 15 - Dampers - Operating.
- .5 Section 25 01 11 - EMCS: Start-Up, Verification and Commissioning.
- .6 Section 25 05 01 - EMCS: General Requirements.
- .7 Section 25 05 02 - EMCS: Shop Drawings, Product Data and Review Process.
- .8 Section 25 05 54 - EMCS: Identification.
- .9 Section 25 90 01 - EMCS: Site Requirements Applications and Systems Sequences of Operation.
- .10 Document 25 00 05, Guidelines for the design of systems of energy management (Document available on request).

### **1.2 REFERENCES**

- .1 American National Standards Institute (ANSI).
  - .1 ANSI C12.7-1993 (R1999), Requirements for Watthour Meter Sockets.
  - .2 ANSI/IEEE C57.13-1993, Standard Requirements for Instrument Transformers.
- .2 American Society for Testing and Materials International, (ASTM).
  - .1 ASTM B148-97(03), Standard Specification for Aluminum-Bronze Sand Castings.
- .3 National Electrical Manufacturer's Association (NEMA).
  - .1 NEMA 250-03, Enclosures for Electrical Equipment (1000 Volts Maximum).
- .4 Air Movement and Control Association, Inc. (AMCA).
  - .1 AMCA Standard 500-D-98, Laboratory Method of Testing Dampers For Rating.

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

### **1.3 DEFINITIONS**

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

### **1.4 SUBMITTALS**

- .1 Submit shop drawings and manufacturer's installation instructions in accordance with section 25 05 02 - EMCS: Shop Drawings, Product Data and Review Process.
- .2 Pre-Installation Tests :
  - .1 Submit samples at random from equipment shipped, as requested by Departmental Representative, for testing before installation. Replace devices not meeting specified performance and accuracy.
- .3 Manufacturer's Instructions:
  - .1 Submit manufacturer's installation instructions for specified equipment and devices.

### **1.5 EXISTING CONDITIONS**

- .1 Cutting and Patching: in accordance with section 01 73 00 - Execution Requirements supplemented as specified herein.
- .2 Repair surfaces damaged during execution of Work.
- .3 Turn over to Departmental Representative existing materials removed from Work not identified for re-use.

## **PART 2 - PRODUCTS**

### **2.1 GENERAL**

- .1 Control devices of each category to be of same type and manufacturer.
- .2 External trim materials to be corrosion resistant. Internal parts to be assembled in watertight, shockproof, vibration-proof, heat resistant, assembly.

- .3 Operating conditions: 0 - 32 °C with 10% - 90% RH (non-condensing) unless otherwise specified.
- .4 Terminations: use standard conduit box with slot screwdriver compression connector block unless otherwise specified.
- .5 Transmitters and sensors to be unaffected by external transmitters including walkie talkies.
- .6 Account for hysteresis, relaxation time, maximum and minimum limits in applications of sensors and controls.
- .7 Outdoor installations: use weatherproof construction in NEMA 4 enclosures.
- .8 Devices installed in user occupied space not exceed Noise Criteria (NC) of 35. Noise generated by any device must not be detectable above space ambient conditions.
- .9 Range: including temperature, humidity, pressure, as indicated in I/O summary in section 25 90 01 - EMCS: Site Requirements Applications and Systems Sequences of Operation.

## **2.2 TRANSMISSION TYPE**

- .1 The control room will be fully electronic. Thermostats shall be adjustable by the occupant between 20 °C in winter and 24 °C in summer, according to the contractual terms of PWGSC.
- .2 The complete system of electronic transmission must provide a linear output signal and proportional to the input signal.

## **2.3 SENSORS AND TRANSMITTERS**

- .1 Room temperature sensors blind type equipped with thermistor element which varies with temperature. Measuring range of 4 to 37 °C and accuracy of 0.2 °C.
  - .1 Acceptable products: Robust sensors for mechanical room or technical "stainless steel plate"
- .2 Average temperature transmitters must allow an accurate reading of the temperature on all operating range. Signal: 4 to 20 mA, linear over the range. Sensible element must have a minimum length of 670 mm.
  - .1 Acceptable products: Average temperature transmitter, -1 to 54 °C, capillary 560mm.
- .3 Pressure transmitters (air) must allow an accurate reading of differential pressure or static pressure over the operating range. Signal of 4 to 20 mA, linear over the range.

The transmitter must resist to overpressure peak, up to 15 lb/in<sup>2</sup>. Reading range adjusted to application.

- .1 Acceptable products:
  - .1 Static pressure transmitter, 24 V DC or AC, output 4-20 mA, range of 0-200 lb/in<sup>2</sup>.
  - .2 Differential pressure transmitter, input 12 V DC 24 V DC or AC, output 4-20 mA, range of 0-5 in H<sub>2</sub>O.

## 2.4 PRESSURE DETECTOR

- .1 The pressure detector makes contact on a pressure variation.
  - .1 Acceptable product: Differential pressure detector and air 0 to 2 inches of water.

## 2.5 CURRENT AND DETECTOR TRANSMITTER

- .1 The current electronic transmitter give an analogical reading of the current circulating through an electric conductor. The adjustment range must be adjustable and the minimal accuracy must be of 2 % of the detection complete range. Output signal must be 0 to 5 V DC, linear and proportional to the current variation.
  - .1 Acceptable products: Alternative current transmitter, 1 to 60 A, adjustable.

## 2.6 CURRENT SENSING RELAYS

- .1 Characteristics:
  - .1 Suitable to detect belt loss or motor failure.
  - .2 Trip point adjustment, output status LED.
  - .3 Split core for easy mounting.
  - .4 Induced sensor power.
  - .5 Relay contacts: capable of handling 0.5 amps at 30 VAC / DC. Output to be NO solid state.
  - .6 Suitable for single or 3 phase monitoring. For 3-Phase applications: provide for discrimination between phases.
  - .7 Adjustable latch level.
- .2 Acceptable product: Veris H708; Greystone CS400; Setra CSS. Replacement materials or products: approved by addendum according to Instructions to bidders.

## 2.7 MOTORIZED DAMPERS

- .1 Motorized dampers, mixing box dampers or pressure dampers are not provided by this section. Only actuators and accessories must be provided by this section.

## 2.8 DAMPER ACTUATORS

- .1 Electric/electronic actuators rotary action with spring return.
  - .1 Acceptable products:
    - .1 AF24 Belimo, electric actuator, all or nothing, 24 V AC, torque 133 lb/in<sup>2</sup>;
    - .2 AF24-SR Belimo, electronic actuator, large capacity, 24 V AC, signal of 0 to 10 V DC, torque 133 lb/in<sup>2</sup>;
    - .3 AF120 Belimo, electric actuator, all or nothing, 120 V AC, torque 133 lb/in<sup>2</sup>.
  - .2 Electric actuator, rotary action:
    - .1 Acceptable products: NM24-SR Belimo, modulating electric actuator, 24 V AC, control signal of 0-10 V DC, torque 75 lb/in<sup>2</sup>.

## 2.9 PANELS

- .1 Free-standing or wall mounted enamelled steel cabinets with hinged and key-locked front door.
- .2 Multiple panels as required or indicated to handle requirements with additional space to accommodate 25 % additional capacity as required by Departmental Representative without adding additional cabinets.
- .3 Panels to be lockable with same key.
- .4 Acceptable products: Eurobex 1100. Replacement materials or products: approved by addendum according to Instructions to bidders.

## 2.10 WIRING

- .1 As required by the division 26 - Electricity.
- .2 For wiring under 70 volts use FT6 rated wiring where wiring is not run in conduit. Other cases use FT4 wiring.

- .3 Wiring must be continuous without joints.
- .4 Sizes:
  - .1 Field wiring to digital device: #18AWG (stranded twisted pair).
  - .2 Analog input and output: shielded #18 minimum solid copper (stranded twisted pair).

## **2.11 CONDUCT**

- .1 As required by the division 26 - Electricity.
- .2 All wiring must be in conduct.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- .1 Install equipment, components so that manufacturer's and CSA labels are visible and legible after commissioning is complete.
- .2 Install field control devices in accordance with manufacturers recommended methods, procedures and instructions.
- .3 Temperature transmitters, humidity transmitters, current-to-pneumatic transducers, solenoid air valves, controllers, relays: install in NEMA I enclosure or as required for specific applications. Provide for electrolytic isolation in cases when dissimilar metals make contact.
- .4 Support field-mounted panels, transmitters and sensors on pipe stands or channel brackets.
- .5 Fire stopping: provide space for fire stopping in accordance with section 07 84 00 - Firestopping. Maintain fire rating integrity.
- .6 Electrical:
  - .1 Complete installation in accordance with requirements of Electricity division.
  - .2 Modify existing starters to provide for EMCS as indicated in I/O Summaries and as indicated.
  - .3 Refer to electrical control schematics included as part of control design schematics in section 25 90 01 - EMCS: Site Requirements Applications and

Systems Sequences of Operation. Trace existing control wiring installation and provide updated wiring schematics including additions, deletions to control circuits for review by Departmental Representative before beginning Work.

- .4 Terminate wires with screw terminal type connectors suitable for wire size, and number of terminations.
- .5 Install communication wiring in conduit.
  - .1 Provide complete conduit system to link Building Controllers, field panels and OWS(s).
  - .2 Conduit sizes to suit wiring requirements and to allow for future expansion capabilities specified for systems.
  - .3 Maximum conduit fill not to exceed 40%.
  - .4 Design drawings do not show conduit layout.
- .6 Do not run exposed conduits in normally occupied spaces unless otherwise indicated or unless impossible to do otherwise. Departmental Representative to review before starting Work. Wiring in mechanical rooms, wiring in service rooms and exposed wiring must be in conduit.

### **3.2 TEMPERATURE AND HUMIDITY SENSORS**

- .1 Stabilize to ensure minimum field adjustments or calibrations.
- .2 Readily accessible and adaptable to each type of application to allow for quick easy replacement and servicing without special tools or skills.
- .3 Outdoor installation:
  - .1 Protect from solar radiation and wind effects by non-corroding shields.
  - .2 Install in NEMA 4 enclosures.
- .4 Duct installations:
  - .1 Do not mount in dead air space.
  - .2 Locate within sensor vibration and velocity limits.
  - .3 Securely mount extended surface sensor used to sense average temperature.

- .4 Thermally isolate elements from brackets and supports to respond to air temperature only.
- .5 Support sensor element separately from coils, filter racks.
- .5 Averaging duct type temperature sensors.
  - .1 Install averaging element horizontally across the ductwork starting 300 mm from top of ductwork. Each additional horizontal run to be no more than 300 mm from one above it. Continue until complete cross sectional area of ductwork is covered. Use multiple sensors where single sensor does not meet required coverage.
  - .2 Wire multiple sensors in series for low temperature protection applications.
  - .3 Wire multiple sensors separately for temperature measurement.
  - .4 Use software averaging algorithm to derive overall average for control purposes.

### **3.3 PANELS**

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

### **3.4 PRESSURE AND DIFFERENTIAL PRESSURE SWITCHES AND SENSORS**

- .1 Install isolation valve and snubber on sensors between sensor and pressure source where code allows.
  - .1 Protect sensing elements on high temperature hot water service with pigtail syphon between valve and sensor.

### **3.5 IDENTIFICATION**

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

### **3.6 AIR FLOW MEASURING STATIONS**

- .1 Protect air flow measuring assembly until cleaning of ducts is completed.



### **3.7 TESTING AND COMMISSIONING**

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

**END OF SECTION**



## **PART 1 - GENERAL**

### **1.1 REFERENCES**

- .1 Public Works and Governmental Services Canada (PWGSC)/Real Property Branch/Engineering and Architecture Services.
- .1 Document 25 00 05, Guidelines for the design of EMCS (Document available on request).

## **PART 2 - SEQUENCES OF OPERATION**

### **2.1 GENERAL SEQUENCES**

- .1 The following control sequences must be read in conjunction with the plans and the points list. Provide all control inputs/outputs necessary to complete the control sequences, regardless of the points being listed or implied.
- .2 Critical protections or protections regulated by codes (gas detection, fire etc.) cannot be bypassed by any means, neither manually nor the central computer. If an input is required at the BAS, provide a relay which will have the dual function of control and alarm.
- .3 When there is an input of information such as proof the system is operating, the total number of operating hours for the system (fans, etc.) will be tabulated with the option of reset from the command post.
- .4 Program the following alarms for every system:
  - .1 A discrepancy between a command and its corresponding state;
  - .2 Temperature readings that are 2 °C beyond the set point temperature;
  - .3 All other values: a greater than 5 % discrepancy with respect to the set point values.
- .5 When the program commands the change between two different control modes (ex: free-cooling to mechanical cooling), a dead-band must be included on the set points. Furthermore, several control stages in sequence have minimum ON and OFF times. These measures are present to eliminate needless cycling of equipment.
- .6 Systems that are assigned to room heating where there is a set point adjustment at night must have an optimized restart sequence. The return to daytime set point temperatures must not increase the overall electrical demand for the building. This

same principle will be applied to systems that supply rooms with air-conditioning and that have a night set point adjustment.

ROOM SETPOINT TEMPERATURES		
Mode	Occupied period	Unoccupied period
Heating	20 °C	20 °C
Cooling	20 °C 25%HR	20 °C 25%HR

- .7 After a power-outage or a similar disturbance, systems will return to their normal functions according to a progressive start-up sequence. Delays of up to 15 minutes can be used for these progressive start-ups.
- .8 Upon receiving a fire detection signal from the fire safety control panel, the ventilation fans are stopped. On restart of the systems, the fans start up according to a pre-established sequence.
- .9 All analog inputs/outputs as well as variables that change state with respect to time must be subject to trending.
- .1 Unless otherwise specified, alarms will be transferred to following devices:

POINTS	ALARM	OPERATION HOURS	TREND	ALARM DESTINATION	COMMENTS
ANALOG INPUTS	X		X	F,P,S	
ANALOG OUTPUTS	X		X	F,P,S	
DIGITAL INPUTS	X	X		F,P,S	Related to the corresponding output
DIGITAL OUTPUTS		X		F,P,S	
SET POINTS	X		X	F,P,S	
VARIABLES	X			F,P,S	
SYSTEM CONTROL	X			F,P,W	

F: File

W: WAN

P: Printer

S: Screen

## **2.2 SPECIAL REQUIREMENTS FOR THE PROJECT**

- .1 Automatic regulation for the draft room ventilation of chlorine and moisture problems halls of the drinking water of the Ste-Anne-Des-Plaines Establishment should be separate to any other floor area.
- .2 Digital controllers should not be shared with other external installation environment.
- .3 A new panel PC-10 shall be provided comprising digital controllers facilities chlorine room must be separate and should be installed in the floor of the operations floor.
- .4 The new panel PC-2 comprising digital controllers of the filters shall be separate and should be installed in the filters gallery.
- .5 The existing panel of the pump, identified PML2, comprising digital controllers' facilities pump room, located in the pump room will be completed to meet the new sequence of operation.
- .6 On automatic regulation diagrams, the identification of the electrical source, the identification of the circuit breaker, the identification of the electrical panel must be indicated.
- .7 On automatic regulation diagrams, the identification of all mechanical equipment (Fans, coils, compressor / condensers, probes) must be indicated.
- .8 The automatic regulation diagrams should be sub vinyl film and fixed inside the panel.

## **2.3 FILTERS GALLERY SYSTEM**

- .1 The filters gallery system consists of an outside air intake with motorized air damper modulating, air recirculating intake with modulating damper, a battery filter, a supply air fan, a cooling coil direct expansion bi-bloc type, an outside compressor/condenser, an electric heating coil and a network of supply air ducts, an exhaust louver with motorized modulating damper.  
  
Two existing heaters have their thermostats and operate autonomously, thermostats should be set at 20 °C.
- .2 System shutdown:
  - .1 The fresh air and exhaust dampers are closed, the return air damper is open, the supply fan is off, the electric heating coil is off, the compressor / condenser of the cooling coil is off.
- .3 The system is automatically turned on by a program of the digital controller; in normal operation, the system operates continuously.

- .4 System start-up:
  - .1 The digital controller opens the fresh air damper at the minimum flow.
  - .2 After confirming the opening of the fresh air damper at the minimum position, the digital controller starts the supply fan.
  - .3 A current sensor checks the starting of the fan.
  - .4 Permission is given to start the compressor/condenser if the outside temperature is above 5 °C and the outdoor relative humidity is above 40%RH.
- .5 Temperature control air supply in winter (less than or equal to 5 °C):
  - .1 The digital controller modulates the air damper at outside airflow of 178 L/s minimum.
  - .2 A temperature sensor in the supply air duct TA-3 and the digital controller modulate the electric heating coil in order to meet the setpoint of 20 °C in winter.
- .6 Temperature control air supply in offseason (greater than 5 °C to 13 °C):
  - .1 A temperature sensor in the supply air duct TA-1 and the digital controller modulate the air dampers in order to meet the air supply setpoint of 13 °C, the electric heating coil, to meet the setpoint of 20 °C room sensor.
  - .2 In dehumidifying mode (%HR room up to 25), the digital controller modulates the air dampers at the minimum fresh air and a temperature sensor in the supply air duct TA-2 and the digital controller makes the air conditioner work, in order to meet the setpoint of 12 °C air supply.
  - .3 A temperature sensor in the room and the digital controller modulate the electric heating coil to meet the room temperature setpoint of 20 °C.
- .7 Temperature control air supply in summer (above 13 °C):
  - .1 On cooling demand by the room sensor, the exhaust damper opens. The fresh air and return air dampers modulate to maintain the room temperature at its setpoint.
  - .2 In dehumidifying mode(%HR up to 25), the digital controller modulates the air damper at the minimum airflow of 178 L/s and a temperature sensor TA-2 in the supply air duct and the digital controller modulate the compressor/condenser unit in order to maintain the air supply temperature at 12 °C pass the cooling coil.

- .3 A room sensor and the digital controller will adjust the air supply temperature by modulating the electric heating coil in order to meet the room temperature setpoint of 20 °C.
- .8 Humidity control:
  - .1 An outdoor humidity sensor allows the compressor/condenser unit start if the outside relative humidity is above 40% RH.
  - .2 A relative humidity sensor in the room and the digital controller starts the compressor/condenser unit to meet the set point of 25% RH.
- .9 Protections:
  - .1 A temperature probe (TA-1) installed after the mixing box take control registers to supply air at 10 °C.
  - .2 A thermostat protection against frost installed after the mixing box will stop the system if the air temperature drops below 5 °C for more than 5 minutes.
  - .3 A temperature sensor TA-3 installed after the electric coil and the digital controller will detect the high limit temperature (up to 60 °C) and will stop the electric coil, an alarm will be send at the centralization.
  - .4 A current detector to check the fan running.
  - .5 A differential pressure sensor indicates whether the locally aeraulic load loss between the input and the output of the filters require the replacement of medium.
- .10 Faults:
  - .1 If there is no evidence of fan running after five minutes, an alarm is generated at the centralization.
  - .2 If there is no evidence of compressor / condenser unit after five minutes, an alarm is generated at the centralization.
- .11 Power outage:
  - .1 Systems are connected to an electrical emergency power and continue to operate.
- .12 Fire detection:
  - .1 The system continues to operate.

.13 Alarms:

.1 Alarms list:

- .1 Fans in fault;
- .2 Air conditioner in fault;
- .3 Électric heat coil
- .4 Low limit air supply temperature;
- .5 High limit room temperature.

## **2.4 PUMPS ROOM SYSTEM (MODIFICATIONS)**

.1 The system of the pumps room is existing and consists of an existing minimum fresh air intake with modulating motorized minimum fresh air damper, a new motorized modulating damper for cooling, a recirculating air intake with motorized damper, an existing battery filter, an existing steam heating coil, an existing supply air fan, a new cooling coil direct expansion bi-block type, an new outside compressor/condenser and a dedicated duct air supply, a discharge louver with existing modulating motorized damper, air recirculation intake with existing motorized damper and an existing return fan.

.2 System shutdown:

.1 The fresh air dampers (VM-1, VM-7) and the exhaust dampers (VM-6) are closed, the return air dampers (VM-2, VM-5) are open and the isolation dampers (VM-3, VM-4) are open, the supply fan and the return fan are off, the steam coil is off, the compressor / condenser of the cooling coil is off.

.3 The system is automatically turned on by a program of the digital controller; in normal operation, the system operates continuously.

.4 System start-up:

.1 The digital controller opens the fresh air damper at the modified minimum flow (168 L/s) all or nothing VM-1 and the dampers VM-3 and VM-5; the VM-4 damper is closing.

.2 After confirming the opening of the fresh air damper VM-1 at the minimum position and the dampers VM-2, VM-3, VM-5, the digital controller starts the supply fan and the return fan.

.3 A current sensor checks the starting of the fan.



- .4 The valve steam heating control opens when the outside temperature is below 4.5 °C.
- .5 Permission is given to start the compressor/condenser if the outside temperature is above 10 °C and the outdoor relative humidity is above 40%RH.
- .5 Temperature control air supply in winter (less than or equal to 5 °C):
  - .1 A room temperature sensor and the digital controller modulate the air registers VM-1(minimum exterior airflow of 178 L/s) and modulate the dampers VM-6 and the steam heating valve in order to meet the setpoint of 20 °C of room sensor in winter.
- .6 Temperature control air supply in offseason (greater than 5 °C to 13 °C):
  - .1 A room temperature sensor and the digital controller modulate the air dampers VM-7, VM-2, VM-5, VM-6, the steam heating valve, in order to meet the setpoint of 20 °C. The minimum air damper VM-1 is now closed.
  - .2 In dehumidifying mode (%HR up to 25), the digital controller modulates the air dampers at the minimum fresh air and a temperature sensor in the supply air duct TA-2 and the digital controller makes the air conditioner work, in order to meet the setpoint of 12 °C air supply. The cooled air damper VM-7 is now closed.
- .7 Temperature control air supply in summer (above 13 °C):
  - .1 On cooling demand by the room sensor (free cooling), the exhaust air damper open. The minimum fresh air damper is closing; the cooling damper VM-7 and the return air damper VM-2 modulate in order to meet the room temperature to its setpoint.
  - .2 In dehumidifying mode (%HR up to 25), the cooling damper VM-7 is closing, the minimum fresh air damper VM-1 and the return air damper VM-2 open. The temperature sensor in the supply air duct TA-2 and the digital controller modulate the air conditioner to supply the air at 12 °C.
- .8 Humidity control:
  - .1 An outdoor humidity sensor allows the compressor/condenser unit start if the outside relative humidity is above 40% RH and the outside temperature is above 5 °C.
  - .2 A relative humidity sensor in the room and the digital controller starts the compressor/condenser unit to meet the set point of 25% RH.

- .9 Cooling the fire pumps room:
  - .1 At the start of one of the fire pump and a temperature rise above 38 °C and when the dehumidification mode is effective, the air cooling damper VM-7, the air damper VM-4, the exhaust air damper open completely, the dampers VM-1, VM-2, VM-3, and VM-5 will close completely.
  - .2 At the start of one of the fire pump and a temperature rise above 38 °C and when the dehumidification mode is effective, the air cooling damper VM-7, the air damper VM-4, the exhaust air damper open completely, the dampers VM-1, VM-2, VM-3 and VM-5 close completely. The digital controller and a temperature probe TA-2 installed inside the supply air duct after the cooling coil modulates the compressor-condenser unit to maintain the supply temperature at 12 °C.
- .10 Protections:
  - .1 A temperature probe (TA-1) installed after the mixing box take control registers to supply air at 10 °C.
  - .2 A thermostat protection against frost installed after the mixing box will stop the system if the air temperature drops below 5 °C for more than 5 minutes.
  - .3 A current detector to check the fan running.
  - .4 A differential pressure sensor indicates whether the locally aeraulic load loss between the input and the output of the filters require the replacement of medium.
- .11 Faults:
  - .1 If there is no proof of a fan running after five minutes, an alarm is generated to the centralization.
  - .2 If there is no proof of a compressor/condenser unit running after five minutes, an alarm is generated to the centralization.
- .12 Power outage:
  - .1 Systems are connected to an electrical emergency power and continue to operate.
- .13 Fire detection:
  - .1 The system continues to operate.

.14 Alarms:

.1 Alarms list:

- .1 Fan in fault;
- .2 Air conditioner in fault;
- .3 Low limit temperature supply air;
- .4 High limit temperature pump room
- .5 High limit temperature fire pump room

**2.5 ROOM CHLORINE TREATMENT SYSTEM (MODIFICATIONS)**

- .1 The system of the chlorine room is in part existent and consists of an outside air intake with motorized fresh air damper all or nothing existent, a new set of filter, a new modulating electric heating coil, a new supply fan, an existing exhaust fan and an existing motorized discharge damper.
- .2 System shutdown:
  - .1 The fresh air dampers and the exhaust dampers are closed, the supply fans and the return fans are off, the electric heating coil is inoperative.
  - .3 The system is automatically turned on by a program of the digital controller; in normal operation, the system operates continuously.
- .4 System start-up:
  - .1 The digital controller opens the fresh air damper all or nothing and the exhaust damper.
  - .2 The digital controller starts the supply and exhaust fans.
  - .3 A current sensor checks the starting of the fan.
- .5 Temperature control air supply in winter (less than or equal to 17 °C):
  - .1 A temperature sensor in the supply air duct and the digital controller modulate the electrical coil in order to meet the setpoint of 15 °C in winter.
- .6 Protections:
  - .1 A thermostat protection against frost installed after the mixing box will stop the system if the air temperature drops below 5 °C for more than 5 minutes.

- .2 A current detector to check the fan running.
- .3 A differential pressure sensor indicates whether the locally aeraulic load loss between the input and the output of the filters require the replacement of medium.
- .7 Faults:
  - .1 If there is no proof of a fan running after five minutes, an alarm is generated to the centralization.
- .8 Power outage:
  - .1 Systems are connected to an electrical emergency power and continue to operate.
- .9 Fire detection:
  - .1 The system continues to operate.
- .10 Alarms:
  - .1 Alarms list:
    - .1 Fans in fault;
    - .2 Low limit temperature air supply;
    - .3 High limit temperature air supply.

### **PART 3 - EXECUTION**

#### **3.1 NOT USED**

- .1 Not Used.

**END OF SECTION**

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**Division 26 / Electrical**

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## **1.1 RELATED REQUIREMENTS**

- .1 All sections of division 01.

## **1.2 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 Group
    - .1 CSA C22.1, Code de construction du Québec – Chapitre V – Électricité, dernière édition.
    - .2 CAN3-C235, Preferred Voltage Levels for AC Systems, 0 to 50,000 V.
  - .2 Institute of Electrical and Electronics (IEEE)/National Electrical Safety Code Product Line (NESC)
    - .1 IEEE SP1122, The Authoritative Dictionary of IEEE Standards Terms, 7th Edition.

## **1.3 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for electrical equipments and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop drawings:
  - .1 Submit wiring diagrams and installation details of equipment indicating proposed location, layout and arrangement, control panels, accessories, piping, ductwork, and other items that must be shown to ensure co-ordinated installation.
  - .2 Identify on wiring diagrams circuit terminals and indicate internal wiring for each item of equipment and interconnection between each item of equipment.

- .3 Indicate of drawings clearances for operation, maintenance, and replacement of operating equipment devices.
- .4 Submit 5 numbers of copies of drawings and product data to authority having jurisdiction.
- .5 If changes are required, notify Ministerial Representative of these changes before they are made.
- .4 Certificates:
  - .1 Provide CSA certified equipment and material.
  - .2 Where CSA certified equipment is not available, submit such equipment to inspection authorities for approval before delivery to site.
  - .3 Submit test results of installed electrical systems and instrumentation.
  - .4 Permits and fees: in accordance with General Conditions of contract.
  - .5 Submit, upon completion of Work, load balance report.
  - .6 Submit certificate of acceptance from authority having jurisdiction upon completion of Work to Ministerial Representative.
- .5 Manufacturer's Field Reports: submit to Ministerial Representative manufacturer's written report, within 3 days of review, verifying compliance of Work and electrical system and instrumentation testing.

#### **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.
  - .1 Provide for each system and principal item of equipment as specified in technical sections for use by operation and maintenance personnel.
  - .2 Operating instructions to include following:
    - .1 Wiring diagrams, control diagrams, and control sequence for each principal system and item of equipment.
    - .2 Start up, proper adjustment, operating, lubrication, and shutdown procedures.
    - .3 Safety precautions.



- .4 Procedures to be followed in event of equipment failure.
- .5 Other items of instruction as recommended by manufacturer of each system or item of equipment.
- .3 Print or engrave operating instructions and frame under glass or in approved laminated plastic.
- .4 Post instructions where directed.
- .5 For operating instructions exposed to weather, provide weather-resistant materials or weatherproof enclosures.
- .6 Ensure operating instructions will not fade when exposed to sunlight and are secured to prevent easy removal or peeling.

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

- .1 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
  - .1 Store materials in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.
- .4 Packaging Waste Management: remove for reuse packaging materials as specified in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

## **PARTIE 2 - PRODUCTS**

### **2.1 DESIGN REQUIREMENTS**

- .1 Operating voltages: to CAN3-C235.
- .2 Motors, electric heating, control and distribution devices and equipment to operate satisfactorily at 60 Hz within normal operating limits established by above standard.

- .1 Equipment to operate in extreme operating conditions established in above standard without damage to equipment.
- .3 Language operating requirements: provide identification nameplates for control items in English and French.
- .4 Use one nameplate for both languages.

## **2.2 MATERIALS AND EQUIPMENT**

- .1 Provide material and equipment in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Material and equipment to be CSA certified. Where CSA certified material and equipment are not available, obtain special approval from inspection authorities before delivery to site and submit such approval as described in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS.
- .3 Factory assemble control panels and component assemblies.

## **2.3 ELECTRIC MOTORS, EQUIPMENT AND CONTROLS**

- .1 Verify installation and co-ordination responsibilities related to motors, equipment and controls, as indicated.
- .2 Control wiring and conduit: in accordance with Section 26 29 03 - Control Devices except for conduit, wiring and connections below 50 V which are related to control systems specified in mechanical sections.

## **2.4 WARNING SIGNS**

- .1 Warning Signs: in accordance with requirements of inspection authorities.
- .2 Decal signs, minimum size 175 x 250 mm.

## **2.5 WIRING TERMINATIONS**

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

## 2.6 EQUIPMENT IDENTIFICATION

- .1 Identify electrical equipment with nameplates as follows:
  - .1 Nameplates: plastic laminate lamicaid 3 mm melamine, black face, white core, lettering accurately aligned and engraved into core, mechanically attached with self tapping screws.
  - .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 to be approved by Ministerial Representative prior to manufacture.
- .4 Allow for minimum of twenty-five (25) letters per nameplate.
- .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" as directed by Ministerial 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.

## 2.7 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.

## **2.8 CONDUIT AND CABLE IDENTIFICATION**

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

Prime	Auxiliary	
up to 250 V	Yellow	
up to 600 V	Yellow	Green
fire alarm	red	

## **2.9 FINISHES**

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

## **PARTIE 3 - EXECUTION**

### **3.1 EXAMINATION**

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for installation in accordance with manufacturer's written instructions.
  - .1 Visually inspect substrate in presence of Ministerial Representative.
  - .2 Inform Ministerial 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 Ministerial Representative.

### **3.2 INSTALLATION**

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

### **3.3 NAMEPLATES AND LABELS**

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

### **3.4 CONDUIT AND CABLE INSTALLATION**

- .1 Install conduit and sleeves prior to pouring of concrete.
  - .1 Sleeves through concrete: schedule 40 steel pipe, sized for free passage of conduit, and protruding 50 mm.
- .2 If plastic sleeves are used in fire rated walls or floors, remove before conduit installation.
- .3 Install cables, conduits and fittings embedded or plastered over, close to building structure so furring can be kept to minimum.

### **3.5 LOCATION OF OUTLETS**

- .1 Locate outlets in accordance with Section 26 05 32 - Outlet Boxes, Conduit Boxes and Fittings.
- .2 Do not install outlets back-to-back in wall; allow minimum 150 mm horizontal clearance between boxes.
- .3 Change location of outlets at no extra cost or credit, providing distance does not exceed 3000 mm, and information is given before installation.
- .4 Locate light switches on latch side of doors.

### **3.6 MOUNTING HEIGHTS**

- .1 Mounting height of equipment is from finished floor to centreline of equipment unless specified or indicated otherwise.
- .2 If mounting height of equipment is not specified or indicated, verify before proceeding with installation.
- .3 Install electrical equipment at following heights unless indicated otherwise.
  - .1 Local switches: 1200 mm.
  - .2 Panelboards: as required by Code or as indicated.

### **3.7 CO-ORDINATION OF PROTECTIVE DEVICES**

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

### **3.8 FIELD QUALITY CONTROL**

- .1 Load Balance:
  - .1 Measure phase current to panelboards with normal loads (lighting) operating at time of acceptance; adjust branch circuit connections as required to obtain best balance of current between phases and record changes.
  - .2 Measure phase voltages at loads and adjust transformer taps to within 2% of rated voltage of equipment.
  - .3 Provide upon completion of work, load balance report as directed in PART 1 - 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.
- .2 Conduct following tests in accordance with Section 01 45 00 - Quality Control.
  - .1 Circuits originating from branch distribution panels.
  - .2 Lighting and its control.
  - .3 Motors, heaters and associated control equipment including sequenced operation of systems where applicable.
  - .4 Insulation resistance testing:
    - .1 Megger circuits, feeders and equipment up to 350 V with a 500 V instrument.
    - .2 Megger 350-600 V circuits, feeders and equipment with a 1000 V instrument.
    - .3 Check resistance to ground before energizing.
- .3 Carry out tests in presence of Ministerial Representative.
- .4 Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project.
- .5 Manufacturer's Field Services:
  - .1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS.

- .2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

### **3.9 SYSTEM STARTUP**

- .1 Instruct Ministerial Representative and operating personnel in operation, care and maintenance of systems, system equipment and components.
- .2 Provide these services for such period, and for as many visits as necessary to put equipment in operation, and ensure that operating personnel are conversant with aspects of its care and operation.

### **3.10 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 Waste Management: separate waste materials for reuse recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
  - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

**END OF SECTION**





## **PART1 -GENERAL**

### **1.1 DEMOLITION**

- .1 Remove all existing electrical equipments indicated on the drawings. This equipment must be removed in appropriate time.

### **1.2 EXISTING EQUIPMENTS**

- .1 Means all existing equipment or components existing materials relevant to the existing electrical installations at the time of signing the contract associated with this specifications and drawings related there to.
- .2 All existing equipment to remove:
  - .1 To be completely removed from its supply point to its point of use, unless indicated in drawing.
  - .2 Becomes the property of the Contractor when the owner does not recover. The Contractor shall dispose promptly.
- .3 All existing equipment to remove and relocate:
  - .1 To be relocated to a location specified in the new drawings.
  - .2 Where indicated in drawings, wiring of an existing unit to remove and relocate may be reused in whole or in part if the wiring is in excellent condition. However, it must respect the existing function of the wiring by giving it the same function.
- .4 Where existing fixtures are relocated, they must be clean and with new lamps:
  - .1 All fixtures having any defective ballast, lenses broken and otherwise damage, must be returned in perfect condition with the appearance of a new device. Submit to Department Representative a listing of all equipment to be replaced. In this way, the replacement cost will be pay by Ministerial Representative.

### **1.3 CONTINUITY OF ELECTRIC SERVICES**

- .1 Ensure the full continuity of electrical services to building occupants during and after construction.
- .2 Where changes to the existing electrical installation affect areas adjacent to works, supply and install conduits, conductors, equipment and accessories necessary for the permanent redistribution of services.

#### **1.4 INTERRUPTION OF POWER**

- .1 Interruptions of power supply should be minimized and shall be implemented in close coordination with the Ministerial Representative, who must be notified at least fifteen (15) working days in advance and recalled forty-eight (48 ) hours before work begins.
- .2 Interruptions of power supply must be planned and documented. The Contractor shall submit for approval a detailed description explaining the actions and work in each step. The duration of each operation must be adequately prepared to allow the Ministerial Representative to decide to proceed with the work.
- .3 In the event of an order-con from the Ministerial Representative, the Contractor shall provide the opportunity to restore power supply in operation in less than twenty (20) minutes.

**END OF SECTION**

## **PART 1 - GENERAL**

### **1.1 RELATED REQUIREMENTS**

- .1 Section 01 74 21 – Construction/Demolition Waste Management and Disposal.
- .2 Section 26 05 00 - Common Works Results - Electrical.

### **1.2 REFERENCES**

- .1 CSA International
  - .1 CAN/CSA-C22.2 No.18, Outlet Boxes, Conduit Boxes and Fittings.
  - .2 CAN/CSA-C22.2 No.65, Wire Connectors (Tri-National Standard with UL 486A-486B and NMX-J-543-ANCE-03).
- .2 National Electrical Manufacturers Association (NEMA)

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

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for wire and box connectors and include product characteristics, performance criteria, physical size, finish and limitations.

### **1.4 CLOSEOUT SUBMITTALS**

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

### **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 off ground, indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect wire and box connectors from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.
- .4 Packaging Waste Management: remove for reuse and return of pallets, crates, padding, packaging materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

## **PART 2 - PRODUCTS**

### **2.1 MATERIALS**

- .1 Pressure type wire connectors to: CAN/CSA-C22.2 No.65, with current carrying parts of copper sized to fit copper conductors as required.
- .2 Fixture type splicing connectors to: CAN/CSA-C22.2 No.65, with current carrying parts of copper sized to fit copper conductors 10 AWG or less.
- .3 Clamps or connectors for armoured cable, as required to: CAN/CSA-C22.2 No.18.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for wire and box connectors installation in accordance with manufacturer's written instructions.
  - .1 Visually inspect substrate.
  - .2 Inform Ministerial Representative of unacceptable conditions immediately upon discovery.
  - .3 Proceed with installation only after unacceptable conditions have been remedied and received write approbation of the Ministerial Representative.

### **3.2 INSTALLATION**

- .1 Remove insulation carefully from ends of conductors and cables 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 fixture type connectors and tighten to CAN/CSA-C22.2 No.65. Replace insulating cap.

### **3.3 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 Waste Management: separate waste materials for recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
  - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

**END OF SECTION**



## **PART 1 - GENERAL**

### **1.1 RELATED REQUIREMENTS**

- .1 Section 01 33 00 – Submittal Procedures
- .2 Section 01 74 21 – Construction/Demolition Waste Management and Disposal.
- .3 Section 26 05 00 - Common Works Results - Electrical.
- .4 Section 26 05 20 - Wire and Box Connectors - (0-1000 V).

### **1.2 REFERENCES**

- .1 Unless opposite indication, execute all works conforms to current “Code de construction du Québec”.
- .2 Execute all works, respending the effective edition of each code or norm having jurisdiction, including but nor limited to:
  - .1 Canadian Standards Association (CSA International)
    - .1 CSA C22.2 n° 0.3, Test Methods for Electrical Wires and Cables.
    - .2 CAN/CSA-C22.2 n° 131, Type TECK 90 Cable.
    - .3 CSA C-22.2 n° 123.96.
    - .4 CSA C-22.2 n° 174-M1984.
  - .2 Underwriters Laboratories of Canada (ULC)
    - .1 ULC-S139-00, Method of Fire Test for Evaluation of Integrity of Electrical Cables

### **1.3 PRODUCT DATA**

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

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

- .1 Packaging Waste Management: remove for reuse in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

## **PART 2 - PRODUCTS**

### **2.1 BUILDING WIRES**

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

### **2.2 TECK 90 CABLE**

- .1 Conductors:
  - .1 Grounding conductor: copper.
  - .2 Circuit conductors: copper, size as indicated.
- .2 Insulation:
  - .1 Cross-linked polyethylene XLPE.
  - .2 Rating: 600 V.
- .3 Inner jacket: polyvinyl chloride material.
- .4 Armour: aluminium.
- .5 Overall covering: thermoplastic polyvinyl chloride, compliant to applicable Building Code classification for this project.
- .6 Fastenings:
  - .1 One hole steel straps to secure surface cables 50 mm and smaller. Two hole steel straps for cables larger than 50 mm.
  - .2 Channel type supports for two or more cables at 1500 mm centers.
  - .3 Threaded rods: 6 mm diameter to support suspended channels.
- .7 Connectors:
  - .1 Watertight, approved for TECK cable.

### **2.3 ARMOURED CABLES**

- .1 Conductors: insulated, copper, size as indicated.



- .2 Type: AC90.
- .3 Armour: interlocking type fabricated from aluminum strip.
- .4 Connectors: anti short connectors.

### **PART 3 - EXECUTION**

#### **3.1 FIELD QUALITY CONTROL**

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

#### **3.2 GENERAL CABLE INSTALLATION**

- .1 Terminate cables in accordance with Section 26 05 20 - Wire and Box Connectors - (0-1000 V).
- .2 Cable Colour Coding: to Section 26 05 00 - Common Work Results for Electrical.
- .3 Conductor length for parallel feeders to be identical.
- .4 Lace or clip groups of feeder cables at distribution centres, pull boxes, and termination points.
- .5 Wiring in walls: typically drop or loop vertically from above to better facilitate future renovations. Generally wiring from below and horizontal wiring in walls to be avoided unless indicated.
- .6 Provide numbered wire collars for control wiring. Numbers to correspond to control shop drawing legend.

#### **3.3 INSTALLATION OF BUILDING WIRES**

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

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

- .1 Group cables wherever possible on channels.
- .2 Install cable exposed, securely supported by straps.

### **3.5 INSTALLATION OF ARMOURED CABLES**

- .1 Group cables wherever possible on channels.

**END OF SECTION**

## **PART 1 - GENERAL**

### **1.1 RELATED REQUIREMENTS**

- .1 Section 01 74 21 – Construction/Demolition Waste Management and Disposal.
- .2 Section 26 05 00 - Common Works Results - Electrical.
- .3 Section 26 05 21 – Wires and Cables (0-1000 V).

### **1.2 REFERENCES**

- .1 American National Standards Institute /Institute of Electrical and Electronics Engineers (ANSI/IEEE)
  - .1 ANSI/IEEE 837, IEEE Standard for Qualifying Permanent Connections Used in Substation Grounding.

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

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for grounding equipment and include product characteristics, performance criteria, physical size, finish and limitations.

### **1.4 CLOSEOUT SUBMITTALS**

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

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

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

- .2 Store and protect grounding equipment from nicks, scratches, and blemishes.
- .3 Replace defective or damaged materials with new.
- .4 Packaging Waste Management: remove for reuse of pallets, crates, padding, packaging materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

## **PART 2 - PRODUCTS**

### **2.1 EQUIPMENT**

- .1 Grounding conductors: bare stranded copper, tinned, soft annealed, size as indicated.
- .2 Insulated grounding conductors: green, copper conductors, size as indicated.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

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

### **3.2 INSTALLATION GENERAL**

- .1 Install complete permanent, continuous grounding system including, conductors, connectors, accessories with EMT-Conduit, including inside a grounding conductor.
- .2 Install connectors in accordance with manufacturer's instructions.
- .3 Protect grounding conductor mounted to access against damage.
- .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 Make grounding connections in radial configuration only, with connections terminating at single grounding point. Avoid loop connections.
- .8 Connect metallic armed cable to source panelboard and side charge.
- .9 Make grounding panelboard and existing poles of surelevation floor.

### **3.3 SYSTEM AND CIRCUIT GROUNDING**

- .1 Install system and circuit grounding.

### **3.4 EQUIPMENT GROUNDING**

- .1 Install grounding connections to typical equipment included in, but not necessarily limited to following list. Service equipment, frames of motors, starters, control panels, distribution panels, outdoor lighting.

### **3.5 FIELD QUALITY CONTROL**

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Perform ground continuity and resistance tests using method appropriate to site conditions and to approval of local authority having jurisdiction over installation.
- .3 Perform tests before energizing electrical system.
- .4 Disconnect ground fault indicator during tests.

### **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 Waste Management: separate waste materials for recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
  - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

**END OF SECTION**



## **PART 1 - GENERAL**

### **1.1 RELATED REQUIREMENTS**

- .1 Section 01 74 21 – Construction/Demolition, Waste Management and Disposal.
- .2 Section 26 05 00 - Common Works Results - Electrical.

### **1.2 WASTE MANAGEMENT AND DISPOSAL**

- .1 Separate and recycle waste materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management And Disposal.
- .2 Remove from site and dispose of all packaging materials at appropriate recycling facilities.
- .3 Collect and separate for disposal paper, plastic, polystyrene, or corrugated cardboard packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.
- .4 Divert unused metal materials from landfill to metal recycling facility as approved by Ministerial Representative.
- .5 Fold up metal banding, flatten and place in designated area for recycling.

## **PART 2 - PRODUCTS**

### **2.1 SUPPORT CHANNELS**

- .1 U shape, size 41 x 41 mm, 2.5 mm thick, surface mounted, suspended or set in poured concrete walls and ceilings.
- .2 Galvanized steel supports.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- .1 Secure equipment to masonry, tile and plaster surfaces with lead anchors.
- .2 Secure equipment to poured concrete with expandable inserts.

- .3 Secure equipment to hollow masonry walls or suspended ceilings with toggle bolts.
- .4 Secure surface mounted equipment with twist clip fasteners to inverted T bar ceilings. Ensure that T bars are adequately supported to carry weight of equipment specified before installation.
- .5 Support equipment, conduit or cables using clips, spring loaded bolts, cable clamps designed as accessories to basic channel members.
- .6 Use the following elements mounting bracket for securing exposed cables or conduits to the structure or structural elements of the building:
  - .1 One-hole straps, galvanized steel, for securing surface-mounted conduits and cables of 53 mm diameter or less.
  - .2 Two-hole straps, galvanized steel, for securing surface-mounted conduits and cables larger than 53 mm diameter.
- .7 Suspended support systems.
  - .1 Support individual cable or conduit runs with 6 mm dia threaded rods and spring clips.
  - .2 Support 2 or more cables or conduits on channels supported by 6 mm dia threaded rod hangers where direct fastening to building construction is impractical.
- .8 For surface mounting of two or more conduits use channels at a maximum of 1.5 m on centre spacing.
- .9 Provide metal brackets, frames, hangers, clamps and related types of support structures where indicated or as required to support conduit and cable runs.
- .10 Ensure adequate support for raceways and cables dropped vertically to equipment where there is no wall support.
- .11 Do not use wire lashing or perforated strap to support or secure raceways or cables.
- .12 Do not use supports or equipment installed for other trades for conduit or cable support except with permission of other.
- .13 Install fastenings and supports as required for each type of equipment cables and conduits, and in accordance with manufacturer's installation recommendations.

**END OF SECTION**



## **PART 1 - GENERAL**

### **1.1 RELATED REQUIREMENTS**

- .1 Section 01 33 00 – Submittal Procedures.
- .2 Section 01 74 21 – Construction/Demolition, Waste Management and Disposal.
- .3 Section 26 05 00 - Common Works Results - Electrical.

### **1.2 REFERENCES**

- .1 Canadian Standards Association (CSA International)
  - .1 CSA C22.1, Code de construction du Québec, Chapitre V, Électricité.

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

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

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

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

## **PART 2 - PRODUCTS**

### **2.1 SPLITTERS**

- .1 Construction: sheet metal enclosure, welded corners and formed hinged cover suitable for locking in closed position.

- .2 Terminations: main and branch lugs or connection blocks to match required size and number of incoming and outgoing conductors as indicated.
- .3 Spare Terminals: minimum three spare terminals or lugs on each connection or lug block sized less than 400 A.

## **2.2 JUNCTION AND PULL BOXES**

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

## **PART 3 - EXECUTION**

### **3.1 SPLITTER INSTALLATION**

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

### **3.2 JUNCTION AND PULL BOXES INSTALLATION**

- .1 Install pull boxes in inconspicuous but accessible locations.
- .2 All junction and pull boxes shall be of appropriate size according to the number of conductors and the diameter of connected conduits.

### **3.3 IDENTIFICATION TAGS**

- .1 Equipment Identification: in accordance with Section 26 05 00 - Common Work Results - Electrical.
- .2 Labels: format 2, indicating name of network, power supply, permissible current, voltage and number of phases.

**END OF SECTION**

## **PART 1 - GENERAL**

### **1.1 RELATED REQUIREMENTS**

- .1 Section 01 33 00 – Submittal Procedures.
- .2 Section 01 74 21 – Construction/Demolition, Waste Management and Disposal.
- .3 Section 26 05 00 - Common Works Results - Electrical.

### **1.2 REFERENCES**

- .1 Canadian Standards Association (CSA International)
  - .1 CSA C22.1, Code de construction du Québec – Chapitre V – Électricité.

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

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

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

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Waste Management and Disposal:
  - .1 Separate waste materials for recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

## **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, for special devices.
- .3 Gang boxes where wiring devices are grouped.
- .4 Blank cover plates for boxes without wiring devices.
- .5 347 V outlet boxes for 347 V switching devices.
- .6 Combination boxes with barriers where outlets for more than one system are grouped.

## **2.2 GALVANIZED STEEL OUTLET BOXES**

- .1 One-piece electro-galvanized construction.
- .2 Single or multi gang flush device boxes for flush installation, minimum size 76 x 50 x 38 mm or as indicated. 102 mm square outlet boxes when more than one conduit enters one side with extension and plaster rings as required.
- .3 Utility boxes for outlets connected to surface-mounted EMT conduit, minimum size 102 x 54 x 48 mm.
- .4 102 mm square or octagonal outlet boxes for lighting fixture outlets.
- .5 Extension and plaster rings for flush mounting devices in gypsum boards, finished plaster or tile walls.

## **2.3 CONDUIT BOXES**

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

## **2.4 FITTINGS - GENERAL**

- .1 Bushing and connectors with nylon insulated throats.
- .2 Knock-out fillers to prevent entry of debris.
- .3 Conduit outlet bodies for conduit up to 35 mm and pull boxes for larger conduits.
- .4 Double locknuts and insulated bushings on sheet metal boxes.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- .1 Support boxes independently of connecting conduits.
- .2 Fill boxes with paper, sponges or foam or similar approved material to prevent entry of debris during construction. Remove upon completion of work.
- .3 For flush installations mount outlets flush with finished wall using plaster rings to permit wall finish to come within 6 mm of opening.
- .4 Provide correct size of openings in boxes for conduit, mineral insulated and armoured cable connections. Do not install reducing washers.

- .5 Vacuum clean interior of outlet boxes before installation of wiring devices.
- .6 Identify systems for outlet boxes as required.
- .7 Install cast FS or FD aluminium boxes surface in all no finish rooms, mechanical rooms, electrical rooms and crawl spaces.

**END OF SECTION**



## **PART 1 - GENERAL**

### **1.1 RELATED REQUIREMENTS**

- .1 Section 01 33 00 – Submittal Procedures.
- .2 Section 01 74 21 – Construction / Demolition, Waste Management and Disposal.
- .3 Section 26 05 00 - Common Works Results - Electrical.

### **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.

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

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product data: submit manufacturer's printed product literature, specifications and datasheets.
  - .1 Submit cable manufacturing data.
- .3 Quality assurance submittals:
  - .1 Test reports: submit certified test reports.
  - .2 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
  - .3 Instructions: submit manufacturer's installation instructions.

### **1.4 WASTE MANAGEMENT AND DISPOSAL**

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

- .2 Place materials defined as hazardous or toxic waste in designated containers.
- .3 Ensure emptied containers are sealed and stored safely for disposal away from children.

## **1.5 GENERAL**

- .1 Routing of conduits and does not appear entirely on drawings. Those who are indicated are represented in schematic form.

## **PART 2 - PRODUCTS**

### **2.1 CONDUITS**

- .1 Electrical metallic tubing (EMT): to CSA C22.2 No. 83, with couplings.
- .2 Flexible metal conduit: to CSA C22.2 No. 56, liquid-tight flexible metal steel.
- .3 Conduit and tubing diameter size : minimum 21 mm unless indicated otherwise.

### **2.2 CONDUIT FASTENINGS**

- .1 One hole steel straps to secure surface conduits 53 mm and smaller.
  - .1 Two hole steel straps for conduits larger than 53 mm.
- .2 Beam clamps to secure conduits to exposed steel work.
- .3 Channel type supports for two or more conduits at 1.5 m on centre.
- .4 Galvanized steel threaded rods, 6 mm diameter, to support suspended channels.

### **2.3 CONDUIT FITTINGS**

- .1 Ensure factory "ells" where 90 degrees bends for 27 mm and larger conduits.
- .2 Watertight connectors and couplings for EMT.
  - .1 Set-screws are not acceptable.

### **2.4 FISH CORD**

- .1 Polypropylene, single length, in each duct and 3 m beyond each end.



## **PART 3 - EXECUTION**

### **3.1 MANUFACTURER'S INSTRUCTIONS**

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

### **3.2 INSTALLATION**

- .1 Install conduits to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass.
- .2 Conceal conduits except in unfinished areas.
- .3 Use electrical metallic tubing (EMT) when not subject to mechanical damage except in cast concrete.
- .4 Use flexible metal conduit for connection to motors in dry areas, connection to recessed incandescent fixtures without prewired outlet box, connection to surface or recessed fluorescent fixtures.
- .5 Use liquid tight flexible metal conduit for connection to motors or vibrating equipment in damp, wet or corrosive locations.
- .6 Minimum conduit size for lighting and power circuits: 21 mm.
- .7 Bend conduit cold:
  - .1 Replace conduit if kinked or flattened more than 1/10<sup>th</sup> of its original diameter.
- .8 Mechanically bend steel conduit over 21 mm diameter.
- .9 Install fish cord in empty conduits.
- .10 Remove and replace blocked conduit sections.
  - .1 Do not use liquids to clean out conduits.
- .11 Dry conduits out before installing wire.

### **3.3 SURFACE CONDUITS**

- .1 Run parallel or perpendicular to building lines.
- .2 Locate conduits behind infrared or gas fired heaters with 1.5 m clearance.
- .3 Group conduits wherever possible on suspended or surface channels.

- .4 Do not pass conduits through structural members except as indicated.
- .5 Do not locate conduits less than 75 mm parallel to steam or hot water lines with minimum of 25 mm at crossovers.

### **3.4 CONCEALED CONDUITS**

- .1 Run parallel or perpendicular to building lines.
- .2 Do not install horizontal runs in masonry walls.
- .3 Do not install conduits in terrazzo or concrete toppings.

### **3.5 CLEANING**

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

**END OF SECTION**

## **PART 1 - GENERAL**

### **1.1 RELATED SECTIONS**

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
- .3 Section 26 05 00 - Common Work Results - Electrical.

### **1.2 REFERENCES**

- .1 Execute all the works, respecting the effective edition of the Construction Code of Quebec.
- .2 Execute all the works, respecting the effective edition of each code or norm having jurisdiction, including but not limited to:
  - .1 Canadian Standards Association (CSA International).
    - .1 CAN/CSA-C22.2, Air-Cooled Transformers (Dry Type).
    - .2 CSA C9, Dry-Type Transformers.
    - .3 CSA C802.2, Minimum efficiency values for dry-type transformers.
  - .3 National Electrical Manufacturers Association (NEMA).

### **1.3 PRODUCT DATA**

- .1 Submit product data and shop drawings in accordance with Section 01 33 00 - Submittal Procedures.

### **1.4 WASTE MANAGEMENT AND DISPOSAL**

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

## **PART 2 - PRODUCTS**

### **2.1 TRANSFORMERS**

- .1 Use transformers of one manufacturer throughout project.
  - .1 Type: transformer, ANN.
  - .2 3-phase, capacity as indicated in drawings, 600 V input, 120/208 V output, 60 Hz.
  - .3 Voltage Taps:  $\pm 2\frac{1}{2}\%$ ,  $\pm 5\%$ .
  - .4 Insulation: Class H, 150°C temperature rise.
  - .5 Windings: copper in accordance with C802.2.
  - .6 Basic Impulse Level (BIL): standard.
  - .7 Hipot: standard.
  - .8 Average Sound Level less than 45dB.
  - .9 Impedance at 170°C: standard.
  - .10 Enclosure: NEMA, removable metal front panel.
  - .11 Finish: in accordance with Section 26 05 00 - Common Work Results - Electrical.
  - .12 Anti-vibration isolators: Novibra supports or approved equivalent.

### **2.2 EQUIPMENT IDENTIFICATION**

- .1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results - Electrical.
- .2 Label Size: 7. Nameplate Wording: primary and secondary voltage, and capacity.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- .1 Mount dry type transformers with a capacity less than 75kVa, on the floor under a concrete base or on the wall, as indicated in drawings.
- .2 Ensure adequate clearance around transformer for ventilation.
- .3 Install transformers in level upright position. Respect the effective earthquake-resistant rules
- .4 If the transformer is suspended, use anti-vibration supports. Respect the effective earthquake-resistant rules.
- .5 Remove shipping supports only after transformer is installed and just before putting into service.
- .6 Loosen isolation pad bolts until no compression is visible.
- .7 Make primary and secondary connections in accordance with wiring diagram.
- .8 Energize transformers after installation is complete.
- .9 Install vibrating isolators between the concrete base and/or the supports and the transformer.

**END OF SECTION**



## **PART 1 - GENERAL**

### **1.1 RELATED SECTIONS**

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
- .3 Section 26 05 00 - Common Work Results - Electrical.
- .4 Section 26 28 16.02 - Moulded Case Circuit Breakers.

### **1.2 REFERENCES**

- .1 Execute all the works, respecting the effective edition of the Construction Code of Quebec.
- .2 Execute all the works, respecting the effective edition of each code or norm having jurisdiction, including but not limited to:
  - .1 Canadian Standards Association (CSA International).
    - .1 CSA C22.2, No. 29, Panelboards and enclosed Panelboards.

### **1.3 SHOP DRAWINGS**

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

### **1.4 WASTE MANAGEMENT AND DISPOSAL**

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

## **PART 2 - PRODUCTS**

### **2.1 PANELBOARDS**

- .1 Panelboards: to CSA C22.2, No. 29 and product of one manufacturer.
  - .1 Install circuit breakers in panelboards before shipment.
  - .2 In addition to CSA requirements manufacturer's nameplate must show fault current that panel including breakers has been built to withstand.
- .2 Bar bus short-circuit rating: 22 000 A at 600 V, and 14 000 A at 208 V, or as indicated. Breakers interrupting capacity: 22 000 A at 600 V and 14 000 A at 208 V, or as indicated.
- .3 Sequence phase bussing with odd numbered breakers on left and even on right, with each breaker identified by permanent number identification as to circuit number and phase.
- .4 Panelboards: mains, number of circuits, and number and size of branch circuit breakers as indicated.
- .5 Two (2) keys for each panelboard and key panelboards alike.
- .6 Copper bus with neutral of same ampere rating as mains.
- .7 Mains: suitable for bolt-on breakers.
- .8 Trim and door finish: baked grey enamel.
- .9 Trim with concealed front bolts and hinges.
- .10 "Space" means to provide empty space with blank plate ready to receive a circuit breaker. "Spare" means to provide and install a circuit breaker for future use.

### **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 Lock-on devices for fire alarm system, emergency lighting and exit signs branch circuit breakers.



## **2.3 EQUIPMENT IDENTIFICATION**

- .1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results - Electrical.
- .2 Nameplate for each panelboard size 4 indicating voltage and panelboard identification.
- .3 Complete circuit directory with typewritten legend showing location and load of each circuit, installed in a plastic pocket under the panelboard 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 fire-rated plywood backboards (dimension: 19 mm) in accordance. Where practical, group panelboards on common backboard.
- .3 Mount panelboards to height specified in Section 26 05 00 - Common Work Results - Electrical or as indicated.
- .4 Connect loads to circuits.
- .5 Connect neutral conductors to common neutral bus with respective neutral identified.
- .6 For each built in wall panelboard, install three (3) spare conduits, 53 mm, between panelboard and ceiling space. Finish these conduits, in accessible ceiling space, with pulling boxes 600 mm x 450 mm x 450 mm.

**END OF SECTION**



## **PART 1 - GENERAL**

### **1.1 RELATED SECTIONS**

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
- .3 Section 26 05 00 - Common Work Results - Electrical.

### **1.2 REFERENCES**

- .1 Execute all the works, respecting the effective edition of the Construction Code of Quebec.
- .2 Execute all the works, respecting the effective edition of each code or norm having jurisdiction, including but not limited to:
  - .1 Canadian Standards Association (CSA International).
    - .1 CSA-C22.2, No. 42, General Use Receptacles, Attachment Plugs and Similar Devices.
    - .2 CSA-C22.2, No. 42.1, Cover Plates for Flush-Mounted Wiring Devices (Bi-national standard, with UL 514D).
    - .3 CSA-C22.2, No. 55, Special Use Switches.
    - .4 CSA-C22.2, No. 111, General-Use Snap Switches (Bi-national standard, with UL 20, twelfth edition).

### **1.3 SHOP DRAWINGS AND PRODUCT DATA**

- .1 Submit shop drawings and product data in accordance with Section 01 33 00 - Submittal Procedures.

### **1.4 WASTE MANAGEMENT AND DISPOSAL**

- .1 Separate and recycle waste materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
- .2 Remove from site and dispose of all packaging materials at appropriate recycling facilities.

- .3 Collect and separate for disposal packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.
- .4 Divert unused metal and wiring materials from landfill to metal recycling facility as approved by Ministerial Representative.

## **PART 2 - PRODUCTS**

### **2.1 SWITCHES**

- .1 15 A, 347 V, three-way switches, "Specification Grade".
- .2 Manually-operated general purpose AC switches with following features:
  - .1 Terminal holes approved for No. 10 AWG wire.
  - .2 Silver alloy contacts.
  - .3 Urea or melamine moulding for parts subject to carbon tracking.
  - .4 Suitable for back and side wiring.
  - .5 Color: white for normal circuits, red for emergency circuits.
- .3 Toggle operated fully rated for tungsten filament and fluorescent lamps, and up to 120% of rated capacity of motor loads.
- .4 Switches of one manufacturer throughout project.
- .5 Acceptable products:

	<b>Pass &amp; Seymour</b>	<b>Hubbell</b>	<b>Leviton</b>
347 V - 20 A - 1 P	372010-I	HBL-18201-I	18201-I
347 V - 20 A - 3 P	372030-I	HBL-18203-I	18203-I
347 V - 20 A - 4 P	372040-I	HBL-18204-I	18204-I

- .1 Replacement materials or products: approved by addendum according to Instructions to bidders

### **2.2 COVER PLATES**

- .1 Provide cover plates for wiring devices.
- .2 Cover plates from one manufacturer throughout project.
- .3 Stainless steel, vertically brushed, 1 mm thick cover plates for wiring devices mounted in flush-mounted outlet box.

- .4 Sheet metal 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 switches in gang type outlet box when more than one switches is required in one location.
  - .2 Mount switches at height in accordance with Section 26 05 00 - Common Work Results - Electrical or as indicated.
  - .3 Install switches close to the doors and in the same side as the pull of the door.
- .2 Cover Plates:
  - .1 Protect stainless steel cover plate finish with paper or plastic film until painting and other work is finished.
  - .2 Install suitable common cover plates where wiring devices are grouped.
  - .3 Do not use cover plates meant for flush outlet boxes on surface-mounted boxes.
- .3 Make tests in accordance with effective standards and supply a report.
- .4 All the receptacles installed at less than 1 m from a wash basin or a sink must be protected by a GFI breaker at the panelboard or GFI receptacle (see section 262820- Ground fault circuit interrupters - class "A").
- .5 Do not install back to back outlets. A minimum 150 mm horizontal space must be left between boxes.

**END OF SECTION**



## **PART 1 - GENERAL**

### **1.1 RELATED SECTIONS**

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
- .3 Section 26 24 16.01 - Panelboards Breaker Type.

### **1.2 REFERENCES**

- .1 Execute all the works, respecting the effective edition of the Construction Code of Quebec.
- .2 Execute all the works, respecting the effective edition of each code or norm having jurisdiction, including but not limited to:
  - .1 Canadian Standards Association (CSA)/CSA International.
    - .1 CSA-C22.2, No. 5, Moulded-Case Circuit Breakers, Moulded-Case Switches and Circuit-Breaker Enclosures.

### **1.3 SUBMITTALS**

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

### **1.4 WASTE MANAGEMENT AND DISPOSAL**

- .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
- .2 Collect and separate for disposal packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.
- .3 Separate and place in designated containers Metal waste in accordance with Waste Management Plan.

## **PART 2 - PRODUCTS**

### **2.1 BREAKERS GENERAL**

- .1 Moulded-Case Circuit Breakers: to CSA C22.2, No. 5.
- .2 Bolt-on Moulded Case Circuit Breaker: quick-make, quick-break type, for manual and automatic operation with temperature compensation for 40 degrees C ambient.
- .3 Common-trip Breakers: with single handle for multi-pole applications.
- .4 Breakers must have at least the interrupting capacity as the panelboard where they are installed.

### **2.2 THERMAL MAGNETIC BREAKERS**

- .1 Moulded case circuit breaker to operate automatically by means of thermal and magnetic tripping devices to provide inverse time current tripping and instantaneous tripping for short circuit protection.
- .2 Minimum Interrupting Capacity Rating:
  - .1 For 120/208V panelboards: 14 kA rms symmetrical, or as indicated.
- .3 Minimum Interrupting Capacity Rating:
  - .1 For 347/600V panelboards: 22 kA rms symmetrical, or as indicated.
- .4 New circuit breaker to be installed in the existing CCM must be type HFD from Cutler Hammer (Westinghouse), 25kA, with connector kit #47B0248.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- .1 Install circuit breakers as indicated.

**END OF SECTION**



## **PART 1 - GENERAL**

### **1.1 RELATED SECTIONS**

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 35 29.06 - Health and Safety Requirements.
- .3 Section 01 74 21 -Construction/Demolition Waste Management and Disposal.
- .4 Section 26 05 00 - Common Work Results - Electrical.
- .5 Section 26 28 13.01 – Fuses – Low Voltage.

### **1.2 REFERENCES**

- .1 Execute all the works, respecting the effective edition of the Construction Code of Quebec.
- .2 Execute all the works, respecting the effective edition of each code or norm having jurisdiction, including but not limited to:
  - .1 Canadian Standards Association (CSA International).
    - .1 CAN/CSA C22.2, No. 4, Enclosed Switches.
    - .2 CAN/CSA C22.2, No. 39, Fuse Support.

### **1.3 SUBMITTALS**

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

### **1.4 HEALTH AND SAFETY**

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

### **1.5 WASTE MANAGEMENT AND DISPOSAL**

- .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
- .2 Remove from site and dispose of packaging materials at appropriate recycling facilities.

- .3 Collect and separate for disposal paper, plastic, polystyrene, corrugated cardboard packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.
- .4 Separate for reuse and recycling and place in designated containers Steel, Metal, Plastic waste in accordance with Waste Management Plan.
- .5 Fold up metal banding, flatten and place in designated area for recycling.

## **PART 2 - PRODUCTS**

### **2.1 DISCONNECT SWITCHES**

- .1 Non-fusible, disconnect switch in NEMA1 for indoor use, and NEMA 3R for outdoor use.
- .2 Provision for padlocking in on-off switch position by three locks.
- .3 Mechanically interlocked door to prevent opening when handle in ON position.
- .4 Fusibles: Calibre as indicated and conform to section 26 28 13.01 – Fusibles – Low Voltage.
- .5 Fuseholders: to CSA C22.2 No. 39 suitable without adaptors, for type and size of fuse indicated.
- .6 Quick-make, quick-break action.
- .7 "ON-OFF" switch position indication on switch enclosure cover.
- .8 Heavy duty construction.

### **2.2 EQUIPMENT IDENTIFICATION**

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

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- .1 Install disconnect switches complete with fuses if applicable.
- .2 Install disconnect switches in order to operate easily the handle with left arm.

**END OF SECTION**

## **PART 1 - GENERAL**

### **1.1 RELATED REQUIREMENTS**

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 61 00 - Common Product Requirements.
- .3 Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
- .4 Section 01 78 00 - Closeout Submittals.
- .5 Section 26 05 00 - Common Work Results - Electrical.

### **1.2 REFERENCES**

- .1 Execute all the works, respecting the effective edition of the Construction Code of Quebec.
- .2 Execute all the works, respecting the effective edition of each code or norm having jurisdiction, including but not limited to:
  - .1 Canadian Standards Association (CSA International).
  - .2 International Electrotechnical Commission (IEC).
    - .1 IEC 947-4-1-2002, Part 4: Electromechanical Contactors and Motor-Starters.

### **1.3 SHOP DRAWINGS AND TECHNICAL DATA**

- .1 Provide Shop Drawings: in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Provide shop drawings for each type of starter to indicate:
  - .1 Mounting method and dimensions.
  - .2 Starter size and type.
  - .3 Layout and components.
  - .4 Enclosure types.
  - .5 Wiring diagram.
  - .6 Interconnection diagrams.

## **1.4 CLOSEOUT SUBMITTALS**

- .1 Provide maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Submit operation and maintenance data for each type and style of motorstarter for incorporation into maintenance manual.
- .3 Extra Materials:
  - .1 Provide listed spare parts for each different size and type of starter.
    - .1 Three (3) contacts, stationary.
    - .2 Three (3) contacts, movable.
    - .3 One (1) contact, auxiliary.
    - .4 One (1) control transformer.
    - .5 One (1) operating coil.
    - .6 Two (2) fuses.
    - .7 10% indicating lamp bulbs used.

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

- .1 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
- .3 Packaging Waste Management: remove for reuse in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

## **PART 2 - PRODUCTS**

### **2.1 MATERIALS**

- .1 Starters: to IEC 947-4 with AC4 utilization category.

## **2.2 FULL VOLTAGE MAGNETIC STARTERS**

- .1 Combination magnetic starters of size, type, rating and enclosure type as indicated with components as follows:
  - .1 Contactor solenoid operated, rapid action type.
  - .2 Motor overload protective device in each phase, manually reset from outside enclosure.
  - .3 Terminals for supply and control cables, with 20% spare.
  - .4 Wiring and schematic diagram inside starter enclosure in visible location.
  - .5 Identify each wire and terminal for external connections, within starter, with permanent number marking identical to diagram.
- .2 Combination type starters to include fused disconnect switch with operating lever on outside of enclosure to control disconnect, and provision for:
  - .1 Locking in "OFF" position with up to three (3) padlocks.
  - .2 Locking in "Auto" position.
  - .3 Independent locking of enclosure door.
  - .4 Provision for preventing switching to "ON" position while enclosure door open.
- .3 Accessories:
  - .1 Selector switches: three-positions "ON-OFF-AUTO" heavy duty labelled as indicated.
  - .2 Indicating lights: heavy duty LED, oil tight type, color: green: ready/red: ON/yellow: overload.
  - .3 Phase failure detector, type Controlab DSP-1A with GB, for motors of 5 HP and above.
  - .4 Two (2) spare auxiliary contacts NO and NC unless otherwise indicated.

## **2.3 FINISHES**

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

## **2.4 EQUIPMENT IDENTIFICATION**

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

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- .1 Install starters and control devices in accordance with manufacturer's instructions.
- .2 Install and wire starters and controls as indicated.
- .3 If the motor is not visible from the starter or the disconnect switch, the contractor must supply a disconnect switch at less than 1500 mm from the motor.
- .4 Confirm motor nameplate and adjust overload device to suit.

### **3.2 FIELD QUALITY CONTROL**

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

**END OF SECTION**

## **PART 1 - GENERAL**

### **1.1 RELATED SECTIONS**

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 45 00 - Quality Control.
- .3 Section 01 61 00 - Common Product Requirements.
- .4 Section 01 74 11 – Cleaning.
- .5 Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
- .6 Section 23 05 49 01- Seismic restraint systems.

### **1.2 REFERENCES**

- .1 Execute all the works, respecting the effective edition of the Construction Code of Quebec.
- .2 Execute all the works, respecting the effective edition of each code or norm having jurisdiction, including but not limited to:
  - .1 Canadian Standards Association (CSA International).
    - .1 CSA C22.2 n° 74, Equipment for Use with Electric Discharge Lamps.
  - .2 American National Standards Institute (ANSI).
    - .1 ANSI C82.1-04, Lamp Ballasts-Line Frequency Fluorescent Lamp Ballast.
  - .3 American National Standards Institute/Institute of Electrical and Electronics Engineers (ANSI/IEEE).
    - .1 ANSI/IEEE C62.41, Recommended Practice for Surge Voltages in Low-Voltage AC Power Circuits.
  - .4 ASTM International Inc.
    - .1 ASTM F1137-00 (2006), Standard Specification for Phosphate/Oil and Phosphate/Organic Corrosion Protective Coatings for Fasteners.

- .5 I.E.S.
  - .1 IES LM-79, Electrical and Photometric Measurements of Solid-State Lighting Products.
  - .2 IES LM-80, Measuring Lumen Maintenance of LED Light Sources.
- .6 Underwriters' Laboratories of Canada (ULC).

### **1.3 SHOP DRAWINGS AND INFORMATIONAL SUBMITTALS**

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Provide manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.
  - .2 Provide complete photometric data prepared by independent testing laboratory for luminaires where specified.
  - .3 Photometric data to include: coefficient of utilization and spacing criterion.

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

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
- .3 Packaging Waste Management: remove for reuse packaging materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
- .4 Divert unused metal materials from landfill to metal recycling facility.
- .5 Disposal and recycling of fluorescent lamps as per local regulations.
- .6 Disposal of old PCB filled ballasts.



## **PART 2 - PRODUCTS**

### **2.1 LAMPS**

- .1 Fluorescent Lamps to be:
  - .1 Rapid start.
  - .2 Form T-8.
  - .3 Power 32 W.
  - .4 Initial flux 3,100 lumens.
  - .5 CRI 86.
  - .6 Colour temperature 4,100 K.
  - .7 Lamp life 40,000 hours.
  - .8 Manufacturers: Osram/Sylvania (Ecologic); Philips (Alto) or equivalent GE approved.

### **2.2 BALLASTS**

- .1 Fluorescent Ballast: CBM and CSA certified, energy efficient type, IC electronic.
  - .1 Rating: 347 V, 60 Hz, for use with 2-32W, programmed start lamps.
  - .2 Electromagnetic emissions: not to exceed Class A, as defined by FCC, part 18, 15C, concerning electromagnetic interference (EMI) and radio frequency interference (RFI).
  - .3 Totally encased and designed for 40 degrees Celsius ambient temperature.
  - .4 Ambient temperature: ballast to start lamps up to a minimal ambient temperature of 10°C.
  - .5 Power factor: minimum 90% with 95% of rated lamp lumens.
  - .6 Protection against transient voltages: ballast to withstand transient voltage fluctuation and electric noise, as described in ANSI C62.41 and IEEE 587, with and without lamps in secondary circuit.
  - .7 Supply voltage: ballast to withstand 10% input voltage variation without damage.

- .8 Thermal protection: according to CSA C22.2 No. 74-1969, item 1.6.7.3 or according to technical information letter (T.I.L.) No. 37 of July 25, 1988.
- .9 Harmonics: 10% maximum THD, including 49<sup>th</sup> harmonic. Harmonic distortion not to increase with aging of the ballast.
- .10 Ballast factor: greater than 0.90.
- .11 Sound rated: Class A.
- .12 Mounting: integral with luminaire.
- .13 Connection: plug and socket.
- .14 Acceptable products: Osram; PHILIPS, G.E, or equivalent approved.

### **2.3 FINISHES**

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

### **2.4 OPTICAL CONTROL DEVICES**

- .1 As indicated in fixtures schedule.

### **2.5 LUMINAIRES**

- .1 As indicated in fixtures schedule.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- .1 Precautions during demolition:
  - .1 The lamps should not be broken during removal and should be placed in appropriate containers for storage and transportation.
  - .2 Only broken or crushed lamps are considered hazardous materials and goods and must be treated according to provincial laws and regulations in force.
  - .3 The arrangement of the lamps must be made intact by a specialist company with a certificate of authorization from the Ministry of Environment of Quebec. The

- Contractor shall submit to the Ministerial Representative a copy of the certificate of authorization of the business dealing.
- .4 A copy of the certificate of recycling should also be given to the Ministerial Representative.
  - .5 Remove and transport off-site all existing fixtures and ballasts to be removed. These are the property of the Contractor.
  - .2 Locate and install fixtures as indicated and in coordination with other equipment.
  - .3 Provide adequate support to suit ceiling system. For suspended ceiling installations support fixtures independently of ceiling.
  - .4 Respect seismic criteria described in Section 23 05 49 01- Seismic restraint systems.
  - .5 The suspension of luminaires is the responsibility of the Electrical Contractor.
  - .6 Install strip-mounted fluorescent fixtures on cable raceway to be supported at each 2.5 m.
  - .7 In mechanical rooms, the suspension of fixtures is performed using suspension chains and exact location to be determined at the scene.
  - .8 Identify all fixtures on the emergency room with a red sticker round 25mm diameter, placed on top of housing.

### **3.2 WIRING**

- .1 Connect fixtures to lighting circuits:
  - .1 Install flexible or rigid conduit for fixtures as indicated.

### **3.3 LUMINAIRE ALIGNMENT**

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

### **3.4 EXISTING INSTALLATIONS**

- .1 When existing fixtures are to be relocated, they shall be provided with new lamps; all fixtures with defective ballast, broken lenses and all other damage to be reconditioned to have the look of a new item.

### **3.5 CLEANING**

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

**END OF SECTION**

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**Division 28 / Electronic Safety and Security**

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## **PART 1 - GENERAL**

### **1.1 RELATED SECTIONS**

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 61 00 - Common Product Requirements.
- .3 Section 01 74 11 - Cleaning.
- .4 Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
- .5 Section 01 78 00 - Closeout Submittals.
- .6 Section 26 05 00 - Common Work Results for Electrical.

### **1.2 REFERENCES**

- .1 Execute all the works, respecting the effective edition of the Construction Code of Quebec.
- .2 Execute all the works, respecting the effective edition of each code or norm having jurisdiction, including but not limited to:
  - .1 Government of Canada.
    - .1 TB OSH Chapter 3-03, 1997-01-28, Treasury Board of Canada, Occupational Safety and Health, Chapter 3-03, Standard for Fire protection Electronic Data Processing Equipment.
    - .2 TB OSH Chapter 3-04, 1994-12-22, Treasury Board of Canada, Occupational Safety and Health, Chapter 3-04, Standard for Fire Alarm Systems.
  - .2 Government of Quebec,
    - .1 Construction code of Quebec-Chapter 1, Building and National building Code- Canada.
    - .2 Construction code of Quebec-Chapter V, Electricity and National building Code- Canada.

- .3 Underwriter's Laboratories of Canada (ULC).
  - .1 CAN/ULC-S524, Standard for the Installation of Fire Alarm Systems.
  - .2 CAN/ULC-S525, Audible Signal Device for Fire Alarm Systems.
  - .3 CAN/ULC-S526, Visual Signal Devices for Fire Alarm Systems.
  - .4 CAN/ULC-S527, Control Units.
  - .5 CAN/ULC-S528, Manual Pull Stations for Fire Alarm Systems.
  - .6 CAN/ULC-S529, Smoke Detectors for Fire Alarm Systems.
  - .7 CAN/ULC-S530, Heat Actuated Fire Detectors for Fire Alarm Systems.
  - .8 CAN/ULC-S531, Standard for Smoke Alarms.
  - .9 CAN/ULC-S536-S537-2004, Burglar and Fire Alarm Systems and Components.
- .4 National Fire Protection Agency.
  - .1 NFPA 72, National Fire Alarm Code.
  - .2 NFPA 90A, Installation of Air Conditioning and Ventilating Systems.

### **1.3 SHOP DRAWINGS:**

- .1 Submit shop drawings of the products described below, in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Include:
  - .1 Layout of equipment.
  - .2 Zoning.
  - .3 Complete wiring diagram, including schematics of modules.



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

- .1 Packing, Shipping, Handling and Unloading:
  - .1 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements.
  - .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Waste Management and Disposal:
  - .1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

#### **1.5 CLOSEOUT SUBMITTALS:**

- .1 Submit all documents and items to give to the completion of the work required under section 01 78 00 specified in Section 01 78 00 – Closeout Submittals.
- .2 Provide instructions for operation and maintenance of additional components of the fire alarm system.
- .3 The operation and maintenance data should include the following:
  - .1 All instructions necessary for the operation and maintenance component of the fire alarm system;
  - .2 Technical data and illustrated parts lists with their catalog number;
  - .3 A copy of the approved shop drawings showing the corrections made, with the exception of the seals of revision, any notation or mark shall be removed from the drawings.

#### **1.6 QUALITY ASSURANCE**

- .1 Qualifications:
  - .1 Installer: company or person specializing in fire alarm system installations with five (5) years documented experience approved by manufacturer.
- .2 Provide services of representative or technician from manufacturer of system, experienced in installation and operation of type of system being provided, to supervise installation, adjustment, preliminary testing, and final testing of system and to provide instruction to project personnel.

- .3 System:
  - .1 To TB OSH Chapter 3-04.
  - .2 Subject to Fire Commissioner of Canada (FC) approval.
  - .3 Subject to FC inspection for final acceptance.
  - .4 Subject to local Fire Services Director approval.
- .4 Training
  - .1 Arrange and pay for on-site lectures and demonstrations by fire alarm equipment manufacturer to train operational personnel in use and maintenance of new elements for the fire alarm system.

## **1.7 SYSTEM DESCRIPTION**

- .1 The existing system, XLS-MSE3-ADPT panel from Siemens, functioning at two stages.

## **1.8 SCOPE OF WORK**

- .1 Take note that the fire alarm system must remain functional in all areas not affected by the works. Where a cut is necessary, notify the Ministerial Representative at least two weeks in advance.
- .2 Coordinate all work with the Ministerial Representative, the competent authorities and the Siemens manufacturer's technician.
- .3 Supply and install all the features needed to operate the new elements (cards for addressable loops DLC, loop isolator modules etc.)
- .4 Supply and install new smoke detectors, such as shown in the new drawings for fire alarm.
- .5 Provide and install new fire alarm relays for new fire-rated curtains, as shown in the new drawings for fire alarm.
- .6 Identified with a P-Touch sticker the loop and component number on each new component.
- .7 Reprogram all devices installed and provide a certificate issued by the manufacturer Siemens.

## **PART 2 - PRODUCTS**

### **2.1 WIRING AND DUCTING**

- .1 Twisted conductors, type FT4 copper, minimum size 12 AWG, rated 300 V.
- .2 Alarm Circuit Conductors: minimum size 16 AWG, FAS105, and according to manufacturer's requirements.
- .3 Signalling Circuit Conductors: minimum size 14 AWG, FAS105, and according to manufacturer's requirements.
- .4 Control Circuit Conductors: minimum size 14 AWG, FAS105, and according to manufacturer's requirements.
- .5 Each wire must be clearly identified. Identification must be embedded in the insulation and shall be in uniform color, color-numbered or another approved method.
- .6 These conductors must be in electrical metallic tubing (EMT). The diameter of the ducts shall be determined using the electrical code.
- .7 The Contractor must ground all metallic elements.

### **2.2 SMOKE DETECTOR**

- .1 Acceptable products: HFP-11C with base DB-X11RSC from Siemens..

### **2.3 ISOLATION MODULE**

- .1 Acceptable products: HLIM from Siemens.

### **2.4 ADDRESSABLE LOOP CARD**

- .1 Acceptable products: DLC from Siemens.

### **2.5 MANUFACTURER**

- .1 Acceptable products: Chubb Edwards without equivalent.

## **PART 3 - EXECUTION**

### **3.1 GENERAL**

- .1 The fire alarm system must be installed in accordance with standard CAN/ULC-S524-01, current edition at work, as well as manuals and wiring diagrams approved by the manufacturer. The Contractor must supply all the accessories (pipes, wiring, outlet boxes, electrical boxes, etc.), necessary to complete the installation. All the wiring must be installed on its entire length in conduit reserved for this purpose. Before putting the system under test, make sure the wiring does not have open circuit or short-circuit or ground fault.
- .2 It is forbidden to make connections with splices.
- .3 All openings for passage of cables in fire walls must be properly sealed in accordance with local codes for fire prevention.
- .4 Install detectors at the locations indicated and connect to fire alarm circuits. The detectors should be installed at 1 m, at least, from the air outlets. In the case of sensors installed on the ceiling, a clearance having a radius of at least 600 mm, around and below the detector.
- .5 Connect all fire alarm circuits and signaling to existing fire alarm panel, located in Room 215 on the 2nd floor.
- .6 Maintain the fire alarm system in function during the construction works. Supply and install by-pass system for areas affected by present works. At the beginning of the workday, disarm the system and rearm it at the end of the day. Protect components from dust. Supply, install and connect the components and accessories required for proper operation.

### **3.2 VISUAL VERIFICATION**

- .1 Any fault (short circuit, cut or fault to earth) found on the existing wiring must be corrected before connecting wiring to a panel or device.

### **3.3 TESTING**

- .1 A complete check of the system must be performed by the manufacturer in accordance with CAN/ULC-S537-04, Standard for the Verification of Fire Alarm Systems.
- .2 During the audit, the electrical contractor must put an apprentice and an electrician available to the technician performing the audit.
- .3 The audit must be done after all installation work has been completed and the system is free from defects.

- .4 Check each device and each alarm circuit (new and existing) to ensure that all the sensors transmit an alarm to the control panel.
- .5 At completion, the manufacturer shall submit to the Ministerial Representative a complete list showing the exact location (room number) of all equipment on the project, and the various changes or modifications that may be made at this inspection.
- .6 Simulating ground leakage and cuts on the alarm and signalling circuits to ensure that failures are shown correctly.
- .7 A full report, as described in the ULC 537-04, must be submitted to the Ministerial Representative after the audit.

### **3.4 CLEANING**

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

**END OF SECTION**

