



**advanced building  
solutions**

**CANADIAN MUSEUM OF CIVILIZATION CORPORATION  
Infocom HACS Air Cooled Cooling System**

**Specifications**  
Mechanical – Issued for Tender

2013-08-07  
Project : 7013-004



**CANADIAN MUSEUM OF CIVILIZATION CORPORATION**

**100, LAURIER STREET**

**GATINEAU (QUÉBEC)**

**K1A 0M8**

**PROJECT : CMCC-12-021 INFOCOM HACS AIR COOLED COOLING SYSTEM**

**DIVISIONS 21, 22, 23**

**MECHANICAL**



**Issued for Tender  
August 07, 2013**



PROJECT : CMCC-12-021: INFOCOM HACS AIR-COOLED COOLING SYSTEM

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MECHANICAL

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**1 MINIMUM STANDARDS**

- .1 Materials shall be new and work shall conform to the minimum applicable standards of the Canadian General Standards Board, the Canadian Standards Association, the National Building Code of Canada 2010 (NBC) and all applicable Provincial and Municipal codes. In the case of conflict or discrepancy the most stringent requirement shall apply.

**2 SHOP DRAWINGS**

- .1 Submit for the Engineer's review, eight (8) copies of each shop drawing.
- .2 The review is for the sole purpose of ascertaining conformance with the general design concept, and does not mean approval of the design details inherent in the shop drawings, responsibility for which shall remain with the Contractor. Such review shall not relieve the Contractor of responsibility for errors or omissions in the shop drawings or of his responsibility for meeting all requirements of the Contract Documents.
- .3 Do not commence manufacture or order materials before shop drawings are reviewed.

**3 TAXES**

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

**4 FEES, PERMITS, AND CERTIFICATES**

- .1 Pay all fees and obtain all permits. Provide authorities with plans and information for acceptance certificates. Provide inspection certificates as evidence that work conforms to requirements of Authority having jurisdiction.

**5 MEETINGS**

- .1 Attend meetings throughout the progress of the Work at the call of the Engineer.
- .2 Representatives of the Contractor, Subcontractors and suppliers attending meetings shall be qualified and authorized to act on behalf of the party each represents.

**6 FIRE SAFETY REQUIREMENTS**

- .1 Comply with the National Building Code of Canada 2010 (NBC) for fire safety in construction and the National Fire Code of Canada 2010 (NFC) for fire prevention, fire fighting and life safety in building in use.
- .2 Welding and cutting:
  - .1 Before welding, soldering, grinding and/or cutting work, obtain a permit from the Building Facilities Personnel as directed by the Engineer. Store flammable liquids in approved CSA containers inspected by the Fire Prevention Unit. No open flame shall be used unless authorized by the Fire Prevention Unit.
  - .2 Ensure that smoke eaters and all other required safety equipment is provided by the related trade prior to commencing work.

- .3 At least 48 hours prior to commencing cutting, welding or soldering procedure, provide to the Building Facilities Personnel.
  - .1 Notice of intent, indicating devices affected, time and duration of isolation or bypass.
- .3 Where work requires interruption of fire alarms or fire suppression, extinguishing or protection systems:
  - .1 Provide watchman service as described in FC 301; In general, watchman service is defined as an individual conversant with Fire Emergency Procedures, performing fire picket duty within an unprotected and unoccupied (no workers) area once per hour.
  - .2 Retain services of manufacturer for fire protection systems on daily basis or as approved by FCC, to isolate and protect all devices relating to:
    - .1 modification of fire alarms, fire suppression, extinguishing or protection systems; and/or
    - .2 Cutting, welding, soldering or other construction activities which might activate fire protection systems.
- .4 Immediately upon completion of work, restore fire protection systems to normal operation and verify that all devices are fully operational.
- .5 Inform fire alarm system monitoring agency and local Fire Department immediately prior to isolation and immediately upon restoration of normal operation.

## **7 FIELD QUALITY CONTROL**

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

## **8 HAZARDOUS MATERIALS**

- .1 Comply with the requirements of the Workplace Hazardous Materials Information System (WHMIS) regarding use, handling, storage, and disposal of hazardous materials; and regarding labelling and the provision of Material Safety Data Sheets (MSDS) acceptable to Human Resources Skills Development Canada (HRSDC), Labour Program.
- .2 For work in occupied buildings give the Engineer 48 hours notice for work involving designated substances, hazardous substances (Canada Labour Code Part II Section 10), and before painting, caulking, installing carpet or using adhesives.

## **9 TEMPORARY UTILITIES**

- .1 Existing services required for the work, excluding power required for space heating, may be used by the Contractor without charge. Ensure capacity is adequate prior to imposing additional loads. Connect and disconnect at own expense and responsibility.

- .2 Notify the Engineer and utility companies of intended interruption of services, obtain requisite permission.
- .3 Give the Engineer two (2) weeks notice related to each necessary interruption of any mechanical or electrical service throughout the course of the work. Keep duration of these interruptions to a minimum. Carry out all interruptions after normal working hours of the occupants or on weekends as required by the contract schedule.

## **10 REMOVED MATERIALS**

- .1 Unless otherwise specified, materials for removal become the Contractor's property and shall be taken from site.

## **11 PROTECTION**

- .1 Protect finished work against damage until take-over.
- .2 Protect adjacent work against the spread of dust and dirt beyond the work areas.
- .3 Protect operatives and other users of site from all hazards.

## **12 USE OF SITE AND FACILITIES**

- .1 Execute work with least possible interference or disturbance to the normal use of premises. Make arrangements with the Engineer to facilitate work as stated. Refer to article 32 Scheduling below for work that must be done during "off hours".
- .2 Maintain existing services to building and provide for personnel and vehicle access.
- .3 Where elevators, dumbwaiters, conveyors or escalators exist Contractor may use these at the Engineer's discretion. Protect from damage, safety hazards and overloading of existing equipment.
- .4 Sanitary facilities will be assigned to the Contractor personnel, others shall be not be used. The Contractor will be responsible for maintaining the cleanliness of the facilities. The Engineer will inspect the facilities on a regular basis, if found to be in disorder, the Engineer will restrict use.
- .5 Closures: Protect work temporarily until permanent enclosures completed.
- .6 Parking is available in the pay parking lot.
- .7 Delivery of equipment, materials etc. required to facilitate the work shall be scheduled 48 hours in advance of delivery. The Contractor will be required to notify the Engineer at which time the Engineer will provide the Contractor with appropriate access number.

## **13 SITE STORAGE**

- .1 There is no storage space available on the site for the Contractor.
- .2 Do not unreasonably encumber site with materials or equipment.
- .3 Move stored products or equipment which interferes with operations of the Engineer or other contractors.
- .4 Obtain and pay for use of storage containers as needed for operations.

**14 CUT, PATCH AND MAKE GOOD**

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

**15 SLEEVES, HANGERS AND INSERTS**

- .1 Co-ordinate setting and packing of sleeves and supply and installation of hangers and inserts. Obtain the Engineer's approval before cutting into structure.

**16 EXAMINATION**

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

**17 SIGNS**

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

**18 ACCESS AND EGRESS**

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

**19 SCAFFOLDS AND WORK PLATFORMS**

- .1 Design, install, and inspect scaffolds and work platforms required for work in accordance with relevant municipal, provincial and other regulations.
- .2 Provide design drawings, signed and sealed by qualified Professional Engineer licensed in the province of Quebec, where prescribed.
- .3 Additions or modifications to scaffolding must be approved by Professional Engineer in writing.

**20 OPERATIONS AND MAINTENANCE MANUALS**

- .1 Two (2) weeks prior to any scheduled training, submit to the Engineer three (3) copies of approved Operations Data and Maintenance Manual in both official languages, compiled as follows:
  - .1 Bind data in vinyl hard cover 3 "D" ring type loose leaf binders for 212 x 275 mm size paper. Binders must not exceed 75 mm thick or be more than 2/3 full.
  - .2 Enclose title sheet labelled "Operation Data and Maintenance Manual," Project Name, Project Number, Date and List of Contents. Project name must appear on binder face and spine.
  - .3 Organize contents into applicable sections of work to parallel project specifications breakdown. Mark each section by labelled tabs protected with celluloid covers fastened to hard paper dividing sheets.
- .2 Include following information plus data specified.
  - .1 Maintenance instruction for all equipment and materials.
  - .2 Description: Operation of the equipment and systems defining start-up, shut-down and emergency procedures, and any fixed or adjustable set points that affect the efficiency of the operation. Include nameplate information such as make, size, capacity and serial number.
  - .3 Maintenance: Use clear drawings, diagrams or manufacturers' literature which specifically apply and detail the following:
    - .1 lubrication products and schedules.
    - .2 trouble shooting procedures.
    - .3 adjustment techniques.
    - .4 operational checks.
    - .5 Suppliers' names, addresses and telephone numbers and components supplied by them must be included in this section. Components must be identified by a description and manufacturers part number.
  - .4 Guarantees showing:
    - .1 Name and address of projects.
    - .2 Guarantee commencement date (date of Certificate of Substantial Performance).
    - .3 Duration of guarantee.
    - .4 Clear indication of what is being guaranteed and what remedial action will be taken under guarantee.
    - .5 Signature and seal of Guarantor.
  - .5 Additional material used in project listed under various sections showing name of manufacturer and source of supply.
- .3 Spare parts: List all recommended spares to be maintained on site to ensure optimum efficiency. List all special tools appropriate to unique application. All parts/tools detailed must be identified as to manufacturer, manufacturer part number and supplier (including address).
- .4 Include one complete set of final shop drawings (bound separately) indicating corrections and changes made during fabrication and installation.



**21 RECORDS**

- .1 As work progresses, maintain accurate records to show deviations from contract drawings. Just prior to the Engineer's inspection for issuance of final certificate of completion, supply to the Engineer one (1) set of white prints with all deviations neatly inked in.

**22 GUARANTEES AND WARRANTIES**

- .1 Before completion of work collect all manufacturer's guarantees and warranties and deposit with the Engineer.

**23 CLEAN UP**

- .1 Clean up work area as work progresses. At the end of each work day and more often if ordered by the Engineer, remove debris from site, neatly stack material for use, and clean up generally.
- .2 Sweep work area on a daily basis. Use sweeping compound to minimize and limit spread of dust. Vacuum all areas using HEPA type unit.
- .3 Upon completion remove scaffolding, temporary protection and surplus materials. Make good defects noted at this stage.
- .4 Clean areas under contract to a condition at least equal to that previously existing and to approval of the Engineer.

**24 BUILDING SMOKING ENVIRONMENT**

- .1 Smoking is not permitted in the Building. Obey smoking restrictions on building property.

**25 DUST CONTROL**

- .1 Provide dust tight screens or partitions to localize dust generating activities, and for protection of workers, finished areas of work and public. Ensure that HEPA vacuums are used to clean areas.
- .2 Maintain and relocate protection until such work is complete.
- .3 Protect all furnishings within work area with 0.102 mm thick polyethylene film during construction. Remove film during non- construction hours and leave premises in clean, unencumbered and safe manner for normal daytime function.

**26 SCHEDULING**

- .1 On award of contract submit a construction schedule for work, indicating anticipated progress stages within time of completion.
- .2 Carry out work during "regular hours" Monday to Friday from 07:00 to 18:00 hours
- .3 Give the Engineer 14 days notice for work to be carried out during "off hours".

- .4 Carry out the all noise generating work during "off hours" Monday to Friday from 18:00 to 07:00 hours and on Saturdays, Sundays, and statutory holidays. Noise generating work includes:
  - .1 Core drilling.
  - .2 Drilling for equipment anchors.
  - .3 Saw cutting of structure.
- .5 Electrical system shutdown for purposes of installing new equipment and modification to existing components or equipment as defined on drawings will be limited to four (4) hours.
- .6 Carry out work that will require a partial power shutdown in the building during 'Off Hours' Monday to Friday from 18:00 to 04:00 and on Saturdays, Sundays and statutory holidays. Coordinate power shutdown(s) with the Engineer. Indicate planned power shutdowns on the project schedule.
- .7 Plan and carry out the work requiring a shutdown of the main electrical service and supply to the computer room to coincide with the facility's annual maintenance shutdown.

**27 COST BREAKDOWN**

- .1 Before submitting first progress claim submit breakdown of Contract Amount in detail as directed by the Engineer and aggregating the Contract Amount. After approval by the Engineer cost breakdown will be used as the basis of progress payments.

**END OF SECTION**

**Part 1        General****1.1        RELATED SECTIONS**

- .1        Section 01 00 10 – General Instructions

**1.2        REFERENCES**

- .1        Canada Labour Code, Part 2, Canada Occupational Safety and Health Regulations.
- .2        Health Canada/Workplace Hazardous Materials Information System (WHMIS).
  - .1        Material Safety Data Sheets (MSDS).

**1.3        SUBMITTALS**

- .1        Make submittals in accordance with Section 01 00 10 – General Instructions.
- .2        Submit site-specific Health and Safety Plan: Within seven (7) days after date of Notice to Proceed and prior to commencement of Work. Health and Safety Plan must include:
  - .1        Results of site specific safety hazard assessment.
  - .2        Results of safety and health risk or hazard analysis for site tasks and operation and procedures for managing hazards.
  - .3        All applicable Material Safety Data Sheets (MSDS).
  - .4        Other safe-work procedures such as:
    - .1        Communication plan,
    - .2        Communication numbers,
    - .3        Emergency procedures,
    - .4        Public protection,
    - .5        Use of personal protective equipment,
    - .6        Name of employees and supervisor(s) on-site and
    - .7        Any required proof (copy) of training for all workers on the project.
- .3        Submit three (3) copies of Contractor's authorized representative's work site health and safety inspection reports to the Engineer weekly.
- .4        Submit construction safety check list after completion.
- .5        Personal training requirements including as follows:
  - .1        Names of personnel and alternates responsible for site safety and health, hazards present on site, and use of personal protective equipment.
- .6        Submit copies of reports or directions issued by Federal, and Provincial health and safety inspectors.
- .7        Submit copies of incident and accident reports.
- .8        Submit Material Safety Data Sheets (MSDS) to the Engineer.

- .9 The Engineer will review Contractor's site-specific Health and Safety Plan and provide comments to Contractor within 7 days after receipt of plan. Revise plan as appropriate and resubmit plan to the Engineer within 7 days after receipt of comments from the Engineer.
- .10 The Engineer's review of Contractor's final Health and Safety plan should not be construed as approval and does not reduce the Contractor's overall responsibility for construction Health and Safety.

#### **1.4 WORK PERMITS**

- .1 Obtain all permits related to project prior to commencement of work.

#### **1.5 FILING NOTICE**

- .1 File Notice of Project with Provincial authorities prior to beginning of Work.

#### **1.6 SAFETY ASSESSMENT**

- .1 Perform site specific safety hazard assessment related to project.

#### **1.7 MEETINGS**

- .1 Schedule and administer Health and Safety meeting with Engineer prior to commencement of Work.

#### **1.8 REGULATORY REQUIREMENTS**

- .1 Do Work in accordance with Section 01 00 10 – General Instructions. Comply with specified standards and regulations to ensure safe operations at site containing hazardous or toxic materials.

#### **1.9 GENERAL REQUIREMENTS**

- .1 Develop written site-specific Health and Safety Plan based on hazard assessment prior to beginning site Work and continue to implement, maintain, and enforce plan until final demobilization from site. Health and Safety Plan must address project specifications.
- .2 The Engineer may respond in writing, where deficiencies or concerns are noted and may request re-submission with correction of deficiencies or concerns.

#### **1.10 RESPONSIBILITY**

- .1 Be responsible for health and safety of persons on site, safety of property on site and for protection of persons adjacent to site and environment to extent that they may be affected by conduct of Work.
- .2 Comply with and enforce compliance by employees with safety requirements of Contract Documents, applicable federal, provincial, territorial and local statutes, regulations, and ordinances, and with site-specific Health and Safety Plan.

**1.11 COMPLIANCE REQUIREMENTS**

- .1 Comply with Canada Labour Code, Canada Occupational Safety and Health Regulations.

**1.12 UNFORSEEN HAZARDS**

- .1 When unforeseen or peculiar safety-related factor, hazard, or condition occurs during performance of Work, follow procedures in place for Employee's Right to Refuse Work in accordance with Acts and Regulations of Province having jurisdiction and advise the Engineer verbally and in writing.

**1.13 HEALTH AND SAFETY CO-ORDINATOR**

- .1 Employ and assign to Work, competent and authorized representative as Health and Safety Co-ordinator. Health and Safety Co-ordinator must:
  - .1 Have construction site-related working experience specific to activities associated with exterior site services and construction of structures and electrical installations in buildings.
  - .2 Have working knowledge of occupational safety and health regulations.
  - .3 Be responsible for completing Contractor's Health and Safety Training Sessions and ensuring that personnel not successfully completing required training are not permitted to enter site to perform Work.
  - .4 Be responsible for implementing, enforcing daily and monitoring site-specific Contractor's Health and Safety Plan.
  - .5 Be on site during execution of Work and report directly to the site supervisor.

**1.14 POSTING OF DOCUMENTS**

- .1 Ensure applicable items, articles, notices and orders are posted in conspicuous location on site in accordance with Acts and Regulations of Province having jurisdiction, and in consultation with the Engineer.

**1.15 CORRECTION OF NON-COMPLIANCE**

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

**1.16 BLASTING**

- .1 Blasting or other use of explosives is not permitted.

**1.17 POWDER ACTUATED DEVICES**

- .1 Do not use powder actuated devices.

**1.18 WORK STOPPAGE**

- .1 Give precedence to safety and health of public and site personnel and protection of environment over cost and schedule considerations for Work.

**Part 2 Products**

**2.1 NOT USED**

- .1 Not used.

**Part 3 Execution**

**3.1 NOT USED**

- .1 Not used.

**END OF SECTION**

**Part 1 General****1.1 RELATED SECTIONS**

- .1 Section 01 00 10 – General Instructions.
- .2 Section 23 05 00 - Common Work Results for HVAC.
- .3 Section 26 05 00 – Common Work Results for Electrical.

**1.2 QUALITY**

- .1 Products, materials, equipment and articles (referred to as products throughout specifications) incorporated in Work shall be new, not damaged or defective, and of best quality (compatible with specifications) for purpose intended. If requested, furnish evidence as to type, source and quality of products provided.
- .2 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.
- .3 Should any dispute arise as to quality or fitness of products, decision rests strictly with the Engineer based upon requirements of Contract Documents.
- .4 Unless otherwise indicated in specifications, maintain uniformity of manufacture for any particular or like item throughout building.
- .5 Permanent labels, trademarks and nameplates on products are not acceptable in prominent locations, except where required for operating instructions, or when located in mechanical or electrical rooms.

**1.3 STORAGE, HANDLING AND PROTECTION**

- .1 Handle and store products in manner to prevent damage, adulteration, deterioration and soiling and in accordance with manufacturer's instructions when applicable.
- .2 Store packaged or bundled products in original and undamaged condition with manufacturer's seal and labels intact. Do not remove from packaging or bundling until required in Work.
- .3 Store products subject to damage from weather in weatherproof enclosures.
- .4 Store cementitious products clear of earth or concrete floors, and away from walls.
- .5 Keep sand, when used for grout or mortar materials, clean and dry. Store sand on wooden platforms and cover with waterproof tarpaulins during inclement weather.
- .6 Store sheet materials on flat, solid supports and keep clear of ground. Slope to shed moisture.
- .7 Store and mix paints in heated and ventilated room. Remove oily rags and other combustible debris from site daily. Take every precaution necessary to prevent spontaneous combustion.

- .8 Remove and replace damaged products at own expense and to satisfaction of the Engineer.
- .9 Touch-up damaged factory finished surfaces to the Engineer's satisfaction. Use touch-up materials to match original. Do not paint over name plates.

#### **1.4 TRANSPORTATION**

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

#### **1.5 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 the Engineer in writing, of conflicts between specifications and manufacturer's instructions, so that the Engineer may establish course of action.
- .3 Improper installation or erection of products, due to failure in complying with these requirements, authorizes the Engineer to require removal and re-installation at no increase in Contract Price or Contract Time.

#### **1.6 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 the Engineer if required Work is such as to make it impractical to produce required results.
- .2 Do not employ anyone unskilled in their required duties. The Engineer 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 the Engineer, whose decision is final.

#### **1.7 CO-ORDINATION**

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

#### **1.8 CONCEALMENT**

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

#### **1.9 REMEDIAL WORK**

- .1 Perform remedial work required to repair or replace parts or portions of Work identified as defective or unacceptable. Coordinate 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.

### **1.10 LOCATION OF FIXTURES**

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

### **1.11 FASTENINGS**

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

### **1.12 FASTENINGS - EQUIPMENT**

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

### **1.13 PROTECTION OF WORK IN PROGRESS**

- .1 Prevent overloading of any part of building. Do not cut, drill or sleeve any load bearing structural member, unless specifically indicated without written approval of the Engineer.

## **Part 2 Products**

### **2.1 NOT USED**

- .1 Not Used.

**Part 3            Execution**

**3.1                NOT USED**

.1            Not Used.

**END OF SECTION**

---

**Part 1            General****1.1                RELATED SECTIONS**

- .1        Section 01 00 10 – General Instructions.
- .2        Section 01 91 13 – General Commissioning (Cx) Requirements.

**1.2                DESCRIPTION**

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

**1.3                QUALITY CONTROL**

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

**1.4                SUBMITTALS**

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

**1.5                CONDITIONS FOR DEMONSTRATIONS**

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

**1.6                PREPARATION**

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

**1.7 DEMONSTRATION AND INSTRUCTIONS**

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

**Part 2 Products**

**2.1 NOT USED**

- .1 Not Used.

**Part 3 Execution**

**3.1 NOT USED**

- .1 Not Used.

**END OF SECTION**

**Part 1 General****1.1 RELATED SECTIONS**

- .1 Section 01 00 10 – General Instructions.
- .2 Section 01 79 00 – Demonstration and Training.
- .3 Section 23 05 00 - Common Work Results for HVAC.
- .4 Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping.
- .5 Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.
- .6 Section 23 81 23 - Computer Room Air Conditioning
- .7 Section 26 05 00 - Common Work Results for Electrical.
- .8 Section 26 05 21 - Wire and Cables 0-1000 V.
- .9 Section 26 28 16.02 - Moulded Case Circuit Breakers.

**1.2 REFERENCES**

- .1 National Electrical Testing Association (NETA), 2005 Acceptance Testing Specifications.

**1.3 QUALIFICATIONS**

- .1 Prior to start of Work, submit name of organization or Contractor personnel proposed to perform services. Designate who has managerial responsibilities for coordination of entire testing and adjusting.
- .2 Retain the services of a recognized Testing Agency to employ qualified technicians for the testing verification and commissioning of electrical systems equipment and components including:
  - .1 Integrated Automation System
  - .2 Fire Alarm System.
- .3 Submit documentation to confirm organization and/or personnel compliance with quality assurance provision.
- .4 Submit one (1) preliminary specimen copy of each report form proposed for use.

**1.4 ROLES AND RESPONSIBILITIES**

- .1 Responsibility for the satisfactory completion of the project and demonstration that the requirements of commissioning are satisfied rests with the Contractor, who will employ and pay for the specialist supervision, inspection and testing as required to complete the work described. This shall include a commissioning manager with experience in performance verification, testing commissioning, integrated system testing and training on projects with similar components and at least equal complexity to those included in this project.

- .2 The roles and responsibilities of the Engineer and the Contractor for the Commissioning Process are as follows:
  - .1 The Engineer is responsible for the oversight of the overall performance verification and commissioning process.
  - .2 The Engineer may participate in some or all of the testing and verification of project components, systems, and integrated systems to meet the client and project objectives.
  - .3 The Contractor shall participate in all of the performance testing and verification of components, systems, and integrated systems to ensure that project components, systems, and integrated systems work correctly as per the project requirements and design intent.
  - .4 The Contractor shall be responsible for organizing and implementing all aspects of the performance verification and commissioning process outlined herein. The Contractor shall arrange with his suppliers and subcontractor's free access for the Engineer to the plants where equipment is being manufactured, for witnessing in plant operational performance testing.
- .3 Further defined in this specification section are:
  - .1 The Contractor's and the Engineer's responsibilities with respect to the performance verification and commissioning process as it applies to each of the phases of the project.
  - .2 The Contractor's and the Engineer's responsibilities relating to the coordination and implementation of the Integrated Systems Testing and Fine Tuning requirements.

## **1.5 PERFORMANCE VERIFICATION AND COMMISSIONING PLAN**

- .1 Prepare and submit a plan outlining the procedures and processes for the performance verification and commissioning of all components and systems. Submit the plan to the Engineer within two (2) weeks of receipt of reviewed shop drawings. The Engineer will review the plan submitted and return with comments within two (2) weeks. Make the indicated revisions and resubmit within one (1) week.
- .2 The plan shall include a schedule for performance verification and commissioning integrated with the overall project schedule. It shall include separate line items for each procedure and process.
- .3 The plan shall also include activities for Instruction and Training as described under Section 01 79 00 – Demonstration and Training.
- .4 The plan shall include a description of the co-ordination and activities of all sub-trades with respect to performance verification and testing.
- .5 The plan shall also include the co-ordination and activities for integrated systems testing. This includes existing components and systems and components and systems being supplied under the work of other related contracts. Related systems requiring integration with systems and components whether or not supplied under this contract include:
  - .1 Computer Room A/C unit.
  - .2 Testing and balancing.

- .6 The schedule shall include meetings for review and co-ordination of performance verification, commissioning and training activities. Hold these meetings at least monthly, with the first meeting to take place two (2) weeks prior to the initial submission of the performance verification commissioning plan. Meeting attendees shall include – Contractor Representatives, the Engineer (Chair); manufacturer’s specialist field technicians when required; specialist performance verification and commissioning personnel. Meetings introduce and resolve issues and deficiencies; monitor progress.
- .7 The plan shall include data sheets for each system and component as listed herein. The first part of each data sheet shall be completed from information contained in the reviewed shop drawings.

## **1.6 VERIFICATION FORMS**

- .1 The Contractor shall develop project specific verification forms and/or check lists for each component and system. This includes check lists for the new power generating system components and all auxiliary systems.
- .2 Form to be used is included at the end of this section. This form is for information and convenience to the Contractor and will not relieve the Contractor of responsibility for identification and performance verification of components and system including integrated systems.
- .3 Verification forms are to include specific data covering the final tested and/or calibrated condition as left for each component and assembly. This includes data such as cable dielectric and insulation resistance test, relay testing and setting, timer settings.
- .4 System and Integrated Verification forms are to be completed by the Contractor and verified by the Engineer.

## **1.7 REPORTS**

- .1 Submit completed reports immediately after inspections and/or tests are performed.
- .2 Record all data gathered on site on approved verification forms.
- .3 Provide the Engineer with original of each completed verification form.
- .4 Maintain one photocopy on site of all data taken during starting and testing period.
- .5 Maintain one copy of all final starting, testing, balancing, and adjusting reports on site up to Certificate of Substantial Performance of the work for reference purposes.
- .6 All final verification forms are to be typewritten.
- .7 Submit to the Engineer for approval.
- .8 Make corrections and resubmit as requested by the Engineer.

## **1.8 MANUFACTURER’S REPORTS AND SPECIAL TESTING AGENCY**

- .1 Arrange for manufacturer’s to submit copies of all production test records for production tests required by these specifications prior to shipping.

- .2 These production test records will be certified by the manufacturer that the item meets the testing performance criteria specified.
- .3 Modify procedures detrimental to equipment performance and review same with manufacturer, before start-up.

## **1.9 WITNESS AND PERFORMANCE VERIFICATION AND COMMISSIONING**

- .1 Provide sufficient notice (minimum ten working days) prior to commencing tests.
- .2 The Engineer may witness all or any portion of testing and starting procedures performed by the Contractor.
- .3 Contractor to be present for all tests.

## **1.10 AVAILABLE DOCUMENTATION**

- .1 The Contractor shall have contract documents, shop drawings, product data, and operation and maintenance data on hand during equipment performance verification process.

## **Part 2 Products**

### **2.1 CONTRACTOR TESTING INSTRUMENTS**

- .1 Contractor to provide effective two way radios capable of transmitting signals clearly throughout the facility, ladders and other equipment as required to complete the program and as outlined in this specification.
- .2 Contractor to provide all safety equipment required for personnel involved in the starting, testing, adjusting, and balancing program.

### **2.2 CONTRACTOR TESTING PERSONNEL**

- .1 Contractor to provide sufficient 'qualified' personnel to the Engineer's satisfaction at field locations and at the central operation work (monitoring) station to successfully test and commission components, systems, and integrated systems.

## **Part 3 Execution**

### **3.1 TESTING OVERVIEW**

- .1 Ensure integrated system operations conform with design documents providing required performance with proper interaction between related systems.
- .2 Verify performance of components and systems operating in conjunction with one another under all conditions (normal and abnormal) and modes of operation.
- .3 Each system is to be operated for as long as required to complete commissioning.



- .4 Commissioning Manager to verify that reported results of testing and procedures are checked and verified to be correct. If inconsistencies appear between reported results and demonstrated values, the relevant testing procedures are repeated and adjustments made until satisfactory results are obtained.

### **3.2 COMPLETION**

- .1 Thoroughly overhaul and restore to new condition all equipment which has been operated by the contractor during the construction phase.
- .2 Permanently mark all final settings in such a manner that they cannot be eradicated or obliterated in any way.
- .3 Record all final settings and record drawings. Include 'As Commissioned' Performance data within Operations and Maintenance Manuals.
- .4 Verify the implementation of all identification procedures as specified in the Contract Documents.
- .5 Due to seasonal requirements, some systems may have to be tested after the facility has been handed over, accepted, and during the warranty period.
- .6 If necessary, occupancy shall be coordinated so as to avoid interference with, or interruption of, any integrated systems testing activities.

### **3.3 INTEGRATED SYSTEMS TESTING**

- .1 Integrated systems testing shall take place only after testing, performance verification and demonstration of satisfactory operation for each individual component and/or system has been completed and accepted by the Engineer.

### **3.4 DOCUMENTATION AVAILABLE**

- .1 Component and system testing shall not take place until operation and maintenance manuals have been reviewed and accepted by the Engineer.

### **3.5 RESPONSIBILITIES**

- .1 The Engineer will do the following during Systems and Integrated System Testing and Fine tuning:
  - .1 Witness and provide instruction in a series of pre planned integrated system performance tests under conditions simulating, to the extent possible, full and partial operating conditions of the systems.
  - .2 Review and verify Contractor recorded test results.
  - .3 Diagnose problems and determine whether or not they are a result of Contract Deficiencies.
  - .4 Request repeat tests as required following correction of Contract Deficiencies.
  - .5 Conduct user surveys and take environmental measurements as necessary to identify existing and potential problems.
  - .6 Provide direction and instruct in the fine tuning of the systems under test to satisfy the operating requirements.

- .2 Contractor/testing personnel to perform the following during Systems and Integrated Systems testing and Fine Tuning:
  - .1 Employ all coordination, resources, services, measures and responsibilities to execute the entire testing and commissioning program (process) without damage to project systems or components, at no additional cost to Crown.
  - .2 Modify operating parameters of the systems to satisfy the fine tuning requirements outlined by the Engineer so to ensure proper system operation. For example:
    - .1 Make adjustments which may become apparent as testing proceeds.
    - .2 Undertake modifications to suit changes as equipment settles down during the running in period.
    - .3 Documentation of results.
    - .4 Diagnosis of problems.
    - .5 Correct contract deficiencies previously outstanding as well as any identified during Systems and Integrated Systems Testing and Fine Tuning.
    - .6 Fine Tuning will provide for the adjustment of the system where the integrated systems testing have shown a need, such as but not limited to:
      - .1 Adjustments to timing of control devices.
      - .2 Adjustments to software to achieve the desired outputs.
      - .3 Calibration of motors and instrumentation devices.
      - .4 Adjustment to protective relaying.

### **3.6 COMPONENT, SYSTEM AND INTEGRATED SYSTEM TESTING AND DOCUMENTATION**

- .1 Actual performance data to be documented by the installing Contractor.
- .2 Commission each component, system, and integrated system and complete the requirements of each test. Record all test data on verification forms, checklists and other reports. Submit reports to the Engineer.

<b>CMMS Equipment Inventory Data Sheet</b>			
<b>PART 1</b>	System Equipment	Component	
<b>GENERAL INFORMATION</b>			
Equipment Description		Life Support	
		Yes	No
Area Served:	Location:	Area :	Room #:
<b>PART 2</b>		Manufacturer Name:	
<b>MANUFACTURER INFORMATION</b>			
Model Number:		Serial Number:	
Local Agent Name:		Phone #:	Fax #:
Local Agent Address:			
<b>PART 3</b>		Start Date:	End Date:
<b>WARRANTY INFORMATION</b>			
Special Warranty Terms and Conditions:			
<b>PART 4</b>			
<b>EQUIPMENT DETAILS</b>			
<i>Electrical Specifications</i>		<i>Mechanical Specifications</i>	
Horsepower:	_____	Belts:	_____
Voltage:	_____	Sheaves:	_____
Ampacity:	_____	Pre-Filter Specs:	_____
Phase:	_____	Final Filter Specs:	_____
Frame:	_____	Bearing (front/left)	_____
Service Factor:	_____	Bearing (back/right)	_____
<b>OTHER INFORMATION:</b>			

**END OF SECTION**

**Part 1        General****1.1        SUBMITTALS**

- .1        Submittals: in accordance with Section 01 00 10 – General Instructions.
- .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        Closeout Submittals:
  - .1        Provide operation and maintenance data for incorporation into manual specified in Section 01 00 10 – General Instructions.
  - .2        Operation and maintenance manual approved by, and final copies deposited with, Engineer 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 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 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 Engineer 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.
- .8 Submit copies of as-built drawings for inclusion in final TAB report.

## **1.2 QUALITY ASSURANCE**

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

## **1.3 MAINTENANCE**

- .1 Furnish spare parts as follows:
  - .1 One glass for each gauge glass.
  - .2 One filter cartridge or set of filter media for each filter or filter bank in addition to final operating set.
- .2 Provide one set of special tools required to service equipment as recommended by manufacturer's instructions.
- .3 Furnish one commercial quality grease gun, grease and adapters to suit different types of grease and grease fittings.

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

- .1 Waste Management and Disposal:
  - .1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Section 01 00 10 – General Instructions.

## **Part 2 Products**

### **2.1 MATERIALS**

- .1 Materials and products in accordance with Section 01 00 10 – General Instructions.

**Part 3 Execution****3.1 PAINTING REPAIRS AND RESTORATION**

- .1 Do painting touch ups in accordance with Section 01 00 10 – General Instructions.
- .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 Infocom A/C unit.

**3.3 FIELD QUALITY CONTROL**

- .1 Manufacturer's Field Services:
  - .1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports.
  - .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 Section 01 00 10 – General Instructions.

**3.4 DEMONSTRATION**

- .1 Engineer will use equipment and systems for test purposes prior to acceptance. Supply labour, material, and instruments required for testing.
- .2 Trial usage to apply to following equipment and systems:
  - .1 Computer Room A/C units
- .3 Supply tools, equipment and personnel to demonstrate and instruct operating and maintenance personnel in operating, controlling, adjusting, trouble-shooting and servicing of all systems and equipment during regular work hours, prior to acceptance.
- .4 Use operation and maintenance manual, as-built drawings, and audio visual aids as part of instruction materials.
- .5 Instruction duration time requirements as specified in appropriate sections.

**3.5 PROTECTION**

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

**END OF SECTION**

**Part 1            General**

**1.1                RELATED REQUIREMENTS**

- .1        Section 01 00 10 - General Instructions.
- .2        Section 21 05 00 - Common Work Results for Mechanical.

**1.2                REFERENCES**

- .1        ASTM International Inc.
  - .1        ASTM B32-08, Standard Specification for Solder Metal.
  - .2        ASTM B306-09, Standard Specification for Copper Drainage Tube (DWV).
  - .3        ASTM C564-11, Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings.
- .2        Canada Green Building Council (CaGBC)
  - .1        LEED Canada-NC Version 1.0-2004, LEED (Leadership in Energy and Environmental Design): Green Building Rating System Reference Package For New Construction and Major Renovations (including Addendum [2007]).
  - .2        LEED Canada-CI Version 1.0-2007, LEED (Leadership in Energy and Environmental Design): Green Building Rating System Reference Guide For Commercial Interiors.
- .3        Canadian Standards Association (CSA International).
  - .1        CSA B67-1972(R1996), Lead Service Pipe, Waste Pipe, Traps, Bends and Accessories.
  - .2        CSA-B70-06, Cast Iron Soil Pipe, Fittings and Means of Joining.
  - .3        CSA-B125.3-05, Plumbing Fittings.
- .4        Green Seal Environmental Standards (GSES)
  - .1        Standard GS-36-00, Commercial Adhesives.
- .5        South Coast Air Quality Management District (SCAQMD), California State
  - .1        SCAQMD Rule 1168-A2005, Adhesive and Sealant Applications.

**1.3                ACTION AND INFORMATIONAL SUBMITTALS**

- .1        Provide submittals in accordance with Section 01 00 10 - General Instructions.
- .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.

**1.4                DELIVERY, STORAGE AND HANDLING**

- .1        Deliver, store and handle in accordance with Section 01 00 10 - General Instructions.

- .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 00 10 - General Instructions.

## **Part 2 Products**

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

- .1 Above ground sanitary 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: tin-lead, 50:50, type 50A, type TA to ASTM B32.

## **Part 3 Execution**

### **3.1 APPLICATION**

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

### **3.2 INSTALLATION**

- .1 Install in accordance with National Plumbing Code.

### **3.3 TESTING**

- .1 Pressure test buried systems before backfilling.
- .2 Hydraulically test to verify grades and freedom from obstructions.

### **3.4 CLEANING**

- .1 Clean in accordance with Section 01 00 10 - General Instructions.
- .2 Waste Management: separate waste materials for reuse recycling in accordance with Section 01 00 10 - General Instructions.

**END OF SECTION**



**Part 1      General****1.1      RELATED SECTIONS**

- .1      Section 01 00 10 General Instructions.

**1.2      SUBMITTALS**

- .1      Submittals: in accordance with Section 01 00 10 – General Instructions.
- .2      Shop drawings; submit drawings stamped and signed by professional engineer registered or licensed in Province of Quebec, Canada.
- .3      Shop drawings to show:
  - .1      Mounting arrangements.
  - .2      Operating and maintenance clearances.
- .4      Shop drawings and product data accompanied by:
  - .1      Detailed drawings of bases and supports designed by structural engineer.
  - .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.
- .5      Closeout Submittals:
  - .1      Provide operation and maintenance data for incorporation into manual specified in Section 01 00 10 General Instructions.
  - .2      Operation and maintenance manual approved by, and final copies deposited with the Engineer 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 Engineer for approval. Submission of individual data will not be accepted unless directed by Engineer.
  - .2 Make changes as required and re-submit as directed by Engineer.
- .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 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 Engineer for approval and make corrections as directed.
  - .4 Perform testing, adjusting and balancing for HVAC using as-built drawings.
  - .5 Submit completed reproducible as-built drawings with Operating and Maintenance Manuals.
- .9 Submit copies of as-built drawings for inclusion in final TAB report.

### **1.3 QUALITY ASSURANCE**

- .1 Quality Assurance: in accordance with Section 01 00 10 - General Instructions.
- .2 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

### **1.4 MAINTENANCE**

- .1 Furnish spare parts in accordance with Section 01 00 10 General Instructions as follows:
  - .1 One (1) set of the fan belt for each fan

### **1.5 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 00 10 – General Instructions.

**Part 2 Products****2.1 NOT USED**

- .1 Not Used.

**Part 3 Execution****3.1 CLEANING**

- .1 Clean interior and exterior of all systems including strainers. Vacuum Computer Room A/C units..

**3.2 FIELD QUALITY CONTROL**

- .1 Site Tests: conduct following tests in accordance with Section 01 00 10 - General Instructions 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.

**3.3 DEMONSTRATION**

- .1 Engineer 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.

**3.4 PROTECTION**

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

**END OF SECTION**

**Part 1 General****1.1 RELATED REQUIREMENTS**

- .1 Section 22 13 17 - Drainage Waste and Vent Piping - Cast Iron and Copper
- .2 Section 23 23 00 - Refrigerant Piping.

**1.2 REFERENCES**

- .1 Canadian General Standards Board (CGSB)
  - .1 CAN/CGSB-1.181-99, Ready-Mixed Organic Zinc-Rich Coating.
- .2 Canada Green Building Council (CaGBC)
  - .1 LEED Canada-NC Version 1.0-2004, LEED (Leadership in Energy and Environmental Design): Green Building Rating System Reference Package For New Construction and Major Renovations (including Addendum [2007]).
  - .2 LEED Canada-CI Version 1.0-2007, LEED (Leadership in Energy and Environmental Design): Green Building Rating System Reference Guide For Commercial Interiors.
- .3 Canadian Standards Association (CSA International)
  - .1 CSA B139-09, Installation Code for Oil Burning Equipment.
- .4 Green Seal Environmental Standards (GSES)
  - .1 Standard GS-11-2008, 2nd Edition, Environmental Standard for Paints and Coatings.
- .5 National Fire Code of Canada (NFCC 2010)
- .6 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 00 10 - General Instructions.
- .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.

- .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 00 10 – General Instructions.

## **Part 2 Products**

### **2.1 MATERIAL**

- .1 Paint: zinc-rich to CAN/CGSB-1.181.
  - .1 Paints: in accordance with manufacturer's recommendations for surface conditions.

## **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 and National Fire Code of Canada
- .2 Provide space for disassembly, removal of equipment and components as recommended by manufacturer without interrupting operation of other system, equipment, 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 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.

### 3.6 PIPEWORK INSTALLATION

- .1 Install pipework to CSA B139.
- .2 Screwed fittings jointed with Teflon tape.
- .3 Protect openings against entry of foreign material.
- .4 Install to isolate equipment and allow removal without interrupting operation of other equipment or systems.
- .5 Assemble piping using fittings manufactured to ANSI standards.
- .6 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.
- .7 Install exposed piping, equipment, rectangular cleanouts and similar items parallel or perpendicular to building lines.
- .8 Install concealed pipework to minimize furring space, maximize headroom, conserve space.
- .9 Slope piping, except where indicated, in direction of flow for positive drainage and venting.
- .10 Install, except where indicated, to permit separate thermal insulation of each pipe.
- .11 Group piping wherever possible and as indicated.
- .12 Ream pipes, remove scale and other foreign material before assembly.
- .13 Use eccentric reducers at pipe size changes to ensure positive drainage and venting.
- .14 Provide for thermal expansion as indicated.
- .15 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 ball valves at branch take-offs for isolating purposes except where specified.

**3.7 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 insulation.
- .5 Installation:
  - .1 Concrete, masonry walls, concrete floors on grade: terminate flush with finished surface.
  - .2 Other floors: terminate 25 mm above finished floor.
  - .3 Before installation, paint exposed exterior surfaces with heavy application of zinc-rich paint to CAN/CGSB-1.181.
- .6 Sealing:
  - .1 Foundation walls and below grade floors: fire retardant, waterproof non-hardening mastic.
  - .2 Elsewhere:
    - .1 Provide space for firestopping.
    - .2 Maintain fire rating integrity.
  - .3 Sleeves installed for future use: fill with lime plaster or other easily removable filler.
  - .4 Ensure no contact between copper pipe or tube and sleeve.

**3.8 ESCUTCHEONS**

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

**3.9 PREPARATION FOR FIRE STOPPING**

- .1 Install firestopping within annular space between pipes, ducts, insulation and adjacent fire separation.
- .2 Insulated pipes and ducts: ensure integrity of insulation and vapour barriers.

**3.10 FLUSHING OUT OF PIPING SYSTEMS**

- .1 Flush system to remove all debris and oil build ups.
- .2 Before start-up, clean interior of piping systems in accordance with requirements of Section 01 00 10 – General Instructions.

- .3 Preparatory to acceptance, clean and refurbish equipment and leave in operating condition, including replacement of filters in piping systems.

**3.11 PRESSURE TESTING OF EQUIPMENT AND PIPEWORK**

- .1 Advise Engineer 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 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 Engineer.
- .6 Pay costs for repairs or replacement, retesting, and making good. Engineer to determine whether repair or replacement is appropriate.
- .7 Insulate or conceal work only after approval and certification of tests by Engineer.

**3.12 EXISTING SYSTEMS**

- .1 Connect into existing piping systems at times approved by Engineer.
- .2 Request written approval by Engineer 10 days minimum, prior to commencement of work.
- .3 Be responsible for damage to existing plant by this work.

**3.13 CLEANING**

- .1 Clean in accordance with Section 01 00 10 – General Instructions.
  - .1 Remove surplus materials, excess materials, rubbish, tools and equipment.
- .2 Waste Management: separate waste materials for reuse recycling in accordance with Section 01 00 10 – General Instructions.

**END OF SECTION**



**Part 1      General****1.1      RELATED SECTIONS**

- .1      Section 01 00 10 – General Instructions.
- .2      Section 01 61 00 - Common Product Requirements.
- .3      Section 23 05 48 – Vibration and Seismic Controls for HVAC Piping.

**1.2      REFERENCES**

- .1      American National Standards Institute/American Society of Mechanical Engineers (ANSI/ASME)
  - .1      ANSI/ASME B31.1-04, Power Piping.
- .2      American Society for Testing and Materials International (ASTM)
  - .1      ASTM A125-1996 (R2001), Specification for Steel Springs, Helical, Heat-Treated.
  - .2      ASTM A307-04, Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
  - .3      ASTM A563-04a, Specification for Carbon and Alloy Steel Nuts.
- .3      Factory Mutual (FM)
- .4      Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  - .1      Material Safety Data Sheets (MSDS).
- .5      Underwriter's Laboratories of Canada (ULC)

**1.3      SYSTEM DESCRIPTION**

- .1      Design Requirements:
  - .1      Construct hangers for refrigeration piping.
  - .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 as specified Section 23 05 48 – Vibration and Seismic Controls for HVAC Piping and Equipment.

#### **1.4 SUBMITTALS**

- .1 Submittals: in accordance with Section 01 00 10 – General Instructions
- .2 Shop drawings: submit drawings stamped and signed by professional engineer registered or licensed in Province of Quebec, Canada.
- .3 Submit shop drawings and product data for following items:
  - .1 Bases, hangers and supports.
  - .2 Connections to equipment and structure.
  - .3 Structural assemblies.
- .4 Quality assurance submittals: submit following in accordance with 01 00 10 – General Instructions
  - .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.
- .5 Closeout Submittals:
  - .1 Provide maintenance data for incorporation into manual specified in Section 01 00 10 - General Instructions.

#### **1.5 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.

#### **1.6 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.
- .2 Waste Management and Disposal:
  - .1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Section 01 00 10 – General Instructions.

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**Part 2 Products****2.1 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.

**2.2 EQUIPMENT SUPPORTS**

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

**2.3 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 Install in accordance with:
  - .1 Manufacturer's instructions and recommendations.
- .2 Vibration Control Devices:
  - .1 Install as Indicated.

**3.3 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.

**3.4 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.

### **3.5 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.

### **3.6 FIELD QUALITY CONTROL**

- .1 Site Tests: conduct following tests in accordance with Section 01 00 10 - General Instructions 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.

**END OF SECTION**

**Part 1 General****1.1 RELATED SECTIONS**

- .1 Section 23 05 29 – Hangers and Supports for HVAC Piping and Equipment.

**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) - 2010

**1.3 SUBMITTALS**

- .1 Submittals: in accordance with Section 01 00 10 – General Instructions.

**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 00 10 – General Instructions.

**Part 2 Products****2.1 GENERAL**

- .1 Size and shape of bases type and performance of vibration isolation as indicated.

**2.2 HANGERS**

- .1 Colour coded springs, rust resistant, painted box type hangers. Arrange to permit hanger box or rod to move through a 30 degrees arc without metal to metal contact.

- .2 Type H1 - stable spring, elastomeric washer, cup with moulded isolation bushing which passes through hanger box.

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

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

### **2.4 HORIZONTAL THRUST RESTRAINT**

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

### **2.5 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 firestopping.
- .2 Static equipment:
  - .1 Anchor equipment to equipment supports. Anchor equipment supports to structure.
  - .2 Suspended equipment:
    - .1 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.
    - .3 Seismic restraints:
      - .1 Cushioning action gentle and steady.
      - .2 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 Bracing methods:
  - .1 Approved by Engineer.
  - .2 Structural angles or channels.
  - .3 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 Ensure piping, ducting and electrical connections to isolated equipment do not reduce system flexibility and that piping, conduit and ducting passage through walls and floors do not transmit vibrations.
- .3 Unless indicated otherwise, support piping connected to isolated equipment with spring mounts or spring hangers with 25 mm minimum static deflection as follows:
  - .1 Up to NPS4: first 3 points of support. NPS5 to NPS8: first 4 points of support. NPS10 and over: first 6 points of support.
  - .2 First point of support: static deflection of twice deflection of isolated equipment, but not more than 50 mm.
- .4 Where isolation is bolted to floor use vibration isolation rubber washers.
- .5 Block and shim level bases so that ductwork and piping connections can be made to rigid system at operating level, before isolator adjustment is made. Ensure that there is no physical contact between isolated equipment and building structure.

#### **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 Engineer 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 equipment listed below.
    - .1 Outdoor Condensing Unit.
  - .3 Provide Engineer with notice 24 h 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 00 10 – General Instructions.
- .2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

**END OF SECTION**



**Part 1 General**

**1.1 SUMMARY**

- .1 Section Includes:
  - .1 Materials and requirements for the identification of piping systems, duct work, valves and controllers, including the installation and location of identification systems.
  - .2 Sustainable requirements for construction and verification.

**1.2 REFERENCES**

- .1 Canadian Gas Association (CGA)
  - .1 CSA/CGA B149.1-10, Natural Gas and Propane Installation Code.
- .2 Canadian General Standards Board (CGSB)
  - .1 CAN/CGSB-1.60-97, Interior Alkyd Gloss Enamel.
  - .2 CAN/CGSB-24.3-92, Identification of Piping Systems.
- .3 National Fire Protection Association (NFPA)
  - .1 NFPA 13, Standard for the Installation of Sprinkler Systems. 2
  - .2 NFPA 14, Standard for the Installation of Standpipe and Hose Systems. 2010 Edition.

**1.3 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Product Data:
- .2 Submittals: in accordance with Section 01 00 10 - General Instructions.
- .3 Product data to include paint colour chips, other products specified in this section.
- .4 Samples:
  - .1 Submit samples in accordance with Section 01 00 10 - General Instructions.
  - .2 Samples to include nameplates, labels, tags, lists of proposed legends.

**1.4 QUALITY ASSURANCE**

- .1 Quality assurance submittals: submit following in accordance with Section 01 00 10 - General Instructions.
- .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 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 recycling in accordance with Section 01 00 10 - General Instructions.

## 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, matte finish, with square corners, letters accurately aligned and machine engraved into core.
- .3 Sizes:
  - .1 Conform to following table:

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

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

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

### **2.3 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 Engineer.

### **2.4 IDENTIFICATION OF PIPING SYSTEMS**

- .1 Identify contents by background colour marking, pictogram (as necessary), legend; direction of flow by arrows. To CAN/CGSB 24.3 except where specified otherwise.
- .2 Pictograms:
  - .1 Where required: Workplace Hazardous Materials Information System (WHMIS) regulations.
- .3 Legend:
  - .1 Block capitals to sizes and colours listed in CAN/CGSB 24.3.
- .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 vinyl with protective overcoating, waterproof contact adhesive undercoating, suitable for ambient of 100% RH and continuous operating temperature of 150 degrees C and intermittent temperature of 200 degrees C.

.7 Colours and Legends:

- .1 Where not listed, obtain direction from Engineer.  
.2 Colours for legends, arrows: to following table:

Background colour:	Legend, arrows:
Yellow	BLACK
Green	WHITE
Red	WHITE

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

Contents	Background colour marking	Legend
Refrigeration suction	Yellow	REF. SUCTION
Refrigeration liquid	Yellow	REF. LIQUID
Refrigeration hot gas	Yellow	REF. HOT GAS

## 2.5 LANGUAGE

- .1 Identification in English and French.  
.2 Use one nameplate and label for each language.

## 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 if there requires any.

### 3.3 INSTALLATION

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

### 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.

### **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.
  - .1 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 CLEANING**

- .1 Proceed in accordance with Section 01 00 10 - General Instructions.
- .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 DEFINITION**

- .1 TAB means to test, adjust and balance to perform in accordance with requirements of Contract Documents and to do other work as specified in this section.

**1.2 QUALIFICATIONS OF TAB PERSONNEL**

- .1 Names of personnel it is proposed to perform TAB to be submitted to and approved by Engineer.
- .2 Provide documentation confirming qualifications, successful experience.

**1.3 PURPOSE OF TAB**

- .1 Test to verify proper and safe operation, determine actual point of performance, evaluate qualitative and quantitative performance of equipment, systems and controls at design, average and low loads using actual or simulated loads.
- .2 Adjust and regulate equipment and systems so as 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.
- .4 To demonstrate air tightness of air distribution systems.
- .5 Note and include results in report.

**1.4 EXCEPTIONS**

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

**1.5 CO-ORDINATION**

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

**1.6 PRE-TAB REVIEW**

- .1 Review contract documents before project construction is started and confirm in writing to Engineer adequacy of provisions for TAB and other aspects of design and installation pertinent to success of TAB.

- .2 Review specified standards and report to Engineer in writing all 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 Engineer for verification of TAB reports.

### **1.9 START OF TAB**

- .1 Notify Engineer 7 days prior to start of TAB.
- .2 Start TAB when work is essentially completed, including:
  - .1 Installation of ceilings, doors, windows, other construction affecting TAB.
  - .2 Application of weatherstripping, sealing, caulking.
  - .3 All provisions for TAB installed and operational.
- .3 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 Correct fan rotation.
    - .3 Coil fins combed, clean.
    - .4 Access doors, installed, closed.

### **1.10 ACCURACY TOLERANCES**

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

### **1.11 INSTRUMENTS**

- .1 Prior to TAB, submit to Engineer list of instruments to be used together with serial numbers.
- .2 Calibrate in accordance with requirements of most stringent of referenced standard for either applicable system or HVAC system.

**1.12 TAB REPORT**

- .1 TAB report to show results in SI units and to include:
  - .1 Project record drawings.
  - .2 System schematics.
- .2 Air systems TAB report shall include:
  - .1 Design characteristics:
    - .1 Identification.
    - .2 Air flows.
    - .3 Fan's static pressure.
    - .4 Motor size (kW).
    - .5 Brake horse power.
    - .6 Fan speed.
  - .2 Characteristics of installed equipment :
    - .1 Manufacturer, model, serial number.
    - .2 Unit size.
    - .3 Arrangement.
    - .4 Motor nameplate:
      - .1 Power.
      - .2 Tension.
      - .3 Number of phases.
      - .4 Frequency.
      - .5 FLA.
      - .6 Speed.
  - .3 Tests results:
    - .1 Fan speed.
    - .2 Power reading at motor connections (tension and current for each phase).
- .3 Submit six (6) pdf copies of TAB Report to Engineer for verification and approval, in English or French, in D-ring binders, complete with index tabs. Final TAB report shall be submitted in both official languages.

**1.13 VERIFICATION**

- .1 Reported results subject to verification by Engineer.
- .2 Number and location of verified results to be at discretion of Engineer.
- .3 Provide personnel and instrumentation to verify up to 30% of reported results.
- .4 Bear costs to repeat TAB as required to satisfaction of Engineer.



**1.14            SETTINGS**

- .1    After TAB is completed to satisfaction of Engineer, 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. Markings not to be eradicated or covered in any way.

**1.15            COMPLETION OF TAB**

- .1    TAB to be considered complete when final TAB Report received and approved by Engineer.

**1.16            AIR SYSTEMS**

- .1    Standard: TAB to be to most stringent of this section or TAB standards of SMACNA.
- .2    Do TAB of new Dx system, take power readings for each fan and compressor.
- .3    Locations of equipment measurements: To include, but not be limited to, following as appropriate:
  - .1    At exterior unit to measure performance.

**1.17            HYDRONIC SYSTEMS**

- .1    Definitions: for purposes of this, to include low pressure hot water heating, chilled water,

**Part 2           Products**

**2.1            NOT USED**

- .1    Not used.

**Part 3           Execution**

**3.1            NOT USED**

- .1    Not used.

**END OF SECTION**

**Part 1 General****1.1 SUMMARY**

- .1 Section Includes:
  - .1 Materials and installation for copper tubing and fittings for refrigerant.

**1.2 REFERENCES**

- .1 American Society of Mechanical Engineers (ASME)
  - .1 ASME B16.22-01 (R2010), Wrought Copper and Copper Alloy Solder - Joint Pressure Fittings.
  - .2 ASME B16.24-11, Cast Copper Pipe Flanges and Flanged Fittings: Class 150, 300, 400, 600, 900, 1500 and 2500.
  - .3 ASME B16.26-06, Cast Copper Alloy Fittings for Flared Copper Tubes.
  - .4 ASME B31.5-06, Refrigeration Piping and Heat Transfer Components.
- .2 American Society for Testing and Materials International (ASTM)
  - .1 ASTM A307-10, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
  - .2 ASTM B280-08, Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service.
- .3 Canadian Standards Association (CSA International)
  - .1 CSA B52-05, 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).

**1.3 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submittals in accordance with Section 01 00 10 - General Instructions.
- .2 Product Data:
  - .1 Submit manufacturer's printed product literature, specifications and datasheet for piping, fittings and equipment.
- .3 Test Reports: submit certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties.
- .4 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .5 Instructions: submit manufacturer's installation instructions.

- .6 Closeout submittals: submit maintenance and engineering data for incorporation into manual specified in Section 01 00 10 - General Instructions.

## **1.4 QUALITY ASSURANCE**

- .1 Pre-Installation Meeting:
  - .1 Convene pre-installation meeting one week prior to beginning of work to:
    - .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.

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

- .1 Waste Management and Disposal:
  - .1 Separate waste materials for reuse recycling in accordance with Section 01 00 10 - General Instructions.
  - .2 Remove from site and dispose of packaging materials at appropriate recycling facilities.

## **Part 2 Products**

### **2.1 MATERIALS**

- .1 Materials and resources in accordance with Section 01 61 00 - Common Product Requirements.

### **2.2 TUBING**

- .1 Processed for refrigeration installations, deoxidized, dehydrated and sealed.
  - .1 Hard copper: to ASTM B280, type B.
  - .2 Annealed copper: to ASTM B280, with minimum wall thickness as per CSA B52 and ASME B31.5.

### **2.3 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, 15% Ag-80% 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.

## **2.4 PIPE SLEEVES**

- .1 Hard copper or steel, sized to provide 6 mm clearance around between sleeve and uninsulated pipe or between sleeve and insulation.

## **2.5 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 Section 23 05 05 - Installation of Pipework.

### **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 Hard drawn copper tubing: do not bend. Minimize use of fittings.
- .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 5Pa 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 h.
  - .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 Engineer.
- .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 Engineer.
- .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 60% complete.
    - .3 Upon completion of the Work, after cleaning is carried out.
  - .4 Obtain reports, within 3 days of review, and submit, immediately, to Engineer.
- .10 Verification requirements, 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.

### **3.7 DEMONSTRATION**

- .1 Instructions:
  - .1 Post instructions in frame with glass cover in accordance with CSA B52.

### **3.8 CLEANING**

- .1 Perform cleaning operations as specified in Section 01 00 10 – General Instructions and in accordance with manufacturer's recommendations.

- .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 REFERENCES**

- .1 American National Standards Institute/American Society of Heating, Refrigeration and Air-Conditioning Engineers (ANSI/ASHRAE)
  - .1 ANSI/ASHRAE 52.2-2007, Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particulate Size.
  - .2 ANSI/ASHRAE 127-2007, Method of Testing for Rating Computer and Data Processing Room Unitary Air-Conditioners.
- .2 ASTM International
  - .1 ASTM C547-11, Specification for Mineral Fiber Pipe Insulation.
- .3 Canada Green Building Council (CaGBC)
  - .1 LEED Canada-NC Version 1.0-2004, LEED (Leadership in Energy and Environmental Design): Green Building Rating System for New Construction and Major Renovations (including Addendum 2007).
  - .2 LEED Canada-NC-2009, LEED (Leadership in Energy and Environmental Design): Green Building Rating System for New Construction and Major Renovations 2009.
  - .3 LEED Canada-CI Version 1.0-2007, LEED (Leadership in Energy and Environmental Design): Green Building Rating System for Commercial Interiors.
  - .4 LEED Canada-EB: O M-2009, LEED (Leadership in Energy and Environmental Design): Green Building Rating System for Existing Buildings: Operations and Maintenance 2009.
- .4 CSA International
  - .1 CSA B52-05(R2009), Mechanical Refrigeration Code.
  - .2 CAN/CSA-C656-05(R2010), Performance Standard for Single Package Central Air-Conditioners and Heat Pumps.

**1.2 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 00 10 – General Instructions.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for air conditioning components and accessories and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
  - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Quebec, Canada.



- .2 Indicate on drawings:
  - .1 Major components and accessories including sound power levels of units.
  - .2 Type of refrigerant used.

### **1.3 CLOSEOUT SUBMITTALS**

- .1 Submit in accordance with Section 01 00 10 – General Instructions.
- .2 Operation and Maintenance Data: submit operation and maintenance data for air conditioning components for incorporation into manual.

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

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

### **1.5 WARRANTY**

- .1 For computer room air conditioning 12 months warranty period is extended to 60 months.
- .2 Contractor hereby warrants that computer room air conditioning will not spall or show visible evidence of cracking, except for normal hairline shrinkage cracks, in accordance with CCDC (CMCC modified version) for a period of 5 years.

## **Part 2 Products**

### **2.1 EVAPORATOR (INDOOR UNIT)**

- .1 The indoor unit is supplied and installed by the client. The evaporator is model ACRD500 by APC.
- .2 Contractor is to supply and install all necessary piping and accessories to connect outdoor condenser to the installed evaporator unit (indoor unit).

### **2.2 CONDENSER (OUTDOOR UNIT)**

- .1 Provide and install condensing units to function with the existing evaporators. Assembly must be provided with manufacturer's warrantee. Coordinate with existing evaporator for model selections.
- .2 Condensing unit to use refrigerant type R407C and come equipped with heated receivers and head pressure control valves for winter operation.

- .3 Condensing unit characteristics:
  - .1 Ambient temp: range of 33 - 37 degrees Celsius.
  - .2 Air quantity: 4900 L/s or more, 1 single fan.
  - .3 Connection sizes: NPS 1-3/8.
  - .4 Voltage: 208-240V, 1ph, 60 Hz.
  - .5 Capacity: 4.6 kW or higher.
  - .6 Supply unit with flooded receiver.
  - .7 Condenser must be compatible and communicate with the existing evaporator.

### **2.3 REFRIGERANT PIPING, VALVES, FITTINGS AND ACCESSORIES WITHIN UNIT**

- .1 To CSA B52.
- .2 Include for each refrigerant circuit:
  - .1 Thermal expansion valve, external equalizing type.
  - .2 Combination filter-dryer.
  - .3 Solenoid valves.
  - .4 Liquid sight glass with moisture indicator.
  - .5 Suction line insulation: flexible elastomeric unicellar to ASTM C547, 12 mm minimum thickness.
  - .6 Liquid refrigerant receiver.

### **2.4 REFRIGERANT CHARGE**

- .1 Charge refrigerant system at factory, seal and test.
- .2 Holding charge of refrigerant applied at factory.
- .3 Provide additional refrigerant required for site installation.

## **Part 3 Execution**

### **3.1 EXAMINATION**

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for air conditioning components installation in accordance with manufacturer's written instructions.
  - .1 Visually inspect substrate in presence of Engineer.
  - .2 Inform Engineer 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 Engineer.

**3.2 GENERAL**

- .1 Install as indicated, to manufacturer's recommendations, and to EPS 1/RA/2.
- .2 Manufacturer to certify installation.
- .3 Run drain line from cooling coil condensate drain pan to terminate over nearest floor drain.

**3.3 EQUIPMENT PREPARATION**

- .1 Provide services of manufacturer's field engineer to set and adjust equipment for operation as specified.

**3.4 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 00 10 - General Instructions.
  - .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 00 10 - General Instructions.

**3.5 PROTECTION**

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

**3.6 SEQUENCING**

- .1 The contractor is responsible for engaging the services of the condenser's manufacturer to program the sequencing and alarm conditions of the air cooled condenser system, compressor and evaporator section for the automatic transfer and lead lag operation between the chilled water cooling system and the air cooled system.
- .2 The air cooled system will engage whenever the chilled water supply temperature reaches the second stage alarm condition that is already programmed.
- .3 Based on a predetermined schedule; an example of which could be, once a week for 24 hours the air cooled system will be primary and the chilled water system will operate as secondary. The schedule shall be programmed at the HACS. The exact schedule shall be provided by the client.

**END OF SECTION**